Electronic Patent Application Fee Transmittal

Application Number:	95002386
Filing Date:	15-Sep-2012
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Filer:	Arpita Bhattacharyy
Attorney Docket Number:	COOL-1.012

Filed as Large Entity

inter partes reexam Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Appeal Forwarding Fee	1413	1	2000	2000
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
		Total in USD ($)		**2000**

Electronic Acknowledgement Receipt

EFS ID:	20234860
Application Number:	95002386
International Application Number:	
Confirmation Number:	7254
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Customer Number:	22852
Filer:	Arpita Bhattacharyy
Filer Authorized By:	
Attorney Docket Number:	COOL-1.012
Receipt Date:	24-SEP-2014
Filing Date:	15-SEP-2012
Time Stamp:	16:48:46
Application Type:	inter partes reexam

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$2000
RAM confirmation Number	3650
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1	Appeal Brief-Owner	Appeal_Brief.pdf	2280710 cf68440c39775ee0204067bfc90707ead725ad23	no	46
Warnings:					
Information:					
2	Reexam Certificate of Service	Cerfiticate_of_Service.pdf	37371 ed1bcdb015e6d17ce137f6a6800ef3412b2de87c	no	1
Warnings:					
Information:					
3	Trans Letter filing of a response in a reexam	Transmittal.pdf	55359 34716268c281799e1898a4f764257ac3c04c2cb2	no	1
Warnings:					
Information:					
4	Other Reference-Patent/App/Search documents	Exhibit_1.pdf	2502617 bfd32fbc7107d0448997ec6bc121f4d0e45c241f	no	31
Warnings:					
Information:					
5	Other Reference-Patent/App/Search documents	Exhibit_2.pdf	1289224 d809661b949e405049e8714aa654c3f1608f550e	no	18
Warnings:					
Information:					
6	Other Reference-Patent/App/Search documents	Exhibit_3.pdf	3552953 35e4f8233f52c48ad662ffde68afbfe6d790018a	no	66
Warnings:					
Information:					
7	Other Reference-Patent/App/Search documents	Exhibit_4.pdf	1944445 8c129a5f17b6f9d14b2917b629c8277592294297	no	33
Warnings:					
Information:					
8	Other Reference-Patent/App/Search documents	Exhibit_5.pdf	2302279 fde57c177e55d52a764e4e5c77d04e193a8307c5	no	42
Warnings:					
Information:					
9	Other Reference-Patent/App/Search documents	Exhibit_6.pdf	193601 90c33193cc8900a98bae1af7f3f45da871d7f45b	no	6
Warnings:					
Information:					

10	Other Reference-Patent/App/Search documents	Exhibit_7.pdf	577457 a1e8c0af4eef6eb8bb9c1bcea532dc3a37075ef0	no	14
Warnings:					
Information:					
11	Other Reference-Patent/App/Search documents	Exhibit_8.pdf	1061694 db151021188fb0d52b5cad3bf2c4d7c8c298d14b	no	22
Warnings:					
Information:					
12	Other Reference-Patent/App/Search documents	Exhibit_9.pdf	493448 733a53912b67c9009733ee176c9623b00baf5f02	no	15
Warnings:					
Information:					
13	Other Reference-Patent/App/Search documents	Order.pdf	1192969 ab035484a5b4424715f2e17a3eeb4622828174f2	no	18
Warnings:					
Information:					
14	Fee Worksheet (SB06)	fee-info.pdf	29829 ef7b11cb014079ab9b33d77cd0dbaa2d6501c2bb	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	17513956		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Document code: WFEE

United States Patent and Trademark Office
Sales Receipt for Accounting Date: 08/13/2015

RWALKER1 ADJ #00000001 Mailroom Dt: 09/24/2014
Seq No: 3650 Sales Acctg Dt: 09/25/2014 95002386
01 FC : 1413 -2000.00 OP

Document code: WFEE

United States Patent and Trademark Office
Sales Receipt for Accounting Date: 08/13/2015

RWALKER1 SALE #00000001 Mailroom Dt: 09/24/2014 95002386
01 FC : 1404 2,000.00 OP

Attorney Docket No. 10494.8000-00000
Reexam Control No. 95/002,386

CERTIFICATE OF SERVICE

The undersigned certifies that on this 20th Day of August 2014, service of a true and complete copy of the "PATENT OWNER'S NOTICE OF APPEAL UNDER 37 C.F.R. § 41.61(a)(1)" was served in its entirety via first class U.S. mail on counsel for the third party requester, at the following address:

Ganz Law P.C.
P.O. Box 2200
Hillsboro, OR 97123

with sufficient postage affixed, and with delivery confirmation requested.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, L.L.P.

Dated: August 20, 2014

By: ____________________
Eric P. Raciti
Reg. No. 41,475

Electronic Acknowledgement Receipt

EFS ID:	19919141
Application Number:	95002386
International Application Number:	
Confirmation Number:	7254
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Customer Number:	22852
Filer:	Arpita Bhattacharyy
Filer Authorized By:	
Attorney Docket Number:	COOL-1.012
Receipt Date:	20-AUG-2014
Filing Date:	15-SEP-2012
Time Stamp:	17:05:26
Application Type:	inter partes reexam

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Miscellaneous Incoming Letter	Certificate_of_Service.pdf	35179 031a7fb780fd5282c926d24dc6ec226e9855c754	no	1

Warnings:

Information:

Total Files Size (in bytes):	35179

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

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New International Application Filed with the USPTO as a Receiving Office
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ATTORNEY DOCKET NO. COOL-1.012
FILED VIA EFS ON AUGUST 20, 2014

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent No.: 8,245,764 **Currently in Litigation Styled:** *Asetek Holdings, Inc et al v. Coolit Systems Inc*, Case No. 3:12-cv-04498-EMC (N.D. Cal.) **Issued:** August 21, 2012 **Filed:** October 7, 2011 **Applicant:** Andre Sloth Eriksen **Title:** COOLING SYSTEM FOR A COMPUTER SYSTEM	**R.C.N.:** 95/002,386 **Confirmation No.:** 7254 **Examiner:** Joseph A. Kaufman **Art Unit:** 3993

SUBMITTED VIA ELECTRONIC FILING SYSTEM ON AUGUST 20, 2014
UNITED STATES PATENT AND TRADEMARK OFFICE

PETITION UNDER 37 C.F.R. § 1.183 TO SUSPEND, IN PART, 37 C.F.R. § 1.951(b)

In the interests of justice and pursuant to 37 C.F.R. § 1.183, Requester respectfully petitions to enter the Declaration of Seri Lee dated October 31, 2013, (attached hereto as Exhibit A, and referred to herein as the "Lee Declaration") and to suspend the provisions of 37 C.F.R. § 1.951(b) that otherwise would prevent entry of the Lee Declaration. As explained more fully below, the relief requested under this Petition comports with the entirety of 35 U.S.C. § 314 (pre-AIA) and 37 C.F.R. § 1.116, and no avenue other than this Petition is available to have the Lee Declaration entered into the record.

A fee under 37 C.F.R. § 1.17(f) for this Petition is being paid concurrently with the filing of this Petition. Requester qualifies to pay reduced fees as a small entity. Nonetheless, if the fee paid is insufficient, or if additional or alternative fees are due in connection with the filing of this Petition in Opposition, please charge such fees to Deposit Account No. 50-1001.

BACKGROUND

1. On August 27, 2013, Patent Owner, Asetek A/S, filed a Complaint in the Disctrict Court for the Northern District of California alleging infringement of U.S. Patent No. 8,245,764 (the '764 Patent) by Third-Party Requester, CoolIT Systems, Inc.

2. On September 15, 2012, Requester filed a Request for *Inter Partes* Reexamination (Request) of all claims (i.e., claims 1-18) in the '764 Patent.

3. On October 26, 2012, the Office issued an Order instituting the present reexamination as to all challenged claims. The same day, an Office Action issued rejecting each of the challenged claims (i.e., claims 1-19) as being anticipated by Koga.

4. On December 26, 2012, Patent Owner amended the listing of claims by adding new claims 19-30 and contested the anticipation rejections in a "Response Under 37 C.F.R. § 1.111" (Amendment).

5. On September 3, 2013, the Examiner issued an Action Closing Prosecution, rejecting each of claims 1-30 as being unpatentable over Koga.

6. On October 3, 2013, Patent Owner served on Requester a "Response to the Action Closing Prosecution," together with a Declaration of Patent Owner's expert, Donald Tilton (hereafter, the "Tilton Declaration"). The "Response" and the Tilton Declaration contested the rejections of claims 1-30 based on Koga.

7. On Monday, November 4, 2013, Requester timely filed Third-Party Requester's Comments Under 37 C.F.R. § 1.951(b), accompanied by the Lee Declaration and a Petition to waive the page limit imposed by 37 C.F.R. § 1.943. Requester made a *bona fide* attempt at complying with 37 C.F.R. §§ 1.947 and 1.948(a)(3) when preparing and submitting the Requester's Comments under 37 C.F.R. § 1.951(b).

8. On January 31, 2014, the Office granted Requester's Petition of November 4, 2013, specifically finding that Requester's Comments were timely filed.

9. On June 30, 2014, the Office issued a Miscellaneous Action expunging Requester's Comments on grounds that they improperly presented new prior art (Ryu and Duan) and rejections of claims 1-30 based on the new prior art.

10. The Lee Declaration was expunged concurrently with the Requester's Comments.

11. Although the content of the Lee Declaration speaks for itself, the Lee Declaration is limited to discussing the Koga reference and rebutting assertions by Patent Owner's expert in relation to the Koga reference. In particular, the subject matter discussed in the Lee Declaration is unrelated in any way to Ryu or Duan, or the subject matter identified as being objectionable by the Miscellaneous Action.

12. On June 30, 2014, the Office also issued a Right of Appeal Notice, maintaining the rejections of claims 1-30 based on Koga, and specifically making findings of fact generally consistent with assertions in the Lee Declaration and generally contrary to assertions in the Tilton Declaration.

13. On July 24, 2014, Patent Owner filed a Notice of Appeal with no accompanying Certificate of Service. Requester only discovered that a Notice of Appeal had been filed when the undersigned counsel checked the file history in PAIR after the time identified in the RAN had expired. As of the date of submission of this Petition, the undersigned counsel has not received a service copy of Patent Owner's Notice of Appeal, nor any Notice of Defective Paper from the Office confirming that Patent Owner's Notice of Appeal is defective.

14. Upon learning of Patent Owner's intention to appeal the rejection of all claims, Requester diligently pursued preparation and filing of the instant Petition to pursue a complete evidentiary record in the event an appeal goes forward.

ARGUMENTS

Requester would suffer undue and unfair prejudice, and Office and Party resources would be wasted if the timely submitted Lee Declaration dated October 31, 2013, is refused entry. Accordingly, Requester respectfully petitions to enter the Lee Declaration and to waive the one-opportunity limitation of 37 C.F.R. § 1.951(b) as to the Lee Declaration.

I. THIS PETITION IS TIMELY

Having been filed less than two months from the mailing date (i.e., June 30, 2014) of the Miscellaneous Action expunging the Lee Declaration, this Petition has been timely filed pursuant to 37 C.F.R. § 1.181.

Patent Owner filed a Notice of Appeal less than four weeks ago, and did not serve a copy of the Notice on Requester. Only through Requester's own initiative by checking PAIR, after the time specified in the RAN for an appeal expired, did Requester discover that Patent Owner intends to pursue an appeal. Upon learning of that intention, Patent Owner diligently pursued preparation and filing of the instant Petition to pursue a complete evidentiary record in the event of an appeal despite Patent Owner's defective Notice of Appeal.

Accordingly, this Petition also has been filed with special dispatch under the circumstances.

II. ENTRY OF THE LEE DECLARATION COMPORTS WITH 35 U.S.C. § 314

Pursuant to 35 U.S.C. § 314(b), each time Patent Owner responds to an action on the merits from the Patent and Trademark Office, Requester shall have one opportunity to file written comments addressing issues raised by the Office action or the Patent Owner's response, provided Requester's comments are received by the Office within 30 days after the date of service of the Patent Owner's response.

The one-opportunity limitation in § 314(b) does not prohibit a replacement submission to correct a defect. *See, e.g.*, M.P.E.P. §§ 2666.05 II, 2672 IV (expressly recognizing that third party requesters can correct defective comments submitted under 37 C.F.R. § 1.951(b), subject to granting of a Petition under 37 C.F.R. § 1.183).

The Lee Declaration (attached as Exhibit A) is substantively identical in every respect to the version filed concurrently with Requester's timely filed Comments. Therefore, entry of the Lee Declaration would comport with the one-opportunity limitation set forth in § 314(b).

In addition, entering the Lee Declaration would cause no delay in the instant proceeding under the current extraordinary circumstances (e.g., heretofore unrecognized defect in the Notice of Appeal inherently delaying any appeal from the rejection of claims 1-30). Thus, suspending 37 C.F.R. § 1.951(b) to the extent necessary to enter the Lee Declaration for consideration in the apparently contemplated Appeal would not violate the "special dispatch" requirement under § 314(c).

Moreover, Patent Owner has had ample opportunity to consider the Lee Declaration in its entirety, as the Lee Declaration was served on Patent Owner on November 4, 2013. Thus, any appeal brief (a due date for which has yet to be set on the current record) filed by Patent Owner can fully address the Lee Declaration.

Accordingly, under the current extraordinary circumstances, entry of the Lee Declaration would cause no delay to the instant proceedings and would comport with the entirety of § 314.

III. ENTRY OF THE LEE DECLARATION SERVES JUSTICE, AVOIDS UNDUE PREJUDICE, AND PRESERVES OFFICE AND PARTY RESOURCES

Refusing to enter the timely filed Lee Declaration because of an unrelated defect in Requester's Comments would waste Office and party resources, in particular if an appeal goes forward. The Lee Declaration interprets the Koga reference and rebuts assertions set forth in the Tilton Declaration.

Thus, any appeal that goes forward on a record lacking the Lee Declaration will necessarily be incomplete and will have an increased likelihood of reaching a decision unfairly (and inaccurately) biased in favor of Patent Owner, since the Board would be deprived of the opportunity to fully assess both sides of contested intepretations of the Koga reference. For example, the Examiner's express findings of fact are generally in line with Dr. Lee's views in the Lee Declaration and contrary to certain assertions in the Tilton Declaration. Consequently, although accurate insofar as they are consistent with Dr. Lee's views, the Examiner's findings stand an increased chance of being reversed during an appeal if the evidentiary record does not include Dr. Lee's rebuttal to the Tilton Declaration.

Moreover, the challenged '764 Patent is the subject of concurrent litigation in District Court. It is highly likely that the contested interpretations of Koga as represented by the Lee Declaration and the Tilton Declaration will form the subject of intensive litigation activity in District Court, particularly if an appeal goes forward on a lop-sided and incomplete evidentiary record, and especially if such an appeal overturns the Examiner without considering all salient facts. Moreover, the likelihood of confirming overly broad claims is increased if the Board is denied the opportunity to consider a full evidentiary record, including the Lee Declaration, increasing the chance of unfair prejudice to the Requester and the Public, and increased costs to the parties.

To pursue an accurate outcome in this reexamination, to avoid unfair and undue prejudice to Requester and the Public, and to preserver party resources, the Lee Declaration should be entered.

IV. ENTRY OF THE LEE DECLARATION COMPORTS WITH 37 C.F.R. § 1.116

Entry and consideration of the Lee Declaration comports with the requirements of 37 C.F.R. § 1.116.[1]

Pursuant to 37 C.F.R. § 1.951(b), Requester is permitted to file comments responsive to the Patent Owner's Response to the ACP. As well, 37 C.F.R. § 1.116(e) permits entry of an affidavit or other

---

[1] The remarks set forth in this Section IV of this Petition are identical to remarks in Requester's timely-filed-but-expunged Comments relating to 37 C.F.R. § 1.116 and the Lee Declaration. Therefore, the remarks in this Section IV do not go beyond Requester's original timely filed Comments and are limited to correcting a defect in those comments. Since the record is silent as to the Lee Declaration, an explicit analysis under 37 C.F.R. § 1.116 is required, since the Lee Declaration was submitted after an Action Closing Prosecution issued.

evidence after an ACP issues upon a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented.

To the extent a petition is deemed to be necessary for the Office to fully consider whether Dr. Lee's Declaration may properly be entered, please consider this a petition therefor and deduct any necessary fees from Deposit Account No. 50-1001. (Requester hereby asserts that it qualifies to pay reduced fees as a small entity.)

A. Dr. Lee's Declaration is Necessary

Patent Owner alleged for the first time in its Response[2] that no heat could transfer between Koga's component 2 and coolant 41 in Koga's channel 19. S*ee* Response to ACP, pp. 4, 5, 7. Patent Owner relied on opinion evidence put forth Dr. Tilton's Declaration to support those allegations. Id.

Dr. Lee's Declaration addresses Patent Owner's allegations and rebuts aspects of Dr. Tilton's opinion evidence. For example, Dr. Lee's Declaration explains how fundamental concepts of heat-transfer dictate that heat transfer must occur between the component 2 and the coolant in the channel 19 based on the configuration of Koga's cooling device.

Requester respectfully submits that entry and consideration of Dr. Lee's Declaration is necessary to fully consider the veracity of Patent Owner's allegations regarding whether heat could transfer between Koga's component 2 and coolant 41 in Koga's channel 19. Entry of Dr. Lee's Declaration is particularly necessary if Dr. Tilton's Declaration remains of record and is considered.

B. Submission of Dr. Lee's Declaration is Timely

As noted above, Patent Owner first raised the issue of whether heat would transfer from Koga's component 2 to the coolant passing through Koga's channel 19 in its Response to the ACP. Moreover, Patent Owner first attempted to submit opinion evidence regarding this issue concurrently with filing its Response to the ACP (i.e., after the close of prosecution). Because the subject matter covered by Dr. Lee's Declaration was not previously at issue in this *Inter Partes* Reexamination, Requester had no reason previously to submit such opinion evidence.

C. Dr. Lee's Declaration should be Entered

For at least the foregoing reasons, 37 C.F.R. § 1.116(e) does not prohibit entry of Dr. Lee's Declaration, particularly if Dr. Tilton's Declaration remains of record.

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[2] Patent Owner's October 3, 2013, "Response to the Action Closing Prosecution"

CONCLUSION

Thus, under the current extraordinary circumstances, and in the interests of justice, Requester respectfully urges the Office to enter the Lee Declaration.

Date: August 20, 2014

Respectfully submitted,
GANZ LAW, P.C.
/Lloyd L. Pollard II/
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Registration No. 64,793

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<u>CERTIFICATE OF SERVICE</u>

The undersigned hereby certifies that a complete copy of this PETITION UNDER 37 C.F.R. § 1.183 TO SUSPEND, IN PART, 37 C.F.R. § 1.951(b), together with EXHIBIT A thereto, was served on counsel for patent owner at the following address:

Finnegan, Henderson, Farabow, Garrett & Dunner LLP
901 New York Avenue, NW
Washington, D.C. 20001-4413

via first class mail, with sufficient postage affixed thereto, on August 20, 2014.

By: *<u>/Lloyd L. Pollard II/</u>*

Lloyd L. Pollard, II
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ATTORNEY DOCKET NO. COOL-1.012
FILED VIA EFS ON August 20, 2014

EXHIBIT A TO REQUESTER'S PETITION UNDER 37 C.F.R. § 1.183

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent No.: 8,245,764	**R.C.N.:** 95/002,386
Currently in Litigation Styled: *Asetek Holdings, Inc et al v. Coolit Systems Inc*, Case No. 3:12-cv-04498-EMC (N.D. Cal.)	**Confirmation No.:** 7254 **Examiner:** Joseph A. Kaufman
Issued: August 21, 2012	**Art Unit:** 3993
Filed: October 7, 2011	
Applicant: Andre Sloth Eriksen	
Title: COOLING SYSTEM FOR A COMPUTER SYSTEM	

Mail Stop *Inter Partes* Reexam
Commission for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION OF SERI LEE, Ph.D.

I, Seri LEE, declare as follows:

I. Qualifications

1. I am a Mechanical Engineer. I earned Bachelor of Science and Ph.D. degrees in Mechanical Engineering from the University of Waterloo (Waterloo, Ontario).
2. I am an experienced innovator. I have published more than 60 technical papers, and am an inventor with 31 issued patents and many patent applications, spanning the fields of medical devices; renewable energy; energy conversion, storage and efficiency; thermal management systems for microelectronics; heat transfer; and fluid mechanics.
3. I am an experienced technologist, entrepreneur, and executive with 25 years of experience developing and proliferating thermal technologies. I served as Assistant Professor of Mechanical Engineering at the University of Waterloo from 1988 to 1993, and as Adjunct Professor at Washington State University, Vancouver, Washington, from 2002 to 2006. I have served as Chief Technology Officer at Nextreme Thermal Solutions and Pipeline Micro, Inc. (2007 to 2010), as Senior Thermal Scientist at the Intel Corporation, responsible for developing Intel's roadmap of thermal technologies (1999 to 2006), and as Director of Advanced Thermal Engineering for Aavid Thermal Technologies (1993 to 1998).
4. I am presently a Principal Scientist in the School of Mechanical and Aerospace Engineering at the Nanyang Technical University, Singapore, (NTU) and Program Manager for Wind and Marine

Renewables in the Energy Research Institute at NTU. I also am an active member of the K-16 Committee on Heat Transfer in Electronic Equipment (American Society of Mechanical Engineers, Heat Transfer Division) and of the Technical Steering Committee of the Institute of Eelectrical and Electronics Engineers, SEMI-THERM.

5. I understand this Declaration will be filed in opposition to the patentability of the claims pending in the reexamination proceeding of U.S. Patent No. 8,245,764 B2 ("the '764 Patent"). I also understand that the '764 Patent is currently assigned to Asetek A/S.
6. In preparing this Declaration, I have considered the '764 Patent, the references cited against the '764 Patent, the Office Action dated October 26, 2012, issued against the '764 Patent, the corresponding Patent Owner's Response under 37 C.F.R. § 1.111 dated December 26, 2012, the Action Closing Prosecution dated September 3, 2013, issued against the '764 Patent, and the corresponding Patent Owner's Response, together with the Declaration of Donald Tilton, dated October 3, 2013.

II. U.S. Patent No. 7,544,049 to Koga et al. ("Koga")

In my opinion:

7. The "sucking channel 19" of Koga's cooling device constitutes a thermal exchange chamber separate from the "pump room 15A" (or pump chamber). The sucking channel 19 defines an enclosed space, or chamber, extending between an inlet and an outlet positioned adjacent the impeller shaft 17. During operation of Koga's device, energy (in the form of heat) transfers from the casing wall 15 to the coolant 41 passing through the sucking channel.
8. The outer surface of the casing wall 15 (which Koga referes to as the "heat-receiving face" or "heat-receiving plane 15B") contacts the electronic component 2. By virtue of that contact, conduction heat transfer occurs through the contact surface, and the casing 15 absorbs heat dissipated by the component.
9. Koga's casing wall 15 has a high thermal conductivity (*see*, Koga, col. 10:22-23). Consequently, heat absorbed by the casing 15 from the component 2 will spread throughout the highly conductive casing, increasing a temperature of the casing wall 15, including in regions adjacent the channel 19. And, as shown in Koga's FIGS. 7 and 8, a portion of the channel 19 extends directly over the heat dissipating component, providing a direct and short conduction path between the outer surface 15B of the casing wall 15 and the coolant 41 in the channel. The portion of the casing wall 15 between the coolant 41 and the outer surface 15B has a high temperature by virtue of its proximity to the component 2.

10. Koga's cooling system includes a radiator 3 to cool the coolant 41. The cooled, low-temperature coolant passes from the radiator and into the channel 19. The incoming cold coolant from the radiator absorbs heat in the channel from the surrounding high-temperature casing wall.
11. The coolant absorbs heat as the coolant passes between the inlet to the channel 19 and the outlet from the discharging channel 20, including through the pump room 15A. The coolant's temperature increases between the inlet and the outlet. Consequently, the high-temperature casing wall adjacent the channel 19 is exposed to the lowest-temperature coolant of any portion of the casing 15.
12. The larger temperature difference between the cold incoming coolant 41 and the surrounding high-tempreature casing wall 15 results in a greater per-surface-area heat transfer from the casing wall 15 to the coolant 41, and a non-negligible amount of heat exchange occurs in the channel 19. Consequently, Koga's channel 19 is properly characterized as a thermal exchange chamber.
13. Mainstream computers such as a PC allow for substantially larger cooling systems than notebook sized computers because mainstream computers such as a PC are larger than notebook sized computers. Thus, it is unsurprising that Koga's thermal exchange chamber 19, sized to be compatible with a notebook sized computer, is relatively smaller than the chamber purportedly disclosed and claimed in the '764 Patent, which was sized to be compatible with a mainstream computer such as a PC. '764 Patent, col. 1:13-15.
14. Despite its relative size, cooling system designers would not neglect the amount of heat absorbed by the coolant passing through Koga's chamber 19, and would account for that heat transfer when quantifying overall cooling performance of Koga's device.
15. Therefore, I disagree that "[the channel 19] does not allow the coolant to accumulate and absorb heat from the cooling device," and that "the sucking channel cannot be reasonably said to function as a heat exchanging chamber," as alleged in the Declaration under 37 C.F.R. § 1.132 of Donald Tilton (hereafter, the "Tilton Declaration").
16. Instead, a designer having ordinary skill would recognize that Koga's channel 19 constitutes a thermal exchange chamber, as claimed in the '764 Patent, particularly considering the large temperature difference between the casing wall 15 and the coolant 41 in the channel 19.
17. Providing dimples, protrusions, or grooves for extending heat transfer surfaces within the channel 19, a thermal exchange chamber as disclosed by Koga, would not prevent flow or delivery of fluid to the center of the pump impeller. Although headloss through the chamber would usually increase with such extended surfaces, they would also increase a rate of heat transfer to the coolant.

18. Nonetheless, cooling-system designers inherently size pumps and/or select pump speeds to match headloss through a liquid-cooling system. Therefore, I disagree with allegations in the Tilton Declaration that "it is not feasible to contain the dimples or protrusions necessary to extend the surface area needed to effectively exchange heat within the sucking channel."
19. The Office Action and the Action Closing Prosecution properly characterize the channel 19 as a thermal exchange chamber as claimed in the '764 Patent.

III. Conclusion

20. I reserve the right to amend, supplement, or otherwise modify my opinions, whether in a written declaration or otherwise. I also reserve the right to reply to positions taken by Patent Owners's experts.
21. I declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and may jeopardize the validity of the patent application to which they are directed or any patent issuing thereon.
22. In signing this declaration, I understand that the declaration will be filed as evidence in the United States Patent and Trademark Office. I acknowledge that I may be subject to cross examination in the case and that cross examination will take place within the United States. If cross examination is required of me, I will appear for cross examination within the United States during the time allotted for cross examination.

Dated October 31, 2013

Seri Lee, Ph.D.

Electronic Patent Application Fee Transmittal

Application Number:	95002386
Filing Date:	15-Sep-2012
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Filer:	Lloyd L. Pollard II/Tracie Semenchalam
Attorney Docket Number:	COOL-1.012

Filed as Small Entity

inter partes reexam Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Petition in Reexam Rroceeding	2824	1	970	970
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
		Total in USD ($)		**970**

Electronic Acknowledgement Receipt

EFS ID:	19919299
Application Number:	95002386
International Application Number:	
Confirmation Number:	7254
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Customer Number:	22852
Filer:	Lloyd L. Pollard II/Tracie Semenchalam
Filer Authorized By:	Lloyd L. Pollard II
Attorney Docket Number:	COOL-1.012
Receipt Date:	20-AUG-2014
Filing Date:	15-SEP-2012
Time Stamp:	19:17:12
Application Type:	inter partes reexam

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$970
RAM confirmation Number	5109
Deposit Account	501001
Authorized User	GANZ LAW, PC

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		PETITION37CFR1183TOWaive1951b.pdf	202002 bc7ffb93e605f785bce25c5b7ea77590dbcb6b32	yes	13

Multipart Description/PDF files in .zip description

Document Description	Start	End
Receipt of Petition in a Reexam	1	7
Reexam Certificate of Service	8	8
Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	9	13

Warnings:

Information:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
2	Fee Worksheet (SB06)	fee-info.pdf	29926 ff32d9f2d1fecb617a22ef8c434ecd0706bfa2f0	no	2

Warnings:

Information:

Total Files Size (in bytes): 231928

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT
Customer No. 22,852
Attorney Docket No. 10494.8000-00000

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Inter Partes* Reexamination of:	
André Sloth ERIKSEN	Group Art Unit: 3993
U.S. Patent No.: 8,245,764 B2	Examiner: Joseph A. KAUFMAN
Filed: October 7, 2011	Confirmation No.: 7254
Issued: August 21, 2012	
For: COOLING SYSTEM FOR A COMPUTER SYSTEM	
Reexamination Proceeding Control No. 95/002,386 Filed: September 15, 2012	

Mail Stop *Inter Partes* Reexam
Attn: Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

PATENT OWNER'S NOTICE OF APPEAL UNDER 37 C.F.R. § 41.61(a)(1)

Pursuant to the Right of Appeal Notice dated June 30, 2014, Patent Owner of U.S. Patent No. 8,245,764 appeals to the Patent Trial and Appeal Board all pending rejections of claims 1-30. The required fee of $800.00 under 37 C.F.R. § 41.20(b)(1) is being submitted herewith.

Please grant any extensions of time required to enter this paper and charge any additional required fees to Deposit Account 06-0916.

Respectfully submitted,

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

Dated: July 24, 2014

By: ____________________
Eric P. Raciti
Reg. No. 41,475

Electronic Patent Application Fee Transmittal

Application Number:	95002386
Filing Date:	15-Sep-2012
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Filer:	Eric Paul Raciti
Attorney Docket Number:	COOL-1.012

Filed as Large Entity

inter partes reexam Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Notice of Appeal	1401	1	800	800
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
		Total in USD ($)		**800**

Electronic Acknowledgement Receipt

EFS ID:	19667678
Application Number:	95002386
International Application Number:	
Confirmation Number:	7254
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Customer Number:	22852
Filer:	Eric Paul Raciti
Filer Authorized By:	
Attorney Docket Number:	COOL-1.012
Receipt Date:	24-JUL-2014
Filing Date:	15-SEP-2012
Time Stamp:	16:14:01
Application Type:	inter partes reexam

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$800
RAM confirmation Number	2764
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1	Reexam Miscellaneous Incoming Letter	Notice_of_Appeal.pdf	53325 4e6afe578a7f57032330bcb1df89d880408c8b9c	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	29746 801c6202a27943bce1d4561396eb95bba8bde185	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	83071	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
95/002,386	09/15/2012	8245764	COOL-1.012	7254

22852 7590 06/30/2014
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER
LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

EXAMINER	
KAUFMAN, JOSEPH A	

ART UNIT	PAPER NUMBER
3993	

MAIL DATE	DELIVERY MODE
06/30/2014	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Transmittal of Communication to Third Party Requester *Inter Partes* Reexamination	Control No.	Patent Under Reexamination	
	95/002,386	8245764	
	Examiner	Art Unit	
	JOSEPH KAUFMAN	3993	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

(THIRD PARTY REQUESTER'S CORRESPONDENCE ADDRESS)

GANZ LAW, P.C.
P.O. BOX 2200
HILLSBORO, OR 97123

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above-identified reexamination prceeding. 37 CFR 1.903.

Prior to the filing of a Notice of Appeal, each time the patent owner responds to this communication, the third party requester of the *inter partes* reexamination may once file written comments within a period of 30 days from the date of service of the patent owner's response. This 30-day time period is statutory (35 U.S.C. 314(b)(2)), and, as such, it <u>cannot</u> be extended. See also 37 CFR 1.947.

If an *ex parte* reexamination has been merged with the *inter partes* reexamination, no responsive submission by any *ex parte* third party requester is permitted.

All correspondence relating to this inter partes reexamination proceeding should be directed to the **Central Reexamination Unit** at the mail, FAX, or hand-carry addresses given at the end of the communication enclosed with this transmittal.

Right of Appeal Notice (37 CFR 1.953)	**Control No.** 95/002,386	**Patent Under Reexamination** 8245764
	Examiner JOSEPH KAUFMAN	**Art Unit** 3993

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

Responsive to the communication(s) filed by:
Patent Owner on 03 October, 2013
Third Party(ies) on _____

Patent owner and/or third party requester(s) may file a notice of appeal with respect to any adverse decision with payment of the fee set forth in 37 CFR 41.20(b)(1) within **one-month or thirty-days (whichever is longer)**. See MPEP 2671. In addition, a party may file a notice of **cross** appeal and pay the 37 CFR 41.20(b)(1) fee **within fourteen days of service** of an opposing party's timely filed notice of appeal. See MPEP 2672.

All correspondence relating to this inter partes reexamination proceeding should be directed to the **Central Reexamination Unit** at the mail, FAX, or hand-carry addresses given at the end of this Office action.

If no party timely files a notice of appeal, prosecution on the merits of this reexamination proceeding will be concluded, and the Director of the USPTO will proceed to issue and publish a certificate under 37 CFR 1.997 in accordance with this Office action.

The proposed amendment filed _____ ☐ will be entered ☐ will not be entered*

*Reasons for non-entry are given in the body of this notice.

1a. ☒ Claims 1-30 are subject to reexamination.
1b. ☐ Claims _____ are not subject to reexamination.
2. ☐ Claims _____ have been cancelled.
3. ☐ Claims _____ are confirmed. [Unamended patent claims].
4. ☐ Claims _____ are patentable. [Amended or new claims].
5. ☒ Claims 1-30 are rejected.
6. ☐ Claims _____ are objected to.
7. ☐ The drawings filed on _____ ☐ are acceptable. ☐ are not acceptable.
8. ☐ The drawing correction request filed on _____ is ☐ approved. ☐ disapproved.
9. ☐ Acknowledgment is made of the claim for priority under 35 U.S.C. 119 (a)-(d) or (f). The certified copy has:
   ☐ been received. ☐ not been received. ☐ been filed in Application/Control No. _____.
10. ☐ Other _____

Attachments

1. ☐ Notice of References Cited by Examiner, PTO-892
2. ☒ Information Disclosure Citation, PTO/SB/08
3. ☐ _____

Extensions of Time

Extensions of time under 37 CFR 1.136(a) will **not** be permitted in these proceedings because the provisions of 37 CFR 1.136 apply only to "an applicant" and not to parties in a reexamination proceeding. Additionally, 35 U.S.C. 314(c) requires that *inter partes* reexamination proceedings "will be conducted with special dispatch" (37 CFR 1.937). Patent owner extensions of time in *inter partes* reexamination proceedings are provided for in 37 CFR 1.956. Extensions of time are not available for third party requester comments, because a comment period of 30 days from service of patent owner's response is set by statute. 35 USC 314(b)(3).

Notification of Concurrent Proceedings

The patent owner is reminded of the continuing responsibility under 37 CFR 1.985 to apprise the Office of any litigation activity, or other prior or concurrent proceeding, involving the Eriksen patent throughout the course of this reexamination proceeding. The third party requester is also reminded of the ability to similarly apprise the Office of any such activity or proceeding throughout the course of this reexamination proceeding. See MPEP § 2686 and 2686.04.

Service of Papers

Any paper filed by either the patent owner or the third party requester ***must be served*** on the other party in the reexamination proceeding in the manner provided by 37 CFR 1.248. See 37 CFR 1.903 and MPEP 2666.06.

Non-Entry of Requester's Response

Requester has been previously notified that when claims have not been amended, no new rejections over those claims are permissible. In the response by Requester dated 4 November 2013, Requester proposes new rejections of all of the claims based on Ryu and Duan. Therefore, Requester's response dated 4 November 2013 is improper, will not be considered in its entirety, and be expunged from the record.

Declaration

The Declaration submitted by Patent Owner on 3 October 2013 has been considered. The following rejections and comments are maintained/made in light of the declaration.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-18 are rejected under 35 U.S.C. 102(b) as being anticipated by Koga et al.

Requester has stated that Patent Owner is only eligible for the effective filing date of 7 October 2011 as the original application did not have Figure 20 or the passages in the specification to support the claimed subject matter. This material was added on 9 January 2009 and 14 July 2011. Therefore, the Examiner will use the effective filing date of 14 July 2011.

The Examiner incorporates by reference the claim charts on pages 149-164 of the Request.

Claims 19, 21-23, 25-27, 29 and 30 are rejected under 35 U.S.C. 102(b) as being anticipated by Koga et al.

Koga et al. has been discussed in detail as noted in the above rejection. In addition, as seen in Figure 7, a passage directs cooling liquid from the pump chamber 15 directly to the thermal exchange chamber; an entire surface of the heat exchange interface that contacts the cooling liquid forms a boundary wall of the thermal exchange chamber as seen with either surface of 19 in Figure 7; and the pump and thermal exchange chambers are connected together by one of more passages as noted above and in Figure 7, and the reservoir has and inlet and outlet at 19 and 20 as seen in Figure 8.

Claim Rejections - 35 USC § 103

The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been

obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 20, 24 and 28 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Koga et al.

Koga et al. has been discussed in detail above, but while showing at least one passage between the pump and thermal exchange chamber, is silent as to a plurality of passages between the two. It would have been obvious to one of ordinary skill in the art to provide a plurality of passages between the pump and thermal exchange chambers in order to further enhance communication between the two which would increase flow and thus be better able to cool the device.

Response to Arguments

Summary of Patent Owner's Arguments:

Patent Owner contends that Koga et al. does not anticipate the claims, nor renders the claims obvious. Specifically, Patent Owner states that Koga et al. does not show a thermal exchange chamber separate from the pump chamber nor is the chamber in thermal contact with the electronic component to be cooled. With regard to the dependent claims, Patent Owner contends that Koga et al. does not disclose that an inner wall of the chamber acts as a heat exchanger and further, does not have the required protrusions. With regard to independent claim 15 and its dependent claims, Patent Owner argues that Koga et al. does not teach the required intermediate member. Patent Owner alleges that the Examiner has not explained how the modification of multiple channels would operate. Finally, Patent Owner has contends that the Examiner has not addressed the priority claim and that the invention is due a filing date going back to the filing date of the PCT.

Examiner's Remarks:

The Examiner begins by referencing the above rejections of the claims. Specifically pages 149-164 of the Request that gives the details of the rejections over Koga et al., Figure 3 of the drawings of Koga and Figure 20 of the Eriksen patent. Eriksen shows a pump chamber 46 and passage 34 connecting the pump chamber to thermal exchange chamber 47A. Now looking at Koga et al., Koga shows pump chamber 15A connected to thermal exchange chamber 19, the thermal exchange chamber being separated vertically from the pump chamber and connected by a channel. Various parts of the casing 15 that forms the thermal exchange chamber cool component 2 as clearly seen in Figure 3.

In light of the above, the Examiner will now address the specific arguments set forth by Patent Owner. Regarding the contention that Koga et al. does not show a separate chamber, it is not clear how feature 19 does not meet the conventional definition of a chamber. The chamber of Koga is an enclosed space and a compartment as would have been recognized by one of ordinary skill in the art. Further, when comparing the Figures of Koga et al. and Eriksen, it is clear that both 19 and 47A respectively have a separate volume, and inlet and outlet.

Patent Owner discusses the passage in Koga that states that the chamber 19 does not sit directly over component 2. It is evident that the wall portion of the chamber does contact the component and acts as the heat-exchanging interface as required by the claims. The chamber 19 is not required to be in direct contact with the component, only the interface. The Tilton declaration also addresses the channel and not the interface.

Regarding claim 4 and by extension 5, looking at Figure 7 of Koga et al., pins 24 and 24A increase the surface area of the heat exchange unit 15B. 15B is the wall of the thermal exchange chamber. Therefore, the pins are the features that "are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber".

With regard to the intermediate member of claim 15 and its dependent claims, Patent Owner contends that the intermediate member must be "separate". First, it should be noted that the intermediate member is part of the reservoir as required by the claim. Further, Requester has shown that Koga et al. discloses that the intermediate member is a region of the reservoir, different in location to the cover and heat exchange interface (page 160 of the Request, copied below):

Koga's reservoir 1A has casings 15 and 16, forming an impeller cover as claimed. An upper wall of the channel 19 defines an intermediate member. The lower portion of the casing defines a heat exchange interface of the reservoir 1A.

This can be seen in Figure 3. Therefore, the region disclosed by Koga et al. defining the intermediate member is indeed separate from the other disclosed features of the reservoir while still being a part of the reservoir as required by the claim.

Patent Owner questions how the addition of additional passages would increase the flow as it would disrupt the purpose of the sucking channel. The Examiner notes that the Koga et al. reference has all of the claimed structure as noted above in the rejection. Therefore, it is unclear how adding the feature of additional passages would negatively impact the operation of the device as this would call into question the operability of Patent Owner's invention. Further, the motivation provided is an implicit reason one would add additional passages. It is implicit in the concept of flow that adding additional passages (more area for the fluid to pass through) would increase the flow with respect to having fewer passages (under the conditions present in the Koga et al. system). Therefore, proper motivation has been provided

Finally, with respect to Patent Owners assertion that the Examiner ignored /did not address Patent Owner's remarks with regard to priority, this is not in evidence. The Examiner reiterated when additional material was added to the disclosure and hence what the effective filing date was. Contrary to Patent Owner's assertions and indeed, in Patent Owner's explanation of support, there are features that were not in the original disclosure that are now claimed. For example, all of the claims require that the thermal exchange chamber be vertically spaced from the pump chamber. There is no mention in the passage cited by Patent Owner of any vertical spacing between the thermal exchange chamber and the pump chamber (see page 18 of Patent Owner's response to

ACP, for example). The Examiner cannot find any evidence in the disclosure as filed that there is explicit support for this relationship. Further, Figure 17 also does not show this relationship. For this one reason alone, Patent Owner is not entitled to the earlier filing date.

Conclusion

This is a RIGHT OF APPEAL NOTICE (RAN); see MPEP § 2673.02 and § 2674. The decision in this Office action as to the patentability or unpatentability of any original patent claim, any proposed amended claim and any new claim in this proceeding is a FINAL DECISION.

No amendment can be made in response to the Right of Appeal Notice in an *inter partes* reexamination. 37 CFR 1.953(c). Further, no affidavit or other evidence can be submitted in an *inter partes* reexamination proceeding after the right of appeal notice, except as provided in 37 CFR 1.981 or as permitted by 37 CFR 41.77(b)(1). 37 CFR 1.116(f).

Each party has a **thirty-day or one-month time period, whichever is longer**, to file a notice of appeal. The patent owner may appeal to the Board of Patent Appeals and Interferences with respect to any decision adverse to the patentability of any original or proposed amended or new claim of the patent by filing a notice of appeal and paying the fee set forth in 37 CFR 41.20(b)(1). The third party requester may appeal to the Board of Patent Appeals and Interferences with respect to any decision favorable to the patentability of any original or proposed amended or new claim of the patent by filing a notice of appeal and paying the fee set forth in 37 CFR 41.20(b)(1).

In addition, a patent owner who has not filed a notice of appeal may file a notice of cross appeal within **fourteen days of service** of a third party requester's timely filed notice of appeal and pay the fee set forth in 37 CFR 41.20(b)(1). A third party requester who has not filed a notice of appeal may file **a notice of cross appeal within fourteen days of service** of a patent owner's timely filed notice of appeal and pay the fee set forth in 37 CFR 41.20(b)(1).

Any appeal in this proceeding must identify the claim(s) appealed, and must be signed by the patent owner (for a patent owner appeal) or the third party requester (for a third party requester appeal), or their duly authorized attorney or agent.

Any party that does not file a timely notice of appeal or a timely notice of cross appeal will lose the right to appeal from any decision adverse to that party, but will not lose the right to file a respondent brief and fee where it is appropriate for that party to do so. If no party files a timely appeal, the reexamination prosecution will be terminated, and the Director will proceed to issue and publish a certificate under 37 CFR 1.997 in accordance with this Office action.

All correspondence relating to this *inter partes* reexamination proceeding should be directed:

By EFS: Registered users may submit via the electronic filing system EFS-Web, at https://efs.uspto.gov/efile/myportal/efs-registered

By Mail to: Mail Stop *Inter Partes* Reexam

Attn: Central Reexamination Unit
Commissioner for Patents
United States Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

By Fax to: (571) 273-9900
Central Reexamination Unit

By hand: Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

For EFS-Web transmissions, 37 CFR 1.8(a)(1)(i)(C) and (ii) states that correspondence (except for a request for reexamination and a corrected or replacement request for reexamination) will be considered timely if (a) it is transmitted via the Office's electronic filing system in accordance with 37 CFR 1.6(a)(4), and (b) includes a certificate of transmission for each piece of correspondence stating the date of transmission, which is prior to the expiration of the set period of time in the Office action.

Any inquiry concerning this communication or earlier communications from the examiner, or as to the status of this proceeding, should be directed to the Central Reexamination Unit at telephone number (571) 272-7705.

Signed:

/Joseph A. Kaufman/
Joseph A. Kaufman
Primary Examiner
Art Unit 3993

Conferees: /RF/

/EDL/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Complete if Known	
	Reexam Control Number	95/002,386
	Filing Date	September 15, 2012
	First Named Inventor	André Sloth Eriksen
	Art Unit	3993
(Use as many sheets as necessary)	Examiner Name	Joseph A. KAUFMAN
Sheet 1 of 2	Attorney Docket Number	10494.8000-00000

U.S. PATENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] *(if known)*	Issue or Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US-6,668,911 B2	12-30-2003	Bingler, Douglas	
		US-6,725,682 B2	04-27-2004	Scott, Alexander	
		US-7,100,389 B1	09-05-2006	Wayburn et al.	
		US-7,156,160 B2	01-02-2007	Lee et al.	
		US-7,209,355 B2	04-24-2007	Koga et al.	
		US-7,222,661 B2	05-29-2007	Wei et al.	

U.S. PUBLISHED PATENT APPLICATIONS

Examiner Initials*	Cite No.[3]	Document Number Number-Kind Code[4] *(if known)*	Issue or Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US-2003/0010050 A1	01-16-2003	Scott, Alexander	
		US-2004/0052048 A1	03-18-2004	Wu et al.	
		US-2005/0082040 A1	04-21-2005	Lee et al.	
		US-2006/0185378 A1	08-24-2006	Duan et al.	

Note: Submission of copies of U.S. Patents and published U.S. Patent Applications is not required.

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[5] Number[6] Kind Code[7] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	Translation[6]
		DE 203 05 281 U1	11-13-2003	Wille et al.		Yes
		JP 2002-151638	05-24-2002	Hitachi Ltd.		Abstract
		KR 10-2003-0031027	04-18-2993	3R System, Inc.		Yes
		KR 20-0314041	05-22-2003	3R System, Inc.		Yes
		TW M244511	09-21-2004	3R System Co., Ltd.		Partial
		TW M244513	09-21-2004	Hon Hai Precision Industry Co., Ltd.		Yes
		TW M251442	11-21-2004	Hon Hai Precision Industry		Partial

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.K./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Complete if Known	
(Use as many sheets as necessary)	Reexam Control Number	95/002,386
	Filing Date	September 15, 2012
	First Named Inventor	André Sloth Eriksen
	Art Unit	3993
	Examiner Name	Joseph A. KAUFMAN
Sheet 2 of 2	Attorney Docket Number	10494.8000-00000

FOREIGN PATENT DOCUMENTS

				Co., Ltd.		
		TW M256682	02-01-2005	Xuanpu Technology Co., Ltd.		Partial
		TW M273032	08-11-2005	First Int. Computer Inc.		No
		TW M275684	09-11-2005	3R System Co., Ltd.		Partial
		TW M324810	01-01-2008	Gigazone Technology Co., Ltd.		Partial
		TW M578997	--	3R System Co., Ltd.		No
		WO 2003/055055 A1	07-03-2003	Coolit Systems Inc.		--

NONPATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	Translation[6]
		User Manual of Single Stream® marketed by GlobalWIN Technology Co. Ltd.	

Examiner Signature	/Joseph Kaufman/	Date Considered	06/17/2014

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.K./

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
95/002,386	09/15/2012	8245764	COOL-1.012	7254

22852 7590 06/30/2014

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

EXAMINER	
KAUFMAN, JOSEPH A	

ART UNIT	PAPER NUMBER
3993	

MAIL DATE	DELIVERY MODE
06/30/2014	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Transmittal of Communication to Third Party Requester *Inter Partes* Reexamination	Control No.	Patent Under Reexamination	
	95/002,386	8245764	
	Examiner	Art Unit	
	JOSEPH KAUFMAN	3993	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

(THIRD PARTY REQUESTER'S CORRESPONDENCE ADDRESS)

GANZ LAW, P.C.
P.O. BOX 2200
HILLSBORO, OR 97123

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above-identified reexamination prceeding. 37 CFR 1.903.

Prior to the filing of a Notice of Appeal, each time the patent owner responds to this communication, the third party requester of the *inter partes* reexamination may once file written comments within a period of 30 days from the date of service of the patent owner's response. This 30-day time period is statutory (35 U.S.C. 314(b)(2)), and, as such, it cannot be extended. See also 37 CFR 1.947.

If an *ex parte* reexamination has been merged with the *inter partes* reexamination, no responsive submission by any *ex parte* third party requester is permitted.

All correspondence relating to this inter partes reexamination proceeding should be directed to the **Central Reexamination Unit** at the mail, FAX, or hand-carry addresses given at the end of the communication enclosed with this transmittal.

NOTICE RE DEFECTIVE PAPER IN INTER PARTES REEXAMINATION	Control No. 95/002,386	Patent Under Reexamination 8245764
	Examiner JOSEPH KAUFMAN	Art Unit 3993

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

1. ☐ No proof of service is included with the paper filed by ☐ patent owner ☐ requester on _____. 37 CFR 1.248 and 1.903. Proof of service is required within a time period of 30-days or one month from the date of this letter, whichever is longer. Failure to serve the paper may result in the paper being refused consideration. If the failure to comply with this requirement results in a patent owner failure to file a timely and appropriate response to any Office action, the prosecution of the reexamination proceeding will be terminated under 37 CFR 1.957(b) or limited under 37 CFR 1.957(c) (as is appropriate for the case).

2. ☐ The paper filed on _____ by the ☐ patent owner ☐ requester is unsigned. A duplicate paper or ratification, properly signed, is required within a time period of 30-days or one month from the date of this letter, whichever is longer. Failure to comply with this requirement will result in the paper not being considered. If the failure to comply results in a patent owner failure to file a timely and appropriate response to any Office action, the prosecution of the reexamination proceeding will be terminated under 37 CFR 1.957(b) or limited under 37 CFR 1.957(c) (as is appropriate for the case).

3. ☐ The paper filed on _____ by the ☐ patent owner ☐ requester is signed by _____ who is not of record. A ratification or a new power of attorney with a ratification, or a duplicate paper signed by a person of record, is required within a time period of 30-days or one month from the date of this letter, whichever is longer. Failure to comply with this requirement will result in the paper not being considered. If the failure to comply results in a patent owner failure to file a timely and appropriate response to any Office action, the prosecution of the reexamination proceeding will be terminated under 37 CFR 1.957(b) or limited under 37 CFR 1.957(c) (as is appropriate for the case).

4. ☐ The amendment filed by patent owner on _____, does not comply with 37 CFR 1.530. Patent owner is given a time period of 30-days or one month from the date of this letter, whichever is longer, to correct this informality, or the prosecution of the reexamination proceeding will be terminated under 37 CFR 1.957(b) or limited under 37 CFR 1.957(c) (as is appropriate for the case). The amendment will not be entered, although the argument the rein will be considered as it applies to the proceeding without the amendment should the prosecution be limited under 37 CFR 1.957(c).

5. ☐ The amendment filed by patent owner on _____, does not comply with 37 CFR ☐1.20(c)(3) and/or ☐1.20(c)(4), as to excess claim fees. Patent owner is given a time period of 30-days or one month from the date of this letter, whichever is longer, to correct this fee deficiency, or the prosecution of the reexamination proceeding will be terminated under 37 CFR 1.957(b) or limited under 37 CFR 1.957(c) (as is appropriate for the case), to effect the "abandonment" set forth in 37 CFR 1.20(c)(5).

6. ☒ Other: see attachment

NOTE: PATENT OWNER EXTENSIONS OF TIME ARE GOVERNED BY 37 CFR 1.956. NO EXTENSION OF TIME IS PERMITTED FOR THIRD PARTY REQUESTER. 35 U.S.C. § 314(b)(2).

All correspondence relating to this *inter partes* reexamination proceeding should be directed to the **Central Reexamination Unit** at the mail, FAX, or hand-carry addresses given at the end of this Office action.

Reexamination

Rule 1.947 states:

§ 1.947 Comments by third party requester to patent owner's response in *inter partes* reexamination.

Each time the patent owner files a response to an Office action on the merits pursuant to § 1.945, a third party requester may once file written comments within a period of 30 days from the date of service of the patent owner's response. These comments shall be limited to issues raised by the Office action or the patent owner's response. The time for submitting comments by the third party requester may not be extended. For the purpose of filing the written comments by the third party requester, the comments will be considered as having been received in the Office as of the date of deposit specified in the certificate under § 1.8.

[Added, 65 FR 76756, Dec. 7, 2000, effective Feb. 5, 2001]

In the paper filed 4 November 2013, in response to the Action Closing Prosecution, requester has proposed new rejections for claims 1-30. As claims 1-30 have not been amended, the response raises issues not raised by Patent Owner or the Office action. Therefore, the new rejections of claims 1-30 set forth on pages 28-38 of the 4 November 2013 communication based on the Ryu and Duan references are improper and the entire response will be expunged.

Requester has stated that the newly provided art just became known and available.

Regarding the requirement for submitting a new rejection, MPEP section 2666.05 states:

As to item (C) above, prior art submitted under **37 CFR 1.948(a)(3)** must be accompanied by a statement that explains the circumstances as to when the prior art first became known or available to the third party requester, including the date and manner that the art became known or available, and why it was not available earlier. The submission must also include a discussion of the pertinency of each reference to the patentability of at least one claim. It is to be noted that entry of prior art submitted under **37 CFR 1.948(a)(3)** does not, in and of itself, allow for a proposed rejection based on that art.

Requester has not provided any reason as required above as to why the references were not available earlier. Therefore, for this reason as well, the entire submission is improper and will be expunged from the record.

While MPEP § 2267 indicates that such inappropriate papers are to be returned to the sender, this may not be possible in an Image File Wrapper (IFW) proceeding where a paper is inappropriately entered into the record. The papers filed 4 November 2013 have been scanned into an IFW, and cannot be returned to sender. However, for the reasons set forth above, the papers have been designated "closed" and "not public", will form no part of the record, and will not be available to the public. This decision will be made of record in the reexamination file.

Requester does not have the right to submit a corrected response as Requester may only once file comments as noted in the previously cited rule.

Conclusion

All correspondence relating to this *inter partes* reexamination proceeding should be directed:

By EFS: Registered users may submit via the electronic filing system EFS-Web, at https://efs.uspto.gov/efile/myportal/efs-registered

By Mail to: Mail Stop *Inter Partes* Reexam
Attn: Central Reexamination Unit
Commissioner for Patents
United States Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

By Fax to: (571) 273-9900
Central Reexamination Unit

By hand: Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

For EFS-Web transmissions, 37 CFR 1.8(a)(1)(i)(C) and (ii) states that correspondence (except for a request for reexamination and a corrected or replacement request for reexamination) will be considered timely if (a) it is transmitted via the Office's electronic filing system in accordance with 37 CFR 1.6(a)(4), and (b) includes a certificate of transmission for each piece of correspondence stating the date of transmission, which is prior to the expiration of the set period of time in the Office action.

Any inquiry concerning this communication or earlier communications from the examiner, or as to the status of this proceeding, should be directed to the Central Reexamination Unit at telephone number (571) 272-7705.

Signed:

/Joseph A. Kaufman/
Joseph A. Kaufman
Primary Examiner
Art Unit 3993

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
95/002,386	09/15/2012	8245764	COOL-1.012	7254

22852 7590 01/31/2014

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

EXAMINER	
KAUFMAN, JOSEPH A	

ART UNIT	PAPER NUMBER
3993	

MAIL DATE	DELIVERY MODE
01/31/2014	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patents and Trademark Office
P.O.Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

THIRD PARTY REQUESTER'S CORRESPONDENCE ADDRESS
GANZ LAW, PC
P O BOX 2200
HILLSBORO, OR 97123

Date: MAILED

JAN 31 2014

CENTRAL REEXAMINATION UNIT

Transmittal of Communication to Third Party Requester
Inter Partes Reexamination

REEXAMINATION CONTROL NO. : 95002386
PATENT NO. : 8245764
ART UNIT : 3993

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above-identified reexamination proceeding. 37 CFR 1.903.

Prior to the filing of a Notice of Appeal, each time the patent owner responds to this communication, the third party requester of the inter partes reexamination may once file written comments within a period of 30 days from the date of service of the patent owner's response. This 30-day time period is statutory (35 U.S.C. 314(b)(2)), and, as such, it cannot be extended. See also 37 CFR 1.947.

If an ex parte reexamination has been merged with the inter partes reexamination, no responsive submission by any ex parte third party requester is permitted.

All correspondence relating to this inter partes reexamination proceeding should be directed to the Central Reexamination Unit at the mail, FAX, or hand-carry addresses given at the end of the communication enclosed with this transmittal.

MAILED

Decision on Petition For Waiver of Page Limit	Control No.: 95/002,386	JAN 31 2014

CENTRAL REEXAMINATION UNIT

1. THIS IS A DECISION ON THE PETITION FILED: November 4, 2013.
2. THIS DECISION IS ISSUED PURSUANT TO:

   37 CFR 1.183 — In an extraordinary situation, when justice requires, any requirement of the regulations in this part which is not a requirement of the statutes may be suspended or waived by the Director or the Director's designee, *sua sponte*, or on petition of the interested party, subject to such other requirements as may be imposed.

   37 CFR 1.943(b) — Responses by the patent owner and written comments by the third party requester shall not exceed 50 pages in length, excluding amendments, appendices of claims, and reference materials such as prior art references.

   The petition is before the Office of Patent Legal Administration.
3. RELIEF REQUESTED

   Petitioner requests waiver of the 50-page limit of 37 CFR 1.943(b) for:

   ☐ patent owner's response to the Office action mailed on ________________.

   ☒ third party requester comments filed after patent owner's response and the Office action mailed on September 3, 2013.
4. FORMAL MATTERS

   a. ☒ Petitioner timely filed a proposed patent owner's response or third party requester comments submission:

      i. ☒ concurrently with the instant petition.

      ii. ☐ on ________________.

   b. ☒ Petition fee per 37 CFR 1.20(c)(6) was provided.

   c. ☒ Proper certificate of service was provided.

   d. ☒ Petition was properly signed.
5. DECISION (see 37 CFR 1.183 and 1.943(b))

   a. ☒ Granted. Based on the specific facts set forth in the petition under 37 CFR 1.183, petitioner's showing in support of the request for waiver of the 50-page limit of 37 CFR 1.943(b) by attempting to draft a submission in compliance with the 50-page limit and submitting the resulting submission which is in excess of 50 pages, and the individual facts and circumstances of this case, the page limit of 37 CFR 1.943(b) is waived to the extent necessary to permit entry of the submission filed on November 4, 2013. This waiver makes the submission filed on November 4, 2013 page-length compliant.*

   b. ☐ Granted-in-part:

   c. ☐ Dismissed because:

      i. ☐ Formal matters above. (See unchecked box(es) 4a, b, c, and/or d.)

      ii. ☐ The petition is unnecessary because the maximum number of pages of the submission filed on ________________ that count toward the regulatory page limit does not exceed 50 pages.

      iii. ☐ The petition is moot in light of the communication from the Central Reexamination Unit (CRU), mailed on ________________.

      iv. ☐ Other/comment:
6. CONCLUSION

   Telephone inquiries with regard to this decision should be directed to Maria Nuzzolillo at 571-272-8150. In his/her absence, calls may be directed to Nicole D. Haines at 571-272-7717 in the Office of Patent Legal Administration.

/Nicole D. Haines/
Nicole D. Haines
[*Signature*]

Senior Legal Advisor
[*Title*]

* This decision is limited to the issue of page-length compliance. The Central Reexamination Unit (CRU) will evaluate the submission for compliance with other applicable regulations. Also, this decision does not address the merits of any patent owner requests for entry of amendments and/or evidence pursuant to 37 CFR 1.116, which will be considered by the CRU examiner.

U.S. Patent and Trademark Office
PTO-2309 (Rev. 06-2013)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent No.: 8,245,764 **Currently in Litigation Styled:** *Asetek Holdings, Inc et al v. Coolit Systems Inc*, Case No. 3:12-cv-04498-EMC (N.D. Cal.) **Issued:** August 21, 2012 **Filed:** October 7, 2011 **Applicant:** Andre Sloth Eriksen **Title:** COOLING SYSTEM FOR A COMPUTER SYSTEM	**R.C.N.:** 95/002,386 **Confirmation No.:** 7254 **Examiner:** Joseph A. Kaufman **Art Unit:** 3993

SUBMITTED VIA ELECTRONIC FILING SYSTEM ON NOVEMBER 4, 2013
UNITED STATES PATENT AND TRADEMARK OFFICE

PETITION UNDER 37 C.F.R. § 1.183 TO WAIVE, IN PART, 37 C.F.R. § 1.943

In the interests of justice and pursuant to 37 C.F.R. § 1.183, Requester respectfully petitions to waive the 50-page limit on the concurrently filed Requester's Comments set forth in 37 C.F.R. § 1.943.

A fee under 37 C.F.R. § 1.20 for this Petition is being paid concurrently with the filing of this Petition. Requester qualifies to pay reduced fees as a small entity. Nonetheless, if the fee paid is insufficient, or if additional or alternative fees are due in connection with the filing of this Petition in Opposition, please charge such fees to Deposit Account No. 50-1001.

BACKGROUND

1. On August 27, 2013, Patent Owner, Asetek A/S, filed a Complaint in the Disctrict Court for the Northern District of California alleging infringement of U.S. Patent No. 8,245,764 (the '764 Patent) by Third-Party Requester, CoolIT Systems, Inc.

2. On September 15, 2012, Requester filed a Request for *Inter Partes* Reexamination (Request) of all claims (i.e., claims 1-18) in the '764 Patent.

3. On October 26, 2012, the Office issued an Order instituting the present reexamination as to all challenged claims. The same day, an Office Action issued rejecting each of the challenged claims as being anticipated by Koga.

4. On December 26, 2012, Patent Owner amended the listing of claims by adding new claims 19-30 and contested the anticipation rejections in a "Response Under 37 C.F.R. § 1.111" (Amendment).

5. On September 3, 2013, the Examiner issued an Action Closing Prosecution.

6. On October 3, 2013, Patent Owner served on Requester a Response to the Action Closing Prosecution. A Declaration of Patent Owner's expert accompanied the Response. Patent Owner's Response, as well as the Declaration, contested the outstanding rejections and argued that each rejected claim should be allowed over the applied reference.

7. Patent Owner alleged that the Examiner first interpreted the term "chamber" in the Action Closing Prosecution, and, on that basis, alleged that entry of the Declaration of its expert was proper under 37 C.F.R. § 1.116.

8. Patent Owner's allegations relating to the timing of Examiner's initial interpretation of the term "chamber" are blatantly false, as explained more fully in the concurrently filed Requester's Comments under 37 C.F.R. § 1.951(b). In particular, the Examiner proferred an identical definition of the term "chamber" in the Order Granting / Denying Reexamination as Examiner set forth in the ACP. The Patent Owner even adopted that definition in its Response filed December 26, 2012.

9. During the course of the concurrent District Court litigation and after the Request for *Inter Partes* Reexamination was filed, the following prior art references first became known or available to Requester (i.e., during June or July 2013):

    a. Jeong-mu Ryu, Korean Patent No. 20-003114041, published on May 22, 2003, from an application filed February 28, 2003 (hereinafter "**Ryu**"); and
    b. Qiang-Fei Duan, *et al.*, U.S. Publication No. 2006/0195378, published on August 24, 2006, from an application filed February 18, 2005 (hereinafter "**Duan Application**").

10. Each of Ryu and the Duan Application constitutes valid prior art to the '764 Patent and renders at least one claim unpatentable for reasons set forth in the concurrently filed Requester's Comments under 37 C.F.R. § 1.951(b) and the concurrently filed claim charts.

11. Pursuant to 37 C.F.R. § 1.948(a)(3), Requester may, with its Comments under 37 C.F.R. § 1.951(b), cite additional prior art which for the first time became known or available to the third party requester after the filing of the request for inter partes reexamination proceeding. Prior art submitted under § 1.948(a)(3) must be accompanied by a statement as to when the prior art first

became known or available to the third party requester and must include a discussion of the pertinency of each reference to the patentability of at least one claim.

12. In preparing the concurrently filed Comments under 37 C.F.R. § 1.951(b), the accompanying Declaration of Requester's expert, and the claim charts relating to Ryu (Exhibit D) and the Duan Application (Exhibit E) as required by § 1.948(a)(3), Requester made a *bona fide* attempt to comply with the 50-page limit imposed by § 1.943, but was unable to comply with that limit by virtue of (A) the many pages needed to rebut Patent Owner's false allegations; and (B) the length of the claim charts required by § 1.948(a)(3).

ARGUMENTS

Requester would suffer undue and unfair prejudice if the concurrently filed Requester's Comments are stricken for failing to comply with the 50-page limit imposed by Rule 943, particularly in view of the many pages of text dedicated to rebutting blatantly false allegations of the Patent Owner. Moreover, Requester would suffer unfair prejudice if the 50-page limit is strictly enforced when the Requester's submission cannot comply with that limit as well as the requirements of Rule 948(a)(3), requiring claim charts (i.e., Exhibits D and E) to fully develop the issues raised by newly discovered prior art.

Under the current extraordinary circumstances, and in the interests of justice, Requester respectfully urges the Office to enter and fully consider the accompanying Comments, together with the concurrently filed Exhibits D and E containing claim charts, in their entirety.

To the extent that the Office determines that the 50-page limit on Requester's Comments should be strictly enforced, Requester respectfully urges that the equities weigh heavily in favor of expunging Exhibits D and E, and entering the main body of Requester's Comments together with Dr. Lee's Declaration, as the combined total of those two documents is less than 50 pages.

Date: November 4, 2013

Respectfully submitted,
GANZ LAW, P.C.
/Lloyd L. Pollard II/

Lloyd L. Pollard II
Registration No. 64,793

P. O. Box 2200
Hillsboro, Oregon 97123
Telephone: (503) 844-9009
Facsimile: (503) 296-2172
email: mail@ganzlaw.com

Certificate of Service

The undersigned hereby certifies that a complete copy of this PETITION UNDER 37 C.F.R. § 1.183 TO WAIVE, IN PART, 37 C.F.R. § 1.943, was served on counsel for patent owner at the following address:

> Finnegan, Henderson, Farabow, Garrett & Dunner LLP
> 901 New York Avenue, NW
> Washington, D.C. 20001-4413

via first class mail, with sufficient postage affixed thereto, on November 4, 2013.

By: *<u>/Lloyd L. Pollard II/</u>*

Lloyd L. Pollard, II
Registration No. 64,793

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P. O. Box 2200
Hillsboro, Oregon 97123
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E-mail: mail@ganzlaw.com

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)				Complete if Known	
				Reexam Control Number	95/002,386
				Filing Date	September 15, 2012
				First Named Inventor	André Sloth Eriksen
				Art Unit	3993
				Examiner Name	Joseph A. KAUFMAN
Sheet	1	of	2	Attorney Docket Number	10494.8000-00000

U.S. PATENTS

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		US-2004/0052048 A1	03-18-2004	Wu et al.	
		US-2005/0082040 A1	04-21-2005	Lee et al.	
		US-2006/0185378 A1	08-24-2006	Duan et al.	

Note: Submission of copies of U.S. Patents and published U.S. Patent Applications is not required.

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[5] Number[6] Kind Code[7] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	Translation[8]
		DE 203 05 281 U1	11-13-2003	Wille et al.		Yes
		JP 2002-151638	05-24-2002	Hitachi Ltd.		Abstract
		KR 10-2003-0031027	04-18-2993	3R System, Inc.		Yes
		KR 20-0314041	05-22-2003	3R System, Inc.		Yes
		TW M244511	09-21-2004	3R System Co., Ltd.		Partial
		TW M244513	09-21-2004	Hon Hai Precision Industry Co., Ltd.		Yes
		TW M251442	11-21-2004	Hon Hai Precision Industry		Partial

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)				*Complete if Known*	
				Reexam Control Number	95/002,386
				Filing Date	September 15, 2012
				First Named Inventor	André Sloth Eriksen
				Art Unit	3993
				Examiner Name	Joseph A. KAUFMAN
Sheet	2	of	2	*Attorney Docket Number*	10494.8000-00000

FOREIGN PATENT DOCUMENTS

				Co., Ltd.		
		TW M256682	02-01-2005	Xuanpu Technology Co., Ltd.		Partial
		TW M273032	08-11-2005	First Int. Computer Inc.		No
		TW M275684	09-11-2005	3R System Co., Ltd.		Partial
		TW M324810	01-01-2008	Gigazone Technology Co., Ltd.		Partial
		TW M578997	--	3R System Co., Ltd.		No
		WO 2003/055055 A1	07-03-2003	Coolit Systems Inc.		--

NONPATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	Translation[6]
		User Manual of Single Stream® marketed by GlobalWIN Technology Co. Ltd.	

Examiner Signature		Date Considered	

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Electronic Acknowledgement Receipt

EFS ID:	17035016
Application Number:	95002386
International Application Number:	
Confirmation Number:	7254
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Customer Number:	22852
Filer:	Eric Paul Raciti/Marlene A Richards
Filer Authorized By:	Eric Paul Raciti
Attorney Docket Number:	COOL-1.012
Receipt Date:	03-OCT-2013
Filing Date:	15-SEP-2012
Time Stamp:	17:16:52
Application Type:	inter partes reexam

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Patent Owner Comments after Action Closing Prosecution	Response.pdf	2257592 db2e3a6dcc46d719b85433c2ba6c2b36b6efc819	no	40

Warnings:

Information:

2	Reexam Certificate of Service	CtfServ.pdf	70100 9c55f99a60305dd3c19bc1e22ba293c353e280de	no	1
Warnings:					
Information:					
3	Affidavit-traversing rejectns or objectns rule 132	Declaration.pdf	182379 8820aa051890f632bfd5010ada2815fe85a02cb1	no	5
Warnings:					
Information:					
4	Transmittal Letter	IDStransmittal.pdf	117358 150670b07f0c384c7b8339bfeaba28c8af24d583	no	2
Warnings:					
Information:					
5	Information Disclosure Statement (IDS) Form (SB08)	SB08.pdf	124115 aaa7e779d073e8f71f8abd00f51bb3f231fbb9ee	no	2
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
		Total Files Size (in bytes):	2751544		

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT
Customer No. 22,852
Attorney Docket No. 10494.8000-00000

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Inter Partes* Reexamination of:	)	
	)	
André Sloth ERIKSEN	)	Group Art Unit: 3993
	)	
U.S. Patent No.: 8,245,764 B2	)	Examiner: Joseph A. KAUFMAN
Filed: October 7, 2011	)	
Issued: August 21, 2012	)	
	)	
For: COOLING SYSTEM FOR A COMPUTER SYSTEM	)	Confirmation No.: 7254
	)	
	)	
Reexamination Proceeding	)	
Control No. 95/002,386	)	
Filed: September 15, 2012	)	

Mail Stop *Inter Partes* Reexam
Attn: Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

PATENT OWNER'S RESPONSE TO ACTION CLOSING PROSECUTION

In reply to the Action Closing Prosecution mailed on September 3, 2013, and in compliance with 37 C.F.R. §§ 1.951 and 1.943, Patent Owner requests the Examiner's consideration of the comments presented herein.

Remarks begin on page 1 of this paper.

Appendix A provides a listing of the claims.

Attachments to this paper are as follows:

(1) **Expert Declaration** under 37 C.F.R. § 1.132.

(2) **Certificate of Service**, pursuant to 37 C.F.R. § 1.903 and M.P.E.P. § 2666.06.

REMARKS

I. INTRODUCTION

This Response is filed in reply to the Action Closing Prosecution mailed on September 3, 2013 ("ACP") in the *Inter Partes* Reexamination of U.S. Patent No. 8,245,764 ("the '764 patent") to Eriksen. The deadline for filing a response to the ACP is October 3, 2013. *See* 37 C.F.R. § 1.951(a). Thus, this Response is timely filed. The number of pages in this Response is less than fifty pages. Therefore, this Response is in compliance with 37 C.F.R. § 1.943.

II. STATUS OF CLAIMS

In accordance with 37 C.F.R. § 1.530(e), Patent Owner provides the status of the pending claims. Claims 1-18 are original patented claims. Claims 19-30 were in the Response filed on December 26, 2012. No claims have been amended by the present Response. Claims 1-30 remain pending. Appendix A provides a listing of the pending claims.

III. ACTION CLOSING PROSECUTION

In the ACP, the Examiner took the following actions:

(a) Rejected claims 1-30 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 7,544,049 to Koga et al. ("*Koga*");

(b) Rejected claims 20, 24, and 28 under 35 U.S.C. § 103(a) as being unpatentable over *Koga;* and

(c) Rejected priority claim to PCT Application No. PCT/DK2005/000310 filed on May 6, 2005 (International Publication No. WO 2006/119761).

Patent Owner respectfully submits that claims 1-30 are patentable at least for the reasons that follow and the reasons stated in Patent Owner's Response filed on

December 26, 2013 ("the First Response"). This Response is supported by a Declaration of Donald Tilton, Ph.D. ("Tilton Decl."). The Declaration is submitted to address arguments presented by the Examiner for the first time in the ACP. For example, the Examiner's interpretation of the term "chamber" was presented for the first time in the ACP, and the Declaration addresses the Examiner's interpretation by highlighting the requirements for an enclosed region to function as a "thermal exchange chamber". Patent Owner respectfully requests the Examiner to consider the Declaration and the following remarks and to confirm the pending claims 1-30.

IV. THE REJECTION UNDER 35 U.S.C. § 102(b) OVER *KOGA*

The Examiner rejected claims 1-30 under 35 U.S.C. § 102(b) as allegedly anticipated by *Koga*. For at least the reasons provided below, Patent Owner respectfully submits that *Koga* does not disclose each and every limitation of claims 1-30.

A. Independent claim 1 and dependent claims 2-9 and 19-22

1. Independent claim 1 is not anticipated by *Koga*

Independent claim 1 recites a cooling system for a heat-generating component, comprising, *inter alia*, a reservoir having "a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber, the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages," and "a heat-exchanging interface, the heat-exchanging interface forming a boundary wall of the thermal exchange chamber, and configured to be placed in thermal contact with a surface of the heat-generating component." (Emphasis added.) As discussed below, *Koga* does not disclose at least these features of independent claim 1.

a) *Koga* fails to disclose a thermal exchange chamber separate from the pump chamber

In the Third Party Request ("Request"), and the Office Action dated October 26, 2012 ("Office Action"), which refers to the Request, the "pump chamber" and the "thermal exchange chamber," recited in claim 1, are equated to the pump room 15A and sucking channel 19 of *Koga,* respectively. *Request,* pp. 149-164. In response to the Office Action, Patent Owner argued that sucking channel 19 does not satisfy the claim element "thermal exchange chamber" as recited in claim 1. *First Response*, p. 18. In the ACP, the Examiner maintains that sucking channel 19 of *Koga* does satisfy the claim requirement for a "chamber," because "chambers can clearly have inlets and outlets." *ACP*, p. 5. Patent Owner respectfully disagrees for the following reasons.

First, *Koga* represents the sucking channel as simply a conduit to deliver coolant to the rotational center of the impeller. *See Koga*, col. 4, ll. 57–67; *see also Tilton Decl.* ¶¶9, 10. For a prior art reference to anticipate a claim, "[t]he identical invention must be shown in as complete detail as is contained in the … claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1126, 1236 (Fed. Cir. 1989). In this case, nowhere does *Koga* disclose or suggest that sucking channel 19 performs as a heat exchanging chamber. Pump room 15A is the only chamber provided in the cooling device of *Koga*, and it performs the dual function of housing the impeller and providing a reservoir for the coolant to collect and absorb thermal energy dissipated from heat-generating component 2. The fact that pump room 15A serves as the "thermal exchange chamber" of the *Koga* device is evident from the fact that inner wall face 50 of pump room 15A comprises dimples or protrusions to facilitate heat transfer from the heat-generating component to the coolant in the pump room. *Koga*, col. 3, ll. 25-27 ("On the inner wall of the pump room, a recess is provided. In this recess, protrusions extending toward the impeller or dimples are provided.") Sucking channel 19 of *Koga*, on the other hand, is simply a passageway for coolant to flow through to pump room 15A. *See Tilton Decl.*, ¶11.

Second, even assuming *arguendo* that sucking channel 19 could properly be reasonably construed to constitute a "chamber," which Patent Owner in no case concedes, sucking channel 19 still cannot constitute a "thermal exchange chamber," as required by claim 1, because sucking channel 19 is simply a flow-through region that would not allow the coolant to accumulate and absorb heat from the cooling device. *Id.* Additionally, the surface area of sucking channel 19 in any thermal contact with heat-generating component 2 would be negligible compared to the total surface area of the heat-receiving face 15B of the base wall of pump casing 15. FIGS. 5 and 8 of *Koga* (FIG. 8 annotated and reproduced below) clearly shows that the sucking channel is a narrow conduit inserted between heat-receiving face 15B and inner wall face 50 of the base wall. *See also Koga,* col. 4, ll. 50-60. Because of the narrow width of the channel, the outer surface area of the channel in any contact with component 2 would be very small. *Tilton Decl.*, ¶12. Therefore, one of ordinary skill in the art would not interpret sucking channel 19 as able to transfer any heat from component 2. *Id.*

(Cont'd)

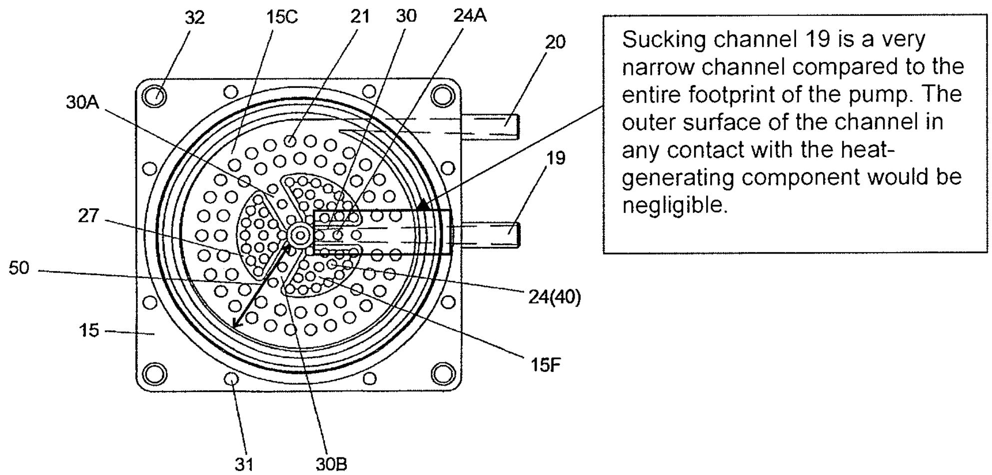

FIG. 8 of *Koga*

Accordingly, even if the Requester's strained construction of "chamber" to read on sucking channel 19 is accepted, the sucking channel still cannot be considered a "thermal exchange chamber," as recited in claim 1, because it would not be able to transfer any heat from the component to be cooled. Even under the most aggressive application of the "broadest reasonable interpretation" standard, a claim element cannot be construed so as to ignore claim limitations. *In re Suitco Surface, Inc.*, 603 F. 3d 1255, 1260 (Fed. Cir. 2010) (explaining that although the USPTO is to give claims their broadest reasonable construction, "[t]he broadest-construction rubric coupled with the term 'comprising' does not give the PTO an unfettered license to interpret claims to embrace anything remotely related to the claimed invention. Rather, claims should always be read in light of the specification and teachings in the underlying patent."). Here, the Examiner's construction of the term "chamber" is contrary to the express language of the claim requiring not just a "chamber," but a "thermal exchange chamber."

The specification also clearly requires a "thermal exchange chamber" as a feature of the cooling system, not simply any compartment or enclosed region as has been construed by the Examiner. Therefore, the Examiner's construction is unreasonably broad in light of the claim and the specification.

At least due to the above reasons, *Koga* fails to disclose a "thermal exchange chamber" that is separate and distinct from the pump chamber under any reasonable interpretation. Accordingly, at least the limitation "a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber, the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages," recited in independent claim 1, is not disclosed by *Koga*.

b) Sucking channel 19 of *Koga* is not in thermal contact with the electronic component to be cooled

Independent claim 1 recites that the cooling system comprises a "heat-exchanging interface," which forms "a boundary wall of the thermal exchange chamber" and is "configured to be placed in thermal contact with a surface of the heat-generating component." (Emphasis added.) As discussed earlier, the Examiner equates the "thermal exchange chamber" to sucking channel 19 of *Koga.* By extension, under the Examiner's reasoning, at least a portion of the outer surface area of sucking channel 19 forms the "heat-exchanging interface," as recited in claim 1. Claim 1 further recites that the "heat-exchanging interface" is "configured to be placed in thermal contact with a surface of the heat-generating component." *Koga*, however, teaches away from placing sucking channel 19 in thermal contact with the electronic component to be cooled. In particular, *Koga* teaches that:

> The shape of heat-receiving plane 15B and the shape of an upper surface of component 2 complement each other three-dimensionally, so that sucking-channel 19 does not extend over component 2. This structure allows heat-receiving plane 15B and the upper surface of component 2 to solidly contact with each other, so that heat can be transferred efficiently.

Koga, col. 8, ll. 47-53, and col. 10, ll. 33-40 (emphasis added). In other words, *Koga* teaches that the cooling device be designed in such a way that the sucking channel does not extend over the heat-generating component, because this would allow heat-receiving face 15B of the base wall and the upper surface of the heat-generating component to be in better contact with each other to allow efficient transfer of heat. Thus, contrary to the Examiner's position, sucking channel 19 does not contact the heat-generating component, and for at least that reason, sucking channel 19 cannot constitute a "thermal exchange chamber" because no heat exchange can take place between the component and sucking channel 19 if they are not in thermal contact with each other.

Accordingly, at least the limitation "a heat-exchanging interface, the heat-exchanging interface forming a boundary wall of the thermal exchange chamber, and configured to be placed in thermal contact with a surface of the heat-generating component," as recited in claim 1, is not disclosed by *Koga*.

For at least the above reasons, *Koga* fails to disclose each and every limitation of independent claim 1. Therefore, claim 1 is not anticipated by *Koga*.

2. *Koga* does not anticipate dependent claims 2-9 and 19-22

Dependent claims 2-9 and 19-22 depend from independent claim 1, and are not anticipated by *Koga* at least due their dependence from claim 1.

Additionally, Patent Owner respectfully submits that at least claim 4 recites an added limitation, not recited in independent claim 1, that further illustrates that the Requester's interpretation of sucking channel 19 as the "thermal exchange chamber" must fail as unreasonable. Claim 4 recites that "the first side [the side that contacts the cooling liquid] of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber." The Examiner equates sucking channel 19 to the "thermal exchanging chamber" recited in claim 1, and thus under the Examiner's argument, a boundary wall of sucking channel 19 must constitute the heat-exchanging interface. But nowhere does *Koga* disclose that an inner wall surface of sucking channel 19, i.e., the side that contacts the coolant, comprises features to increase heat transfer to the coolant. In fact, inclusion of such features would impede the flow of coolant to pump room 15A. *Tilton Decl.*, ¶13. FIG. 7, annotated and reproduced below, further shows that sucking channel 19 is not a thermal exchange chamber as interpreted by the Requester and the Examiner.

(Cont'd)

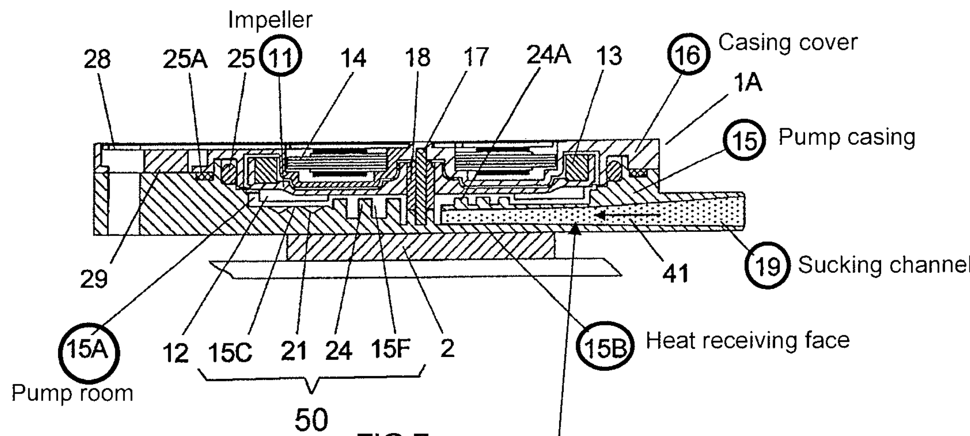

FIG.7

If sucking channel 19 is the thermal exchange chamber per the Examiner's argument, then this inner surface of sucking channel 19 should have included dimples/protrusion to facilitate heat transfer to the coolant inside the channel. Protrusions 24/24A are instead provided on the inner surface 50 of pump room 15A.

Koga teaches that dimples, or protrusions extending towards the impeller, may be provided to help in transfer of heat from the pump casing 15 to the coolant. *See Koga,* col. 8, ll. 11-22. However, the protrusions and/or dimples are provided on the inner surface of the pump room 15A, as shown in FIG. 3 (showing that protrusions 24 and dimples 40 are located on recessed area 15E of inner surface wall 50 of the pump room). *See also Koga*, col. 3, ll. 25-27 ("On the inner wall of the pump room, a recess is provided. In this recess, protrusions extending toward the impeller or dimples are provided.") Since sucking channel 19 is sandwiched between inner wall surface 50 and heat-receiving face 15B of the base wall, the sucking channel itself does not comprise any features to help in the transfer of heat. Thus the Examiner has improperly conflated the pump room 15A and the sucking channel 19. It is respectfully submitted that the need to do so is evidence that sucking channel 19 is not a thermal exchange chamber under any reasonable interpretation of the term. Thus, contrary to the Examiner's position, nowhere does *Koga* discloses that "the first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber."

Accordingly, claim 4 (and claim 5 which depends from claim 4) are not anticipated by *Koga* for this additional limitation.

B. Independent claim 10 and dependent claims 11-14 and 23-26

Independent claim 10 recites a cooling system comprising, *inter alia*, a reservoir having "a thermal exchange chamber adapted to be positioned in thermal contact with the heat-generating component," and "a separate pump chamber vertically spaced part from the thermal exchange chamber and coupled with the thermal exchange chamber through one or more passages configured for fluid communication between the pump chamber and the thermal exchange chamber." (Emphasis added.) At least these limitations of claim 10 are not disclosed by *Koga*. As discussed in Section A above, *Koga* fails to disclose a "pump chamber" separate from the "thermal exchange chamber;" the pump room 15A of *Koga* is both the "pump chamber" and the "thermal exchange chamber." Further, as discussed in Section A, sucking channel 19 of *Koga*, which the Examiner alleges satisfies the recitation of a "thermal exchange chamber," is not placed in thermal contact with the component to be cooled. Therefore, at least the above-identified limitations of claim 10 are not disclosed by *Koga* under any reasonable interpretation. Accordingly, claim 10, and claims 11-14 and 23-26, which depend from claim 10, are not anticipated by *Koga*.

C. Independent claim 15 and dependent claims 16-18 and 27-30

Independent claim 15 recites a cooling system, comprising, *inter alia*, "a reservoir including an impeller cover, an intermediate member and a heat exchange interface, wherein a top wall of the reservoir and the impeller cover define a pump chamber for housing the impeller, and the intermediate member and the heat exchange interface define a thermal exchange chamber, the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together." (Emphasis added.) Patent Owner respectfully submits that at least this limitation of claim 15 is not disclosed by *Koga*.

Although not identical, independent claim 15 recites features similar to independent claims 1 and 10. As in claims 1 and 10, claim 15 recites a "pump chamber" that is vertically spaced apart from the "thermal exchange chamber." That is, the "pump chamber" and the "thermal exchange chamber" are separate chambers within the "reservoir." As discussed in Sections A and B above, *Koga* fails to teach a "pump chamber" that is separate from the "thermal exchange chamber;" pump room 15A of *Koga* serves as both the "pump chamber" and the "thermal exchange chamber."

Additionally, claim 15 recites that "a top wall of the reservoir and the impeller cover define a pump chamber for housing the impeller, and the intermediate member and the heat exchange interface define a thermal exchange chamber." Neither the Request nor the Office Action identifies an "impeller cover" and an "intermediate member" in the cooling device of *Koga*. The Request simply asserts that casing 15 forms the impeller cover and "the upper wall of the channel 19 defines the intermediate member." *Request*, pp. 160-161. Patent Owner respectfully disagrees with this assertion in the Request. *Koga* clearly describes that sucking channel 19 is inserted between heat-receiving plane 15B and inner wall surface 50 of the base wall of pump casing 15. *See Koga,* Abstract; *see also Koga*, col. 4, ll. 58-60 ("Sucking channel 19 is disposed between heat-receiving plane 15B and inner wall face 50."). Therefore, sucking channel 19 does not have an upper wall that is separate and distinct from the inner wall face 50 of the pump casing 15. Although inner wall face 50 and cover wall 16 are asserted to be equivalent to the "impeller cover" and the "top wall of the reservoir," respectively, which Patent Owner in no case concedes, nowhere does *Koga* disclose a separate "intermediate member." The use of different terms in a claim indicates that different elements are required. *See CAE Screen Plates, Inc. v. Heinrich Fiedler GMBH & Co.* KG, 224 F.3d 1308, 1317 (Fed. Cir. 2000) ("In the absence of any evidence to the contrary, we must presume that the use of these different terms in the claims connotes different meanings.") (citation omitted). Here, the Request and the Office Action have failed to identify an "intermediate member" in the *Koga* device, and have applied the inner wall face 50 as both the "impeller cover" and the "intermediate member" in their analysis. Accordingly, *Koga* fails to disclose the limitation "intermediate member and the heat exchange interface define a thermal exchange chamber."

For at least the above reasons, *Koga* fails to anticipate independent claim 15. Claims 16-18 and 27-30, which depend from claim 30, are also not anticipated by *Koga* at least due to their dependence from claim 15.

D. Conclusion regarding the anticipation rejection over *Koga*

As stated in the M.P.E.P., for a prior art reference to anticipate a claim under 35 U.S.C. § 102, the reference must teach each and every element of the claim. *See* M.P.E.P. § 2131. "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). "The identical invention must be shown in as complete detail as is contained in the . . . claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 U.S.P.Q.2d 1913, 1920 (Fed. Cir. 1989).

The USPTO, in applying the broadest reasonable interpretation of claim elements, is bounded by what would be reasonable from the perspective of one of ordinary skill in the art. *See In re Buszard*, 504 F.3d 1364, 65-66 (Fed. Cir. 2007) (The Federal Circuit found that the Board's interpretation that equated a "flexible" polyurethane foam with a crushed "rigid" foam was not reasonable because persons experienced in the field of polyurethane foams knew that a flexible mixture is different from a rigid foam mixture). In the rejection appearing in the ACP, the strained interpretations of the Requester are simply not reasonable because, from the perspective of one of ordinary skill in the art, a small diameter sucking channel cannot be reasonably said to serve a heat exchange function in a device whose primary purpose is heat exchange. Therefore, it is respectfully submitted that *Koga* cannot be shoehorned into the role of an anticipating reference.

For at least the reasons identified in Sections A–D, Patent Owner respectfully submits that *Koga* fails to teach each and every limitation of claims 1-30. Therefore, Patent Owner requests withdrawal of the rejection of claims 1-30 under 35 U.S.C. § 102(b).

IV. THE REJECTION UNDER 35 U.S.C. § 103(a) OVER *KOGA*

The Examiner rejected claims 20, 24, and 28 under 35 U.S.C. § 103(a) as being unpatentable over *Koga.* The Examiner admits that *Koga* fails to teach a plurality of passages between the pump chamber and the thermal exchange chamber, but contends that "[i]t would have been obvious to one of ordinary skill in the art to provide a plurality of passages between the pump and thermal exchange chambers to order to further enhance communication between the two which would increase flow and thus be better able to cool the device." *ACP,* p. 5.

The Examiner offers no explanation as to how the single-outlet sucking channel 19 (allegedly the "thermal exchange chamber") might be modified to "increase flow" by providing more passages. The Examiner's argument is especially confounding when *Koga* requires the sucking channel to deliver fluid to the center of the pump room 15A. *Koga*, col. 4, ll. 57–67; *Tilton Decl.,* ¶9. Adding more outlets to the channel would disrupt the very purpose of the sucking channel. Again, therefore, Patent Owner respectfully points out the unreasonableness of the Requester's interpretation.

Nevertheless, Patent Owner respectfully submits that claims 20, 24, and 28 depend from independent claims 1, 10, and 15, respectively. As discussed in Section IV above, *Koga* fails to disclose, teach, or suggest at least one limitation of independent claims 1, 10, and 15. Therefore, claims 20, 24, and 28 are patentable over *Koga* at least due to their dependence from one of the independent claims 1, 10, and 15.

For at least the above-stated reason, Patent Owner respectfully requests withdrawal of the rejection of claims 20, 24, and 28 under 35 U.S.C. § 103(a).

V. PRIORITY CLAIM

U.S. Application No. 13/269,234 (the '234 application) which issued as the '764 patent is a continuation of U.S. Patent Application No. 11/919,974 (the '974 application). The '974 application is a national stage entry of PCT Application No. PCT/DK2005/000310 ("the International Application") filed on May 6, 2005.

The Requester alleges that since FIG. 20 and its description were added to the specification of the '974 application after the filing of the International Application, the '764 patent in not entitled to the effective filing date of the International Application. Referring to these allegations, the Office Action states that "the Examiner will use the effective filing date of 14 July 2011." *ACP*, p. 3.

The Patent Owner disagrees that the International Application does not provide support for the issued claims of the '764 patent. In the Response filed on December 26, 2013, Patent Owner had explained that FIG. 20 was added during prosecution of the '974 application only to "help clearly identify previously presented subject matter." *See* Supplemental Preliminary Amendment in U.S. Patent Application No. 11/919,974 filed on January 9, 2009, p. 12. FIG. 20 did not add any new subject matter to the application. To the contrary, the International Application provides support for each and every claim of the '764 patent, as was shown in the claim chart provided in the First Response. Indeed, support was explicitly found by the Examiner during prosecution. *See, e.g.,* Exhibit B submitted with the First Response.

The ACP does not address the priority arguments presented by Patent Owner in the First Response. The Examiner ignores Patent Owner's detailed argument and simply reiterates that he has used the effective filing date of July 14, 2011 without comment. *ACP*, p. 3. That is, the Examiner has not made any finding regarding the §112 support for claims 1-30 in the International Application. For at least this reason, the Office Action mailed on September 3, 2013, should not have been made an ACP. *See* M.P.E.P. § 2671.02 ("Before an ACP is in order, a clear issue should be developed."). Therefore, Patent Owner requests the Examiner to withdraw the ACP as premature and to consider the claim chart presented below to make a proper determination of the support for pending claims 1-30 in the International Application.

Pending claims 1-30	**§ 112 support in the International Application**
1. A cooling system for a heat-generating component, comprising:	"The invention relates to a cooling system for a computer system, said computer system comprising at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit and comprising a reservoir having an amount of cooling liquid, said cooling liquid intended for accumulating and transferring of thermal energy dissipated from the processing unit to the cooling liquid." *See* Abstract.
a double-sided chassis adapted to mount a pump configured to circulate a cooling liquid, the pump comprising a stator and an impeller, the impeller being positioned on the underside of the chassis and the stator being positioned on the upper side of the chassis and isolated from the cooling liquid;	FIG. 17 shows that the housing of the reservoir 14 is in the form of a double-sided chassis, with the stator 37 mounted on the upper side and the impeller 33 mounted on the underside of the chassis. "[T]he pumping member of the pump and a driven part of the motor of the pump, such as a rotor of the an electrical motor, is placed inside the reservoir embedded in the cooling liquid, and wherein a stationary part of the motor of the pump, such as a stator of an electrical motor, is placed outside the reservoir." *See* p. 2, ll. 36-39. (Cont'd)

Pending claims 1-30	§ 112 support in the International Application
	"The reservoir 14 has a recess 40 in the of the reservoir. The recess [40] is intended for accommodating a stator 37 of an electrical motor driving an impeller 33 of the pump, said impeller being attached to a shaft 38 of a rotor 39 of the electrical motor. The recess 40 has an orifice 41, four sidewalls 42, a bottom 43 and a circular jacket 44 extending from the bottom 43 of the recess 40 and outwards towards the orifice 41 of the recess 40. The interior (not shown) of the jacket 44 is intended for encompassing the rotor 39 of the pump." *See* p. 26, ll. 6-12. "[A] liquid-proof division is made between the rotor 39 of the motor, said rotor 39 being placed inside the interior of the jacket 44 and being submerged in the cooling liquid, and the stator 37 of the pump, said stator 37 being positioned in the recess 40 and surrounding the exterior of the jacket 44. Accordingly, the stator 37 need not be sealed against the cooling liquid, because the recess 40 together with the jacket 44 ensures the stator staying dry from the cooling liquid, but the stator 37 still being capable of driving the rotor 39, when being supplied with electrical power from a power supply (not shown) of the computer system." *See* p. 26, ll. 14-21.
a reservoir adapted to pass the cooling liquid therethrough, the reservoir including:	"The object may also be obtained by a cooling system for a computer system, said computer system comprising: ... a pump intended for pumping the cooling liquid into the reservoir, through the reservoir and from the reservoir to a heat radiating means." *See* p. 3, ll. 7-21.
a pump chamber including the impeller and formed below the chassis, the pump chamber being defined by at least an impeller cover having one or more passages for the cooling liquid to pass through;	"An impeller 33 of the pump of the cooling system is provided in direct communication with a pump chamber 46 formed by impeller cover 46A having an outlet 34 provided tangentially to the circumference of the impeller 33." *See* p. 29, ll. 17-19. *See also* FIG. 17.

Pending claims 1-30	§ 112 support in the International Application
a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber, the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages; and	"An impeller 33 of the pump of the cooling system is provided in direct communication with a pump chamber 46 having an outlet 34 provided tangentially to the circumference of the impeller 33...An intermediate member 47 is provided between the pump chamber 46 together with the interior of the reservoir and a heat exchanging interface 4. The intermediate member 47 is provided with a first passage 48 for leading cooling liquid from the pump chamber 46 to a thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47. The intermediate member 47 is provided also with a second passage 49 for leading cooling liquid from the thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47 to the interior of the reservoir 14." *See* p. 29, ll. 21-28. *See also* FIG. 17.
a heat-exchanging interface, the heat-exchanging interface forming a boundary wall of the thermal exchange chamber, and configured to be placed in thermal contact with a surface of the heat-generating component; and	"[A] heat exchanging interface 4 such as a surface made from a copper plate, alternatively a plate of another material having a high thermal conductivity, is placed in thermal communication with the thermal exchange chamber (not shown) at the opposite side of the intermediate member 47." *See* p. 29, ll. 30-33. "The heat exchanging interface 4 is a separate element and is made of a heat conducting material having a relative high heat thermal conductivity such as copper or aluminium *[sic]*, and which will be in thermal contact with the CPU 1, when the cooling system is fastened to the motherboard 2 of the CPU. The heat exchanging surface constitutes part of a liquid reservoir housing 14, thus the heat exchanger 4 constitutes the part of the liquid reservoir housing facing the CPU." *See* p. 4, ll. 18-23.
a heat radiator fluidly coupled to the reservoir and configured to dissipate heat from the cooling liquid.	"The tube inlet connection and the tube outlet connection are connected to a heat radiator by means of connecting tubes 24 and 25 through which the cooling liquid flows into and out of the reservoir and the heat radiator, respectively. Within the heat radiator 11, the cooling liquid passes a number of channels for radiating the heat, which has been dissipated into the cooling liquid inside the reservoir, and to the surroundings of the heat exchanger.

Pending claims 1-30	§ 112 support in the International Application
	The air fan 10 blows air past the channels of the heat radiator in order to cool the radiator and thereby cooling the cooling liquid flowing inside the channels through the heat radiator and back into the reservoir." *See* p. 20, l. 34-p. 21, l. 3. *See also* FIG. 8.
2. The cooling system of claim 1, wherein the chassis shields the stator from the cooling liquid in the reservoir.	"[A] a liquid-proof division is made between the rotor 39 of the motor, said rotor 39 being placed inside the interior of the jacket 44 and being submerged in the cooling liquid, and the stator 37 of the pump, said stator 37 being positioned in the recess 40 and surrounding the exterior of the jacket 44. Accordingly, the stator 37 need not be sealed against the cooling liquid, because the recess 40 together with the jacket 44 ensures the stator staying dry from the cooling liquid, but the stator 37 still being capable of driving the rotor 39, when being supplied with electrical power from a power supply (not shown) of the computer system." *See* p. 28, ll. 14-21.
3. The cooling system of claim 1, wherein the heat-exchanging interface includes a first side and a second side opposite the first side, and wherein the heat-exchanging interface contacts the cooling liquid in the thermal exchange chamber on the first side and the heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component on the second side.	At least paragraphs [0113] and [0173], and FIG. 20 "[A] heat exchanging interface 4 such as a surface made from a copper plate, alternatively a plate of another material having a high thermal conductivity, is placed in thermal communication with the thermal exchange chamber (not shown) at the opposite side of the intermediate member 47." *See* p. 29, ll. 30-33. "The heat exchanging interface 4 is a separate element and is made of a heat conducting material having a relative high heat thermal conductivity such as copper or aluminium *[sic]*, and which will be in thermal contact with the CPU 1, when the cooling system is fastened to the motherboard 2 of the CPU. The heat exchanging surface constitutes part of a liquid reservoir housing 14, thus the heat exchanger 4 constitutes the part of the liquid reservoir housing facing the CPU." *See* p. 4, ll. 18-23.

Pending claims 1-30	§ 112 support in the International Application
4. The cooling system of claim 3, wherein the first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber.	"The inner surface facing the thermal exchange chamber (not shown) at the opposite side of the intermediate member 47 is provided with pins 4A extending from the base of the copper plate and into the thermal exchange chamber (not shown) at the opposite side of intermediate member 47. The pins 4A constitutes an uneven surface and may either be provided during casting of the copper plate or may be provided by means of milling or other machining process of a copper plate. The pins provide a network of channels across the inner surface of the heat exchanging interface, along which network the cooling liquid is intended to flow." *See* p. 29, l. 38-p. 30, l. 6. *See also* FIG. 17.
5. The cooling system of claim 4, wherein the features include at least one of pins or fins.	Same as claim 4.
6. The cooling system of claim 1, wherein a passage of the one or more passages that fluidly couple the pump chamber and the thermal exchange chamber is offset from a center of the impeller.	"An intermediate member 47 is provided between the pump chamber 46 together with the interior of the reservoir and a heat exchanging interface 4. The intermediate member 47 is provided with a first passage 48 for leading cooling liquid from the pump chamber 46 to a thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47. The intermediate member 47 is provided also with a second passage 49 for leading cooling liquid from the thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47 to the interior of the reservoir 14." *See* p. 29, ll. 21-28.
7. The cooling system of claim 1, wherein the impeller includes a plurality of curved blades.	FIG. 17 shows that the impeller 33 includes a plurality of curved blades.
8. The cooling system of claim 1, wherein the heat-exchanging interface includes one of copper and aluminum.	"[A] heat exchanging interface 4 such as a surface made from a copper plate, alternatively a plate of another material having a high thermal conductivity, is placed in thermal communication with the thermal exchange chamber (not shown) at the opposite side of the intermediate member 47." *See* p. 29, ll. 30-33. (Cont'd)

Pending claims 1-30	§ 112 support in the International Application
	"The heat exchanging interface 4 is a separate element and is made of a heat conducting material having a relative high heat thermal conductivity such as copper or aluminium *[sic]*, and which will be in thermal contact with the CPU 1, when the cooling system is fastened to the motherboard 2 of the CPU. The heat exchanging surface constitutes part of a liquid reservoir housing 14, thus the heat exchanger 4 constitutes the part of the liquid reservoir housing facing the CPU." *See* p. 4, ll. 18-23.
9. The cooling system of claim 1, wherein the heat radiator is fluidly coupled to the reservoir using flexible conduits, and the heat radiator is configured to be positioned remote from the reservoir.	"The tube inlet connection and the tube outlet connection are connected to a heat radiator by means of connecting tubes 24 and 25 through which the cooling liquid flows into and out of the reservoir and the heat radiator, respectively. Within the heat radiator 11, the cooling liquid passes a number of channels for radiating the heat, which has been dissipated into the cooling liquid inside the reservoir, and to the surroundings of the heat exchanger. The air fan 10 blows air past the channels of the heat radiator in order to cool the radiator and thereby cooling the cooling liquid flowing inside the channels through the heat radiator and back into the reservoir." *See* p. 20, l. 34-p. 21, l. 3. *See also* FIG. 8.
10. A cooling system for a computer system, comprising:	At least the abstract of the present application "The invention relates to a cooling system for a computer system, said computer system comprising at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit and comprising a reservoir having an amount of cooling liquid, said cooling liquid intended for accumulating and transferring of thermal energy dissipated from the processing unit to the cooling liquid." *See* Abstract.
a centrifugal pump adapted to circulate a cooling liquid, the pump including:	"The object may also be obtained by a cooling system for a computer system, said computer system comprising:... a pump intended for pumping the cooling liquid into the reservoir, through the reservoir and from the reservoir to a heat radiating means." *See* p. 3, ll. 7-17. (Cont'd)

Pending claims 1-30	§ 112 support in the International Application
	"An impeller 33 of the pump of the cooling system is provided in direct communication with a pump chamber 46 having an outlet 34 provided tangentially to the circumference of the impeller 33. Thus, the pump functions as a centrifugal pump." *See* p. 29, ll. 17-19.
an impeller exposed to the cooling liquid; and	"[A] liquid-proof division is made between the rotor 39 of the motor, said rotor 39 being placed inside the interior of the jacket 44 and being submerged in the cooling liquid, and the stator 37 of the pump, said stator 37 being positioned in the recess 40 and surrounding the exterior of the jacket 44. Accordingly, the stator 37 need not be sealed against the cooling liquid, because the recess 40 together with the jacket 44 ensures the stator staying dry from the cooling liquid, but the stator 37 still being capable of driving the rotor 39, when being supplied with electrical power from a power supply (not shown) of the computer system." *See* p. 26, ll. 14-21.
a stator isolated from the cooling liquid;	"[A] liquid-proof division is made between the rotor 39 of the motor, said rotor 39 being placed inside the interior of the jacket 44 and being submerged in the cooling liquid, and the stator 37 of the pump, said stator 37 being positioned in the recess 40 and surrounding the exterior of the jacket 44. Accordingly, the stator 37 need not be sealed against the cooling liquid, because the recess 40 together with the jacket 44 ensures the stator staying dry from the cooling liquid, but the stator 37 still being capable of driving the rotor 39, when being supplied with electrical power from a power supply (not shown) of the computer system." *See* p. 26, ll. 14-21.
a reservoir configured to be thermally coupled to a heat-generating component of the computer system, the reservoir including:	"[T]he heat exchanging interface constitutes an integrate surface of the reservoir, and where the heat exchanging surface extends along an area of the surface of the reservoir, said area of surface being intended for facing the processing unit and said area of surface being intended for the close thermal contact with the processing unit." *See* p. 5, ll. 18-21.

Pending claims 1-30	§ 112 support in the International Application
a thermal exchange chamber adapted to be positioned in thermal contact with the heat-generating component;	"[A] heat exchanging interface 4 such as a surface made from a copper plate, alternatively a plate of another material having a high thermal conductivity, is placed in thermal communication with the thermal exchange chamber (not shown) at the opposite side of the intermediate member 47." *See* p. 29, ll. 30-33. "The heat exchanging interface 4 is a separate element and is made of a heat conducting material having a relative high heat thermal conductivity such as copper or aluminium *[sic]*, and which will be in thermal contact with the CPU 1, when the cooling system is fastened to the motherboard 2 of the CPU. The heat exchanging surface constitutes part of a liquid reservoir housing 14, thus the heat exchanger 4 constitutes the part of the liquid reservoir housing facing the CPU." *See* p. 4, ll. 18-23.
a separate pump chamber vertically spaced part from the thermal exchange chamber and coupled with the thermal exchange chamber through one or more passages configured for fluid communication between the pump chamber and the thermal exchange chamber, and wherein at least one of the one or more passages is offset from a center of the impeller.	An impeller 33 of the pump of the cooling system is provided in direct communication with a pump chamber 46 having an outlet 34 provided tangentially to the circumference of the impeller 33...An intermediate member 47 is provided between the pump chamber 46 together with the interior of the reservoir and a heat exchanging interface 4. The intermediate member 47 is provided with a first passage 48 for leading cooling liquid from the pump chamber 46 to a thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47." *See* p. 29, ll. 17-26. *See also* FIG. 17.
11. The cooling system of claim 10, wherein a top wall of the reservoir physically separates the impeller from the stator.	"[A] liquid-proof division is made between the rotor 39 of the motor, said rotor 39 being placed inside the interior of the jacket 44 and being submerged in the cooling liquid, and the stator 37 of the pump, said stator 37 being positioned in the recess 40 and surrounding the exterior of the jacket 44. Accordingly, the stator 37 need not be sealed against the cooling liquid, because the recess 40 together with the jacket 44 ensures the stator staying dry

Pending claims 1-30	§ 112 support in the International Application
	from the cooling liquid, but the stator 37 still being capable of driving the rotor 39, when being supplied with electrical power from a power supply (not shown) of the computer system." *See* p. 26, ll. 14-21.
12. The cooling system of claim 10, wherein the thermal exchange chamber includes a heat-exchange interface configured to be placed in thermal contact with the heat-generating component.	"[A] heat exchanging interface 4 such as a surface made from a copper plate, alternatively a plate of another material having a high thermal conductivity, is placed in thermal communication with the thermal exchange chamber (not shown) at the opposite side of the intermediate member 47." *See* p. 29, ll. 30-33. "The heat exchanging interface 4 is a separate element and is made of a heat conducting material having a relative high heat thermal conductivity such as copper or aluminium *[sic]*, and which will be in thermal contact with the CPU 1, when the cooling system is fastened to the motherboard 2 of the CPU. The heat exchanging surface constitutes part of a liquid reservoir housing 14, thus the heat exchanger 4 constitutes the part of the liquid reservoir housing facing the CPU." *See* p. 4, ll. 18-23.
13. The cooling system of claim 10, further including a heat radiator fluidly coupled to the reservoir using flexible conduits, wherein the heat radiator is configured to be positioned remote from the reservoir.	"The tube inlet connection and the tube outlet connection are connected to a heat radiator by means of connecting tubes 24 and 25 through which the cooling liquid flows into and out of the reservoir and the heat radiator, respectively. Within the heat radiator 11, the cooling liquid passes a number of channels for radiating the heat, which has been dissipated into the cooling liquid inside the reservoir, and to the surroundings of the heat exchanger. The air fan 10 blows air past the channels of the heat radiator in order to cool the radiator and thereby cooling the cooling liquid flowing inside the channels through the heat radiator and back into the reservoir." *See* p. 20, l. 34-p. 21, l. 3. *See also* FIG. 8.
14. The cooling system of claim 10, wherein the fluid passage that is offset from the center of the impeller is positioned tangentially to the circumference of the impeller.	"An impeller 33 of the pump of the cooling system is provided in direct communication with a pump chamber 46 having an outlet 34 provided tangentially to the circumference of the impeller 33." *See* p. 29, ll. 17-19.

Pending claims 1-30	§ 112 support in the International Application
15. A cooling system for a heat-generating component, comprising:	At least the abstract of the present application "The invention relates to a cooling system for a computer system, said computer system comprising at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit and comprising a reservoir having an amount of cooling liquid, said cooling liquid intended for accumulating and transferring of thermal energy dissipated from the processing unit to the cooling liquid." *See* Abstract.
a pump adapted to circulate a cooling liquid, the pump including:	"The object may also be obtained by a cooling system for a computer system, said computer system comprising:... a pump intended for pumping the cooling liquid into the reservoir, through the reservoir and from the reservoir to a heat radiating means." *See* p. 3, ll. 7-17.
an impeller exposed to the cooling liquid; and	"[A] liquid-proof division is made between the rotor 39 of the motor, said rotor 39 being placed inside the interior of the jacket 44 and being submerged in the cooling liquid, and the stator 37 of the pump, said stator 37 being positioned in the recess 40 and surrounding the exterior of the jacket 44. Accordingly, the stator 37 need not be sealed against the cooling liquid, because the recess 40 together with the jacket 44 ensures the stator staying dry from the cooling liquid, but the stator 37 still being capable of driving the rotor 39, when being supplied with electrical power from a power supply (not shown) of the computer system." *See* p. 26, ll. 14-21.
a stator isolated from the cooling;	"[A] liquid-proof division is made between the rotor 39 of the motor, said rotor 39 being placed inside the interior of the jacket 44 and being submerged in the cooling liquid, and the stator 37 of the pump, said stator 37 being positioned in the recess 40 and surrounding the exterior of the jacket 44. Accordingly, the stator 37 need not be sealed against the cooling liquid, because the recess 40 together with the jacket 44 ensures the stator staying dry from the cooling liquid, but the stator 37 still being capable of driving the rotor 39, when being supplied with electrical power from a power supply (not shown) of the computer system." *See* p. 26, ll. 14-21.

Pending claims 1-30	§ 112 support in the International Application
a reservoir including an impeller cover, an intermediate member and a heat exchange interface, wherein a top wall of the reservoir and the impeller cover define a pump chamber for housing the impeller, and the intermediate member and the heat exchange interface define a thermal exchange chamber,	"An impeller 33 of the pump of the cooling system is provided in direct communication with a pump chamber 46 having an outlet 34 provided tangentially to the circumference of the impeller 33...An intermediate member 47 is provided between the pump chamber 46 together with the interior of the reservoir and a heat exchanging interface 4. The intermediate member 47 is provided with a first passage 48 for leading cooling liquid from the pump chamber 46 to a thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47." *See* p. 29, ll. 17-26. *See also* FIG. 17.
the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together; and	"An impeller 33 of the pump of the cooling system is provided in direct communication with a pump chamber 46 having an outlet 34 provided tangentially to the circumference of the impeller 33...An intermediate member 47 is provided between the pump chamber 46 together with the interior of the reservoir and a heat exchanging interface 4. The intermediate member 47 is provided with a first passage 48 for leading cooling liquid from the pump chamber 46 to a thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47. The intermediate member 47 is provided also with a second passage 49 for leading cooling liquid from the thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47 to the interior of the reservoir 14." *See* p. 29, ll. 17-28. *See also* FIG. 17.
wherein a first side of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and a second side of the heat-exchanging interface opposite the first side is configured to be placed in thermal contact with a	"[A] heat exchanging interface 4 such as a surface made from a copper plate, alternatively a plate of another material having a high thermal conductivity, is placed in thermal communication with the thermal exchange chamber (not shown) at the opposite side of the intermediate member 47." *See* p. 29, ll. 30-33. "The heat exchanging interface 4 is a separate element and is made of a heat conducting material having a relative high heat thermal conductivity such as copper or aluminium *[sic]*, and which will be in thermal contact with

Pending claims 1-30	§ 112 support in the International Application
surface of the heat-generating component; and	the CPU 1, when the cooling system is fastened to the motherboard 2 of the CPU. The heat exchanging surface constitutes part of a liquid reservoir housing 14, thus the heat exchanger 4 constitutes the part of the liquid reservoir housing facing the CPU." *See* p. 4, ll. 18-23.
a liquid-to-air heat exchanger fluidly coupled to the reservoir using flexible conduits, the heat exchanger being configured to be positioned remote from the reservoir.	"The tube inlet connection and the tube outlet connection are connected to a heat radiator by means of connecting tubes 24 and 25 through which the cooling liquid flows into and out of the reservoir and the heat radiator, respectively. Within the heat radiator 11, the cooling liquid passes a number of channels for radiating the heat, which has been dissipated into the cooling liquid inside the reservoir, and to the surroundings of the heat exchanger. The air fan 10 blows air past the channels of the heat radiator in order to cool the radiator and thereby cooling the cooling liquid flowing inside the channels through the heat radiator and back into the reservoir." *See* p. 20, l. 34-p. 21, l. 3. *See also* FIG. 8.
16. The cooling system of claim 15, wherein the impeller cover includes a first opening radially offset from a center of the impeller and the intermediate member includes a second passage that is aligned with the first opening, the first and the second opening being configured to direct the cooling liquid from the pump chamber into the thermal exchange chamber.	"An impeller 33 of the pump of the cooling system is provided in direct communication with a pump chamber 46 having an outlet 34 provided tangentially to the circumference of the impeller 33...An intermediate member 47 is provided between the pump chamber 46 together with the interior of the reservoir and a heat exchanging interface 4. The intermediate member 47 is provided with a first passage 48 for leading cooling liquid from the pump chamber 46 to a thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47. The intermediate member 47 is provided also with a second passage 49 for leading cooling liquid from the thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47 to the interior of the reservoir 14." *See* p. 29, ll. 17-28. *See also* FIG. 17.
17. The cooling system of claim 15, wherein the first side of the heat-exchanging interface includes at least one of	"The inner surface facing the thermal exchange chamber (not shown) at the opposite side of the intermediate member 47 is provided with pins 4A extending from the base of the copper plate and into the thermal exchange chamber (not shown) at the opposite side of intermediate

Pending claims 1-30	§ 112 support in the International Application
pins or fins.	member 47. The pins 4A constitutes an uneven surface and may either be provided during casting of the copper plate or may be provided by means of milling or other machining process of a copper plate. The pins provide a network of channels across the inner surface of the heat exchanging interface, along which network the cooling liquid is intended to flow." *See* p. 29, l. 38–p. 30, l. 6. *See also* FIG. 17.
18. The cooling system of claim 15, wherein the top wall of the reservoir extends between the stator and the impeller and shields the stator from the cooling liquid in the reservoir.	"[A] liquid-proof division is made between the rotor 39 of the motor, said rotor 39 being placed inside the interior of the jacket 44 and being submerged in the cooling liquid, and the stator 37 of the pump, said stator 37 being positioned in the recess 40 and surrounding the exterior of the jacket 44. Accordingly, the stator 37 need not be sealed against the cooling liquid, because the recess 40 together with the jacket 44 ensures the stator staying dry from the cooling liquid, but the stator 37 still being capable of driving the rotor 39, when being supplied with electrical power from a power supply (not shown) of the computer system." *See* p. 26, ll. 14-21.
19. The cooling system of claim 1, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	"An impeller 33 of the pump of the cooling system is provided in direct communication with a pump chamber 46 having an outlet 34 provided tangentially to the circumference of the impeller 33...An intermediate member 47 is provided between the pump chamber 46 together with the interior of the reservoir and a heat exchanging interface 4. The intermediate member 47 is provided with a first passage 48 for leading cooling liquid from the pump chamber 46 to a thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47. The intermediate member 47 is provided also with a second passage 49 for leading cooling liquid from the thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47 to the interior of the reservoir 14." *See* p. 29, ll. 17-28. *See also* FIG. 17

Pending claims 1-30	§ 112 support in the International Application
20. The cooling system of claim 1, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber.	Same as claim 19.
21. The cooling system of claim 1, wherein an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms the boundary wall of the thermal exchange chamber.	FIG. 17 (showing that an entire surface of heat exchange interface 4 forms a boundary wall of the thermal exchange chamber defined by intermediate member 47 on one side and heat exchange interface 4 on the other).
22. The cooling system of claim 1, wherein the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	"The reservoir 14 may also be provided with an inlet (not shown) and an outlet (not shown) for the cooling liquid. The inlet and outlet are provided along a surface of the reservoir facing downward and inwards when seen in the perspective view of the drawing [FIG. 17]." *See* p. 28, ll. 30-35.
23. The cooling system of claim 10, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	"An impeller 33 of the pump of the cooling system is provided in direct communication with a pump chamber 46 having an outlet 34 provided tangentially to the circumference of the impeller 33...An intermediate member 47 is provided between the pump chamber 46 together with the interior of the reservoir and a heat exchanging interface 4. The intermediate member 47 is provided with a first passage 48 for leading cooling liquid from the pump chamber 46 to a thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47. The intermediate member 47 is provided also with a second passage 49 for leading cooling liquid from the thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47 to the interior of the reservoir 14." *See* p. 29, ll. 17-28.

Pending claims 1-30	§ 112 support in the International Application
24. The cooling system of claim 10, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber.	Same as claim 23
25. The cooling system of claim 12, wherein an entire surface of the heat-exchange interface in contact with the cooling liquid in the reservoir forms a boundary wall of the thermal exchange chamber.	FIG. 17 (showing that an entire surface of heat exchange interface 4 forms a boundary wall of the thermal exchange chamber defined by intermediate member 47 on one side and heat exchange interface 4 on the other).
26. The cooling system of claim 10, wherein the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	"The reservoir 14 may also be provided with an inlet (not shown) and an outlet (not shown) for the cooling liquid. The inlet and outlet are provided along a surface of the reservoir facing downward and inwards when seen in the perspective view of the drawing [FIG. 17]." *See* p. 28, ll. 30-35.
27. The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, the one or more passages including a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	"An impeller 33 of the pump of the cooling system is provided in direct communication with a pump chamber 46 having an outlet 34 provided tangentially to the circumference of the impeller 33…An intermediate member 47 is provided between the pump chamber 46 together with the interior of the reservoir and a heat exchanging interface 4. The intermediate member 47 is provided with a first passage 48 for leading cooling liquid from the pump chamber 46 to a thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47. The intermediate member 47 is provided also with a second passage 49 for leading cooling liquid from the thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47 to the interior of the reservoir 14." *See* p. 29, ll. 17-28.

Pending claims 1-30	§ 112 support in the International Application
28. The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by a plurality of passages positioned within the reservoir that open into the thermal exchange chamber.	Same as claim 27.
29. The cooling system of claim 15, wherein an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms a boundary wall of the thermal exchange chamber.	FIG. 17 (showing that an entire surface of heat exchange interface 4 forms a boundary wall of the thermal exchange chamber defined by intermediate member 47 on one side and heat exchange interface 4 on the other).
30. The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, and the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	"An impeller 33 of the pump of the cooling system is provided in direct communication with a pump chamber 46 having an outlet 34 provided tangentially to the circumference of the impeller 33…An intermediate member 47 is provided between the pump chamber 46 together with the interior of the reservoir and a heat exchanging interface 4. The intermediate member 47 is provided with a first passage 48 for leading cooling liquid from the pump chamber 46 to a thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47. The intermediate member 47 is provided also with a second passage 49 for leading cooling liquid from the thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47 to the interior of the reservoir 14." *See* p. 29, ll. 17-28. "The reservoir 14 may also be provided with an inlet (not shown) and an outlet (not shown) for the cooling liquid. The inlet and outlet are provided along a surface of the reservoir facing downward and inwards when seen in the perspective view of the drawing [FIG. 17]." *See* p. 28, ll. 30-35.

Patent Owner respectfully requests the Examiner to consider the claim chart presented above and to accord the '764 patent the priority date of May 6, 2005.

VI. CONCLUSION

For at least the reasons discussed above, Patent Owner respectfully requests withdrawal of the pending rejection of claims 1-30, and the allowance and confirmation of all pending claims 1-30

Patent Owner notes that the Request, Order, Office Action, and ACP contain a number of assertions and allegations concerning the claims and/or the cited art. The Patent Owner declines to subscribe to any assertion or allegation in the Request, Order, Office Action, or ACP, regardless of whether it might be addressed specifically herein.

Pursuant to 37 C.F.R. § 1.903 and M.P.E.P. § 2666.06, Patent Owner served a copy of this Response on the third party requester in the manner provided by 37 C.F.R. § 1.248 on the same date this paper was filed with the Office.

Please grant any extensions of time required to enter this response and charge any additional required fees to our deposit account 06-0916.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

Dated: October 3, 2013

By: ______________________
Eric P. Raciti
Reg. No. 41,475

APPENDIX A — LISTING OF THE CLAIMS

1. (Original) A cooling system for a heat-generating component, comprising::

a double-sided chassis adapted to mount a pump configured to circulate a cooling liquid, the pump comprising a stator and an impeller, the impeller being positioned on the underside of the chassis and the stator being positioned on the upper side of the chassis and isolated from the cooling liquid;

a reservoir adapted to pass the cooling liquid therethrough, the reservoir including

a pump chamber including the impeller and formed below the chassis, the pump chamber being defined by at least an impeller cover having one or more passages for the cooling liquid to pass through

a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber, the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages; and

a heat-exchanging interface, the heat-exchanging interface forming a boundary wall of the thermal exchange chamber, and configured to be placed in thermal contact with a surface of the heat-generating component; and

a heat radiator fluidly coupled to the reservoir and configured to dissipate heat from the cooling liquid.

2. (Original) The cooling system of claim 1, wherein the chassis shields the stator from the cooling liquid in the reservoir.

3. (Original) The cooling system of claim 1, wherein the heat-exchanging interface includes a first side and a second side opposite the first side, and wherein the heat-exchanging interface contacts the cooling liquid in the thermal exchange chamber on the first side and the heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component on the second side.

4. (Original) The cooling system of claim 3, wherein the first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber.

5. (Original) The cooling system of claim 4, wherein the features include at least one of pins or fins.

6. (Original) The cooling system of claim 1, wherein a passage of the one or more passages that fluidly couple the pump chamber and the thermal exchange chamber is offset from a center of the impeller.

7. (Original) The cooling system of claim 1, wherein the impeller includes a plurality of curved blades.

8. (Original) The cooling system of claim 1, wherein the heat-exchanging interface includes one of copper and aluminum.

9. (Original) The cooling system of claim 1, wherein the heat radiator is fluidly coupled to the reservoir using flexible conduits, and the heat radiator is configured to be positioned remote from the reservoir.

10. (Original) A cooling system for a computer system, comprising:

a centrifugal pump adapted to circulate a cooling liquid, the pump including:

an impeller exposed to the cooling liquid; and

a stator isolated from the cooling liquid;

a reservoir configured to be thermally coupled to a heat-generating component of the computer system, the reservoir including:

a thermal exchange chamber adapted to be positioned in thermal contact with the heat-generating component;

a separate pump chamber vertically spaced part from the thermal exchange chamber and coupled with the thermal exchange chamber through one or more passages configured for fluid communication between the pump chamber and the thermal exchange chamber, and wherein at least one of the one or more passages is offset from a center of the impeller.

11. (Original) The cooling system of claim 10, wherein a top wall of the reservoir physically separates the impeller from the stator.

12. (Original) The cooling system of claim 10, wherein the thermal exchange chamber includes a heat-exchange interface configured to be placed in thermal contact with the heat-generating component.

13. (Original) The cooling system of claim 10, further including a heat radiator fluidly coupled to the reservoir using flexible conduits, wherein the heat radiator is configured to be positioned remote from the reservoir.

14. (Original) The cooling system of claim 10, wherein the fluid passage that is offset from the center of the impeller is positioned tangentially to the circumference of the impeller.

15. (Original) A cooling system for a heat-generating component, comprising:

a pump adapted to circulate a cooling liquid, the pump including:

an impeller exposed to the cooling liquid; and

a stator isolated from the cooling liquid;

a reservoir including an impeller cover, an intermediate member and a heat exchange interface, wherein a top wall of the reservoir and the impeller cover define a pump chamber for housing the impeller, and the intermediate member and the heat exchange interface define a thermal exchange chamber, the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together; and

wherein a first side of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and a second side of the heat-exchanging interface opposite the first side is configured to be placed in thermal contact with a surface of the heat-generating component; and

a liquid-to-air heat exchanger fluidly coupled to the reservoir using flexible conduits, the heat exchanger being configured to be positioned remote from the reservoir.

16. (Original) The cooling system of claim 15, wherein the impeller cover includes a first opening radially offset from a center of the impeller and the intermediate member includes a second passage that is aligned with the first opening, the first and the second opening being configured to direct the cooling liquid from the pump chamber into the thermal exchange chamber.

17. (Original) The cooling system of claim 15, wherein the first side of the heat-exchanging interface includes at least one of pins or fins.

18. (Original) The cooling system of claim 15, wherein the top wall of the reservoir extends between the stator and the impeller and shields the stator from the cooling liquid in the reservoir.

19. (Previously Added) The cooling system of claim 1, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.

20. (Previously Added) The cooling system of claim 1, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber.

21. (Previously Added) The cooling system of claim 1, wherein an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms the boundary wall of the thermal exchange chamber.

22. (Previously Added) The cooling system of claim 1, wherein the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.

23. (Previously Added) The cooling system of claim 10, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.

24. (Previously Added) The cooling system of claim 10, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber.

25. (Previously Added) The cooling system of claim 12, wherein an entire surface of the heat-exchange interface in contact with the cooling liquid in the reservoir forms a boundary wall of the thermal exchange chamber.

26. (Previously Added) The cooling system of claim 10, wherein the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.

27. (Previously Added) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, the one or more passages including a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.

28. (Previously Added) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by a plurality of passages positioned within the reservoir that open into the thermal exchange chamber.

29. (Previously Added) The cooling system of claim 15, wherein an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms a boundary wall of the thermal exchange chamber.

30. (Previously Added) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, and the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.

CERTIFICATE OF SERVICE

The undersigned certifies that on this 3rd day of October 2013, service of a true and complete copy of the "PATENT OWNER'S RESPONSE TO ACTION CLOSING PROSECUTION" was served in its entirety via first class U.S. mail on counsel for the third party requester, at the following address:

Ganz Law P.C.
P.O. Box 2200
Hillsboro, OR 97123

with sufficient postage affixed, and with delivery confirmation requested.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

Dated: October 3, 2013

By: ______________________
Eric P. Raciti
Reg. No. 41,475

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Inter Partes* Reexamination of:	
André Sloth ERIKSEN	Group Art Unit: 3993
U.S. Patent No.: 8,245,764 B2 Filed: October 7, 2011 Issued: August 21, 2012	Examiner: Joseph A. KAUFMAN
For: COOLING SYSTEM FOR A COMPUTER SYSTEM	Confirmation No.: 7254
Reexamination Proceeding Control No. 95/002,386 Filed: September 15, 2012	

Mail Stop *Inter Partes* Reexam
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

DECLARATION UNDER 37 C.F.R. § 1.132 OF DONALD TILTON

I, Donald TILTON, declare as follows:

I. Qualifications

1. I am a Mechanical Engineer. I have a B.S. in Mechanical Engineering from Washington State University, Pullman, WA. I also have an M.S. and a Ph.D. in Mechanical Engineering from the University of Kentucky, Lexington, KY.

2. I am an experienced innovator and inventor with 23 issued patents, and many pending applications, spanning the fields of energy efficiency, renewable energy, thermal management systems, heat transfer, and fluid flow.

3. I founded Isothermal Systems Research, Inc. (sold to Parker Aerospace) in 1988 while attending graduate school at the University of Kentucky. I worked at Isothermal Systems Research from 1988 to 2008, and during that time I developed and deployed critical liquid cooling technologies for aerospace and defense electronic systems.
4. I am an experienced entrepreneur and executive leader with 22 years of experience founding, growing and leading technology companies. I am currently the Managing Director of Emerging Ventures at Mindshare Resources where I assist in the formation and growth of new technology businesses.
5. I understand this Declaration will be filed in support of the patentability of the claims pending in the reexamination proceeding of U.S. Patent No.: 8,245,764 B2 ("the '764 patent"). I also understand that the '764 patent is currently assigned to Asetek A/S.
6. In preparing this Declaration, I have considered the '764 patent, the references cited against the '764 patent, the Office Action (mailed on October 26, 2012), and the Action Closing Prosecution (mailed on September 3, 2013) issued against the '764 patent.

II. U.S. Patent No. 7,544,049 to Koga et al. ("*Koga*")

In my opinion:

7. The cooling device of *Koga* has a single chamber—the pump room—which houses the impeller and serves as a heat exchanging chamber. The pump room is defined by the base wall and the cover wall of the pump casing. The base wall

serves as a heat exchanging interface between the coolant in the pump room and the electronic component to be cooled.

8. The outer surface of the base wall (which *Koga* refers to as the "heat-receiving face" or "heat-receiving plane") contacts the electronic component, and the inner surface of the base wall faces the impeller. The inner surface has dimples, or protrusions extending towards the impeller, which help in transfer of heat from the base wall to the coolant in the pump room.

9. An inlet conduit (which *Koga* refers to as the "sucking channel") is inserted between the outer surface and the inner surface of the base wall. The sucking channel guides the coolant to the center of the pump room, so that coolant can enter the pump room near the rotational center of the impeller.

10. The Office Actions and the Action Closing Prosecution refer to the sucking channel as a "heat exchanging chamber." I disagree with this characterization of the sucking channel. Throughout the written description of *Koga*, the sucking channel is represented as nothing more than a conduit to deliver coolant to the rotational center of the impeller.

11. The pump room of *Koga* serves as a reservoir for the coolant to spread out and absorb thermal energy dissipated from the electronic component. Thus, the pump room serves as the heat exchanging chamber. The sucking channel, on the other hand, is simply a passageway for coolant to flow through to the pump room; it does not allow the coolant to accumulate and absorb heat from the cooling device.

12. The sucking channel occupies a very small percentage of the heat exchanging interface between the pump and the electronic component. FIGS. 5 and 8 clearly show that the sucking channel is very narrow compared to the overall footprint of the pump. As such any outer surface area of the channel in any contact with the electronic component would be negligible compared to the total surface area of the base wall. The sucking channel would not be able to transfer hardly any heat from the electronic component if it is in thermal contact with only a sliver of the electronic component. Accordingly, the sucking channel cannot be reasonably said to function as a heat exchanging chamber.

13. It is also not feasible to contain the dimples or protrusions necessary to extend the surface area needed to effectively exchange heat within the sucking channel, as these features would impede the flow or delivery of fluid to the center of the pump impeller.

III. Conclusion

14. I reserve the right to amend, supplement, or otherwise modify my opinions, whether in a written declaration or otherwise. I also reserve the right to reply to positions taken by the Requester's experts.

15. I declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and may jeopardize the validity of the patent application to which they are directed or any patent issuing thereon.

16. In signing this declaration, I understand that the declaration will be filed as evidence in the United States Patent and Trademark Office. I acknowledge that I may be subject to cross examination in the case and that cross examination will take place within the United States. If cross examination is required of me, I will appear for cross examination within the United States during the time allotted for cross examination.

Dated: October 1, 2013 Signed: ______________________
Donald Tilton

PATENT
Customer No. 22,852
Attorney Docket No. 10494.8000-00000

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Inter Partes* Reexamination of:	
André Sloth ERIKSEN	Group Art Unit: 3993
U.S. Patent No.: 8,245,764 B2 Filed: October 7, 2011 Issued: August 21, 2012	Examiner: Joseph A. KAUFMAN
For: COOLING SYSTEM FOR A COMPUTER SYSTEM	Confirmation No.: 7254
Reexamination Proceeding Control No. 95/002,386 Filed: September 15, 2012	

Mail Stop *Inter Partes* Reexam
Attn: Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

INFORMATION DISCLOSURE STATEMENT

Pursuant to 37 C.F.R. §§ 1.555 and 1.933, Patent Owner brings to the attention of the Examiner the documents listed on the attached Form PTO/SB/08. Patent Owner attaches copies of the listed foreign patent documents.

Patent Owner respectfully requests that the Examiner consider the listed documents and indicate that they were considered by making appropriate notations on the attached form.

This submission does not represent that a search has been made or that no better art exists and does not constitute an admission that the listed documents are material or constitute "prior art." If the Examiner applies any of the documents as prior art against any claims in the reexamination proceeding, and Patent Owner determines that one or more of the cited documents do not constitute "prior art" under United States law, Patent Owner reserves the right to present to the U.S. Patent and Trademark Office the relevant facts and law regarding the appropriate status of such documents.

Patent Owner further reserves the right to take appropriate action to establish the patentability of the instant patent over the listed documents, should one or more of the documents be applied against the claims of the instant patent in the reexamination proceeding.

Please grant any extensions of time required to enter this response and charge any additional required fees to our Deposit Account No. 06-0916.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

Dated: October 3, 2013

By:______________________
Eric P. Raciti
Reg. No. 41,475

(19) **FEDERAL REPUBLIC OF GERMANY**

GERMAN PATENT OFFICE

(12) **Utility Model**

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DE 203 05 281 U 1

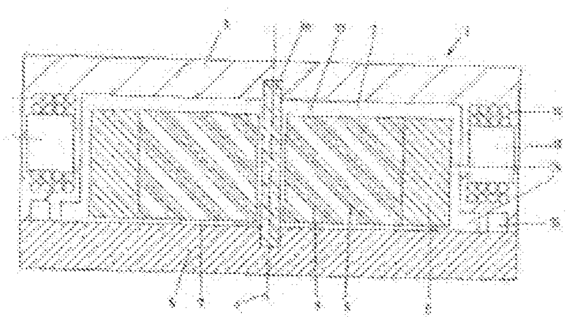
(30) Internal priority:
102 15 718.9 10 April 2002

(73) Holder:
Wille, Stephan, 37077 Göttingen, DE; May, Stefan, 377077 Göttingen, DE

(74) Agent:
Rehberg und Kollegen, 37073 Göttingen

(54) Temperature control device for temperature-controlling, particularly cooling electronic component, with temperature control liquid

(57) Temperature control device with a heat exchange compartment and with a centrifugal pump having a pump wheel for pumping a temperature control liquid through the heat exchange compartment, characterized in that the pump wheel (5) is arranged in the heat exchange compartment (2).



DE 203 05 281 U 1

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Ihr Zeichen
Your reference

Unser Zeichen
Our reference
16438gm / co6

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01.04.2003 [01 April 2003]

Stephan Wille und Stefan May
37077 Göttingen, Ludwig-Prandtl-Str. 41

Temperature control device for temperature-controlling, particularly for cooling electronic component, with a temperature control liquid

The invention relates to a temperature control device with a heat exchange chamber and with a centrifugal pump having a pump wheel for pumping a temperature control liquid through the heat exchange chamber.

In principle, a temperature control device can be a cooling device, a temperature stabilization device or a heating device. In particular, the invention involves a cooling device in which the temperature control liquid is a cooling liquid in the form of cooling water. The cooling liquid then absorbs heat energy in the heat exchange chamber. The cooling water can then be drained off. However, it is preferred to remove the absorbed heat again from the cooling liquid and to conduct it in the loop.

DE 203 05 281 U1

The area of application in which the temperature control device is particularly intended to be used is the cooling of electronic components in computer systems. While high-performance processors in modern computer systems convert a relative large amount of electrical energy into heat, they are relatively heat-sensitive in terms of their performance and the durability of their components. For this reason, they must be cooled when computer systems are in operation. The approach to cooling that is still common in computer systems is air cooling with fans, but this is associated with various drawbacks. These include noise, the entry of dust into the computer systems and the limited performance of this type of cooling.

It has therefore already been begun to cool electronic components with cooling liquid. For instance, DE 196 45 709 A1 discloses a temperature control device of the type described at the outset which is used to cool a main processor in a computer. The temperature control device has a cooling head that is comprised of a housing bordering the heat exchange chamber. The housing has a plate that borders the heat exchange chamber with a heat main transfer surface. This plate is provided to lie flat against the main processor to be cooled, so that the excess heat of the main processor is conducted away through this plate. In the heat exchange chamber, the excess heat is transferred to the cooling liquid, which is conducted to the heat exchange chamber via an intake line and is conducted out of the heat exchange chamber again via the outlet line. The intake and outlet lines are connected to each other in a heat exchanger, in which a submerged impeller pump is provided as a circulating pump for the cooling liquid. The heat exchanger is provided for remote arrangement with respect to the respective computer. Accordingly, a cooling device is depicted that operates with low noise and already cools the main processor of a computer relatively effectively. Often, however, sufficient cooling performance is only achieved when the cooling liquid flows through the heat exchange chamber at relatively high speed, i.e., at a high throughput rate.

A cooling device for electronic components is known from DE 101 23 307 A1 in which a heat exchange chamber is embodied between a heat transfer plate and a hollow profile that is open on one side. A cooling liquid that is pumped around by a remotely arranged liquid pump flows through the heat exchange chamber. Several housings, each of which encloses a heat exchange chamber, are connected in series to each other and to a heat exchanger via connection hoses. This known temperature control device also operates with low noise. However, in order to achieve good cooling performance, a relatively high throughput speed of the cooling liquid must be set here as well.

It is the object of the invention to provide a temperature control device of the type described at the outset which achieves high temperature control performance even with low throughput of temperature control liquid.

According to the invention, this object is achieved in a temperature control device of the type described at the outset by arranging the pump wheel of the centrifugal pump in the heat exchange chamber.

In the new temperature control device, a pump that is arranged remotely from the heat exchange chamber is not used for the temperature control liquid. Rather, a centrifugal pump is provided whose pump wheel is arranged directly in the heat exchange chamber. In this way, it is at least ensured that the temperature control liquid moves in the heat exchange chamber in the area of the pump wheel, i.e., is distributed around over and over again. The recirculation of the temperature control liquid in the heat exchange chamber results in it being used for effectively for controlling the temperature. In the preferred embodiment of the invention, the centrifugal pump is modified insofar as the pump wheel is not optimized for effective pumping of the temperature control liquid through the heat exchange chamber, but rather the recirculation of the temperature control liquid in the heat exchange chamber. Such movement of the temperature control liquid in the heat exchange chamber is ideal, since it ensures that as of yet unused portions of the temperature control liquid repeatedly reach the heat main transfer surface. This means, in particular, that direct heat transfer can occur on the heat main transfer surface to the unused portions of the temperature control liquid and no heat transfer through an immobile boundary layer of the temperature control liquid is necessary, which would have the effect of thermally insulating the heat main transfer surface. Through the recirculation of the temperature control liquid in the heat exchange chamber, the new temperature control device manages with a very low throughput of temperature control liquid. At the same time, the temperature change of the temperature control liquid in the heat exchange chamber is relatively large. This is not a disadvantage, however, but rather creates good conditions for a high degree of effectiveness of the heat exchanger for the temperature control liquid.

To prevent the formation of a nearly immovable boundary layer of temperature control liquid at a heat main transfer surface adjacent to the heat exchange chamber, an axis of rotation of the pump wheel can be arranged perpendicular to this heat main transfer surface. It is preferred here if the pump wheel is directly adjacent to the heat main transfer surface in order to remove any boundary layer repeatedly from the heat main transfer surface. At the same tine, the heat exchange chamber can have a free cross section on the opposing side of the pump wheel. A free cross section of the heat exchange chamber can be provided around the periphery of the pump wheel as well. These free cross sections ensure backflow possibilities for the temperature control liquid counter to the discharge direction of the centrifugal pump in which an eddying of the temperature control liquid in the heat exchange chamber occurs. Moreover, the pure delivery rate of the centrifugal pump is reduced in favor of the recirculation of the temperature control liquid in the heat exchange chamber. It is especially preferred if the free cross section encompasses an area with enlarged radial extension around the periphery of the pump wheel adjacent to the heat main transfer surface. In this way, a maximum surface of the heat main transfer surface is flowed over by the temperature control liquid without reducing the rate of flow of the temperature control liquid in the heat exchange chamber as a result of excessively large free cross sections.

It can also be useful to provide backflow channels in the heat main transfer surface in order to allow a strongly eddying backflow in the area of the pump wheel to spread over the heat main transfer surface as well.

The centrifugal pump of the new temperature control device preferably has an electric motor for driving the pump wheel. The permanent magnets of this electric motor are preferably arranged within the heat exchange chamber. In this way, a duct for a shaft driving the pump wheel in the heat exchange chamber can be avoided. As will readily be understood, when the permanent magnets are arranged in the heat exchange chamber, the permanent magnets and the pump wheel are preferably arranged on one and the same shaft and there is not also a gear between them, for example.

An especially compact construction results if the permanent magnets of the electric motor are arranged in blades of the pump wheel. If the design space allows it, however, the electric motor can also be arranged on a plane above the pump wheel, for example.

An intake and an outlet for the temperature control liquid into the heat exchange chamber can flow together from directions opposite and tangential to the axis of rotation of the pump wheel into the heat exchange chamber. To ensure a defined direction of conveyance for the temperature control liquid, the electric motor must have a fixed direction of rotation for the pump wheel. For example, it can be a direct-current motor with a fixed direction of rotation. Preferably, it is a four-coil motor.

However, the new temperature control device can also operate with an electric motor without a fixed direction of rotation. If, for example, an intake for the temperature control liquid on the axis of rotation of the pump wheel and an outlet for the temperature control liquid in the radial direction to the axis of rotation flows into the heat exchange chamber, the temperature control liquid is taken in at the intake and discharged at the outlet independently of the direction of rotation of the pump wheel.

In the new temperature control device, the heat exchange chamber between the heat main transfer surface and a housing molded body can be made of plastic. The housing molded body made of plastic provides rearward insulation of the heat exchange chamber, so that the desired heat transfer does in fact occur predominantly at the heat main transfer surface. The housing molded body encloses the pump wheel and the parts of the electric motor for driving the pump wheel that are supported on the pump wheel. The housing molded body can be embodied in a single piece. For example, it can be a cast-molded body. In that case, the heat main transfer surface can be provided on a copper plate connected to the housing molded body. However, the heat main transfer surface adjacent to the heat exchange chamber next to the housing molded body can also be a surface of the electronic component to be cooled. In other words, the heat exchange chamber is then directly adjacent to the electronic component or another object to be temperaure-controlled.

To regulate the rotary speed of the pump wheel of the new temperature control device, a temperature sensor can be provided on the heat main transfer surface. If the heat main transfer surface is provided on a copper plate, the temperature sensor can be arranged in this copper plate. The temperature sensor can also be one that is based on a thermoelement.

The temperature sensor and an electric motor of the pump wheel can be connected to interfaces of a computer in which the temperature control device is used to cool an electronic component. In this way, the computer can itself regulate the temperature prevailing on the surface of the electronic component to be cooled in order, for example, to optimize the operating temperature of a processor.

As was already mentioned, the heat exchange chamber can be connected via intake and outlet lines to a passive heat exchanger for the temperature control liquid. Since the invention leads to a relatively pronounced temperature change of the temperature control liquid in the heat exchange chamber, a simple radiator is often sufficient to re-cool the cooling liquid used to cool an electronic component, for example.

The invention is explained and described in further detail below on the basis of sample embodiments.

Fig. 1 shows a vertical section through a first embodiment of the temperature control device,

Fig. 2 shows a horizontal section through the temperature control device according to Fig. 1,

Fig. 3 shows a vertical section through another embodiment of the temperature control device,

Fig. 4 shows a horizontal section through the temperature control device according to Fig. 3,

Fig. 5 shows a plan view of the temperature control device according to Figs. 3 and 4 with a representation of various internal components of the temperature control device,

Fig. 6 shows a horizontal section running parallel to Fig. 5 through a modification of the device according to Figs. 3 to 5,

Fig. 7 shows a corresponding horizontal section through another modification of the temperature control device according to Figs. 3 to 5,

Fig. 8 shows a vertical section through a third embodiment of the temperature control device, and

Fig. 9 shows a horizontal section through the temperature control device according to Fig. 8

Figs. 1 and 2 show a temperature control device 1 in which a heat exchange chamber 2 is embodied between a housing molded body 3 and a copper plate 4. The copper plate 4 is provided to lie flat with its surface on an object to be temperature-controlled, for example on an electronic component to be cooled. Arranged in the heat exchange chamber 2 is a pump wheel 5 of a centrifugal pump that is pivoted about an axis of rotation 6 which runs perpendicular to a heat main transfer surface 7 of the copper plate 4. To drive the pump wheel 5, permanent magnets 8 are arranged on the outer ends of blades 9 of the pump wheel, and coils 10 are embedded in the housing molded body 3 which together form an electric motor 8, 10. This is a direct-current motor with a fixed direction of rotation in which the pump wheel 5 takes in a temperature control liquid (not shown here) via an intake 11 in the housing molded body 3, recirculates the temperature control liquid in the heat exchange chamber 2 and expels it again through an outlet 12 in the housing molded body 3. Here, the movement of the blades 9 of the pump wheel 5 over the heat main transfer surface 7 prevents the formation there of an immobile boundary layer of the temperature control liquid. What is more, the pump wheel 5 is arranged and dimensioned such in relation to the housing molded body 3 that free cross sections 13 and 14 remain between it and the housing molded body 3 through which a backflow of the temperature control liquid impinged on by the blades 9 of the pump wheel 5 can occur in order to promote eddying of the temperature control liquid in the heat exchange chamber 2. Here, the free cross section 13 lies on the side of the pump wheel 5 opposite the heat main transfer surface 7, whereas the free cross section 14 runs radially outside of the area of the pump wheel 5 around the periphery of the pump wheel 5 and has its maximum radial expansion at the heat main transfer surface 7 in order to flow over as large an area of the heat main transfer surface 7 with the temperature control liquid as possible. Figs. 1 and 2 also show a sealing channel 15 and attachment holes 16 in the housing molded body 3. The sealing channel 15 is used to arrange a seal between the housing molded body 3 and the copper plate 4. The attachment holes 16 are used to attach the temperature control device 1 to an object to be temperature-controlled.

The embodiment of the temperature control device 1 according to Figs. 3 to 5 differs from that according to Figs. 1 and 2 essentially in that the electric motor 8, 10 is not embodied in the immediate area of the pump wheel 5, but rather on a plane lying above it. Accordingly, while the permanent magnets 8 are connected directly to the pump wheel 5 and are also still in the heat exchange chamber 2 so that no shaft duct through the housing molded body 3 is necessary, the permanent magnets 8 are provided in an axial area of the axis of rotation 6 into which the blades 9 of the pump wheel 5 do not protrude. The coils 10 of the electric motor 8, 10 are therefore arranged outside of the housing molded body 3 and poured into a separate molded body 17 or one that is permanently connected to the housing molded body 3. Here, in addition to cores 18, the coils 10 also have a common flux ring 19 which is also covered in the molded body 17.

Fig. 5 is a view of the temperature control device according to Figs. 3 and 4 from above, with internal components of the temperature control device 1 that are actually hidden being also depicted in this view2. Also shown is the structural design of the intake 11 and of the outlet 12, which are provided with fluid quick connectors 20. Via the fluid quick connectors 20 are connected an intake line 21 and an outlet line 22 which are connected to one another via a heat exchanger 23 in the form of a radiator 24. Moreover, it is schematically indicated in Fig. 5 that a control 25 generates a control signal 28 for the coils 10 of the electric motor 8, 10 on the basis of a temperature signal 26 from a temperature sensor 27. The control 25 can be part of a computer in which the temperature control device 1 is being used to cool an electronic component, for example the main process of the computer. In that case, the signals 26, 28 can be fed via appropriate interfaces of the computer.

Fig. 6 shows an alternative with respect to the arrangement of the intake 11 and the outlet 12 to the pump wheel 5. Here, too, the intake 11 flows tangentially into the area of the pump wheel 5, i.e., into the heat exchange chamber 2, and the outlet 12 exits tangentially from the heat exchange chamber 2. However, they are not provided on the same side of the housing molded body 3 but on opposite sides.

In contrast, Fig. 7 provides a sketch of a case in which the intake 11 and the outlet 12 are arranged on adjacent sides of the housing molded body 3. However, there is no basic functional difference between the variants described previously for the arrangement of the intake 11 and outlet 12.

Nonetheless, such a variant is given in the embodiment according to Figs. 8 and 9. Here, the intake 11 runs axially in the direction of the axis of rotation 6 from above onto the heat main transfer surface 7, but first past the permanent magnets 8 above the pump wheel 5 and into the heat exchange chamber 2. The outlet 12 is arranged radially to the axis of rotation 6 in the area of the pump wheel 5. This arrangement of the intake 11 and outlet 12 offers the advantage that, independently of the direction of rotation of the pump wheel 5, a predetermined direction of conveyance of the temperature control liquid is predetermined by the heat exchange chamber 2. To realize the intake 11, through holes 31 are provided in the housing molded body 3 around an upper guide 29 for a support rod 30 on which the bladed wheel 5 and the permanent magnets 8 are pivoted. The through holes 31 are part of the intake 11 for the temperature control liquid.

LIST OF REFERENCE SYMBOLS

1 - temperature control device
2 - heat exchange chamber
3 - housing molded body
4 - copper plate
5 - pump wheel
6 - axis of rotation
7 - heat main transfer surface
8 - permanent magnet
9 - blade
10 - coil
11 - intake
12 - outlet
13 - free cross section
14 - free cross section
15 - sealing channel
16 - attachment hole
17 - molded body
18 - core
19 - flux ring
20 - fluid quick connector
21 - intake line
22 - outlet line
23 - heat exchanger
24 - radiator
25 - control
26 - temperature signal
27 - temperature sensor
28 - control signal
29 - guide
30 - support rod
31 - through hole

PATENT CLAIMS:

1. Temperature control device with a heat exchange chamber and with a centrifugal pump having a pump wheel for pumping a temperature control liquid through the heat exchange chamber, characterized in that the pump wheel (5) is arranged in the heat exchange chamber (2).

2. Temperature control device as set forth in claim 1, characterized in that an axis of rotation (6) of the pump wheel (5) is arranged perpendicular to a heat main transfer surface (7) bordering the heat exchange chamber (2).

3. Temperature control device as set forth in claim 2, characterized in that the pump wheel (5) is directly adjacent to the heat main transfer surface (7), whereas the heat exchange chamber (2) has a free cross section (13) on the opposite side of the pump wheel (5).

4. Temperature control device as set forth in claim 2 or 3, characterized in that the heat exchange chamber (2) has a free cross section (13) around the periphery of the pump wheel (5) which has an area with enlarged radial expansion adjacent to the heat main transfer surface (7).

5. Temperature control device as set forth in one of claims 2 to 4, characterized in that backflow channels are provided in the heat main transfer surface (7).

6. Temperature control device as set forth in one of claims 1 to 5, characterized in that permanent magnets (8) of an electric motor (8, 10) driving the pump wheel are arranged in the heat exchange chamber (2).

7. Temperature control device as set forth in claim 6, characterized in that the permanent magnets (8) and the pump wheel (5) are arranged on a common shaft.

8. Temperature control device as set forth in claim 7, characterized in that the permanent magnets (8) are arranged in blades (9) of the pump wheel (5).

9. Temperature control device as set forth in one of claims 1 to 8, characterized in that an intake (11) and an outlet (12) for the temperature control liquid flow together into the heat exchange chamber (2) from opposing tangential directions to the axis of rotation (6) of the pump wheel.

10. Temperature control device as set forth in one of claims 1 to 8, characterized in that an intake (11) for the temperature control liquid flows into the heat exchange chamber (2) at the axis of rotation (6) of the pump wheel (5) and an outlet (12) for the temperature control liquid flows into the heat exchange chamber (2) in the direction radial to the axis of rotation (6).

11. Temperature control device as set forth in one of claims 2 to 5, characterized in that the heat exchange chamber (2) between the heat main transfer surface (7) and a housing molded body(3) is made of plastic.

12. Temperature control device as set forth in claim 11, characterized in that the heat main transfer surface (7) is provided on a copper plate (4) that is connected to the housing molded body (3).

13. Temperature control device as set forth in one of claims 2 to 5, 11 and 12, characterized in that a temperature sensor is provided for regulating the rotary speed of the pump wheel at the heat main transfer surface.

14. Temperature control device as set forth in claim 13, characterized in that the temperature sensor (27) and an electric motor (8, 10) of the pump wheel (5) are connected to interfaces of a computer in which the temperature control device (1) is used to cool an electronic component.

15. Temperature control device as set forth in one of claims 1 to 14, characterized in that the heat exchange chamber (2) is connected via intake and outlet likes (21, 22) to a passive heat exchanger (23) for the temperature control liquid.

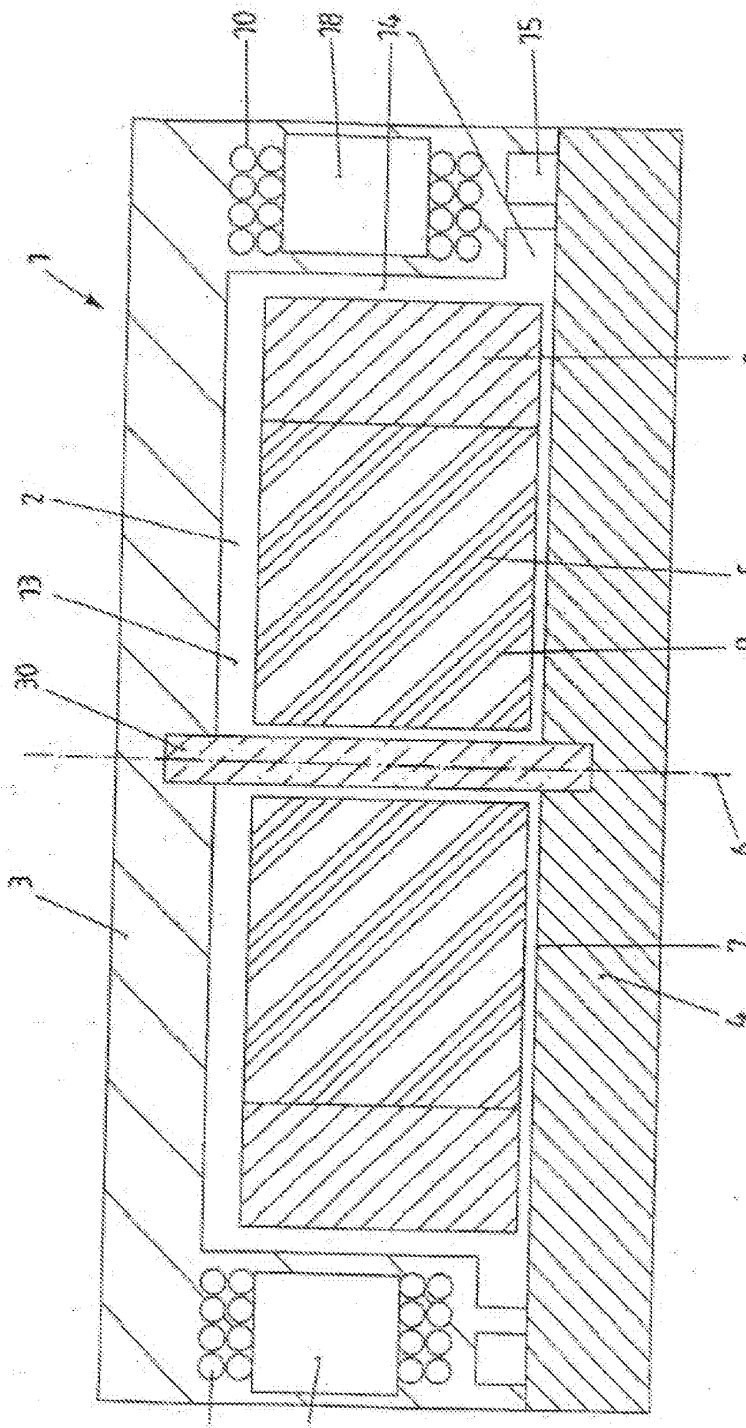

Fig. 1

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Fig. 2

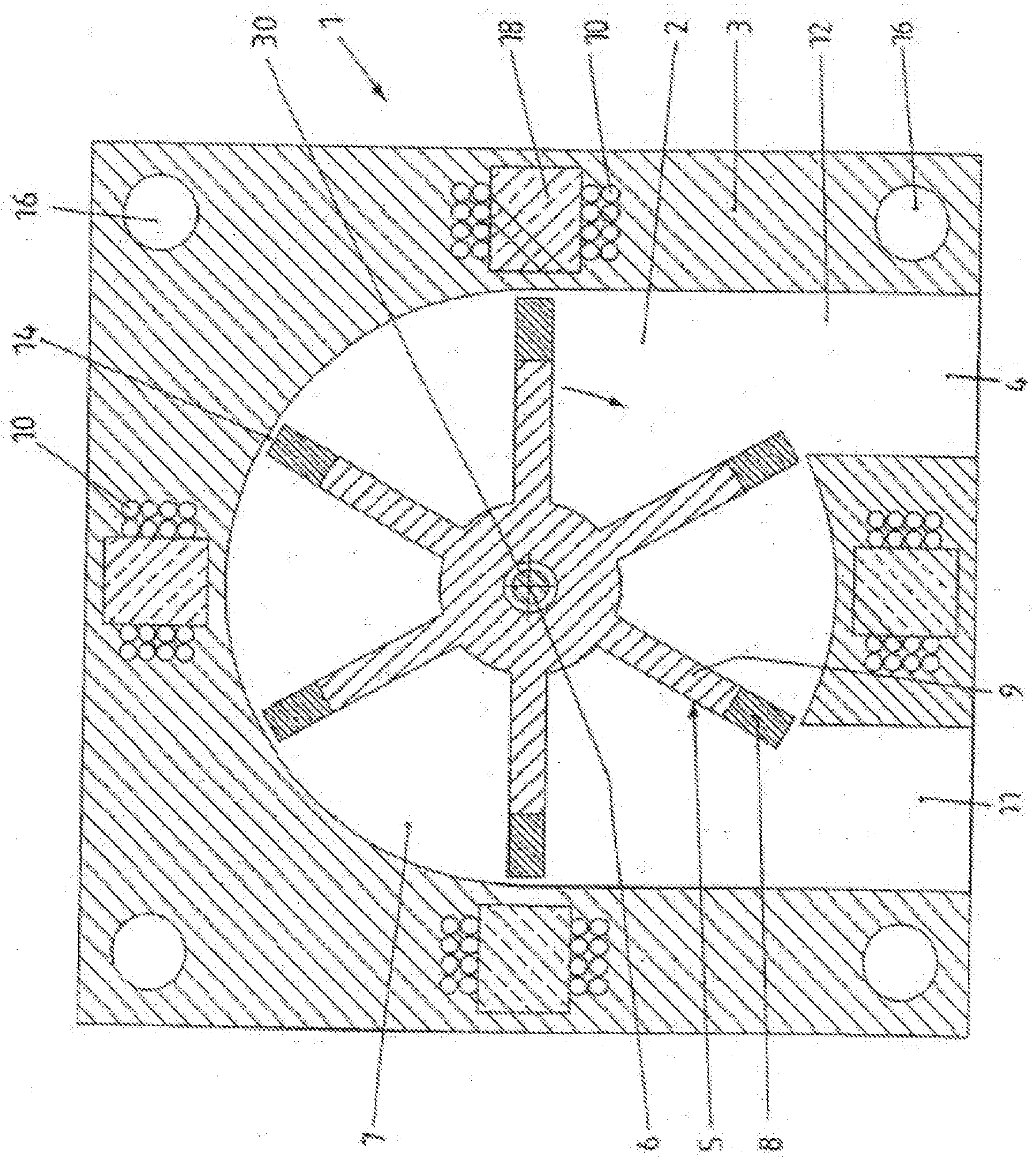

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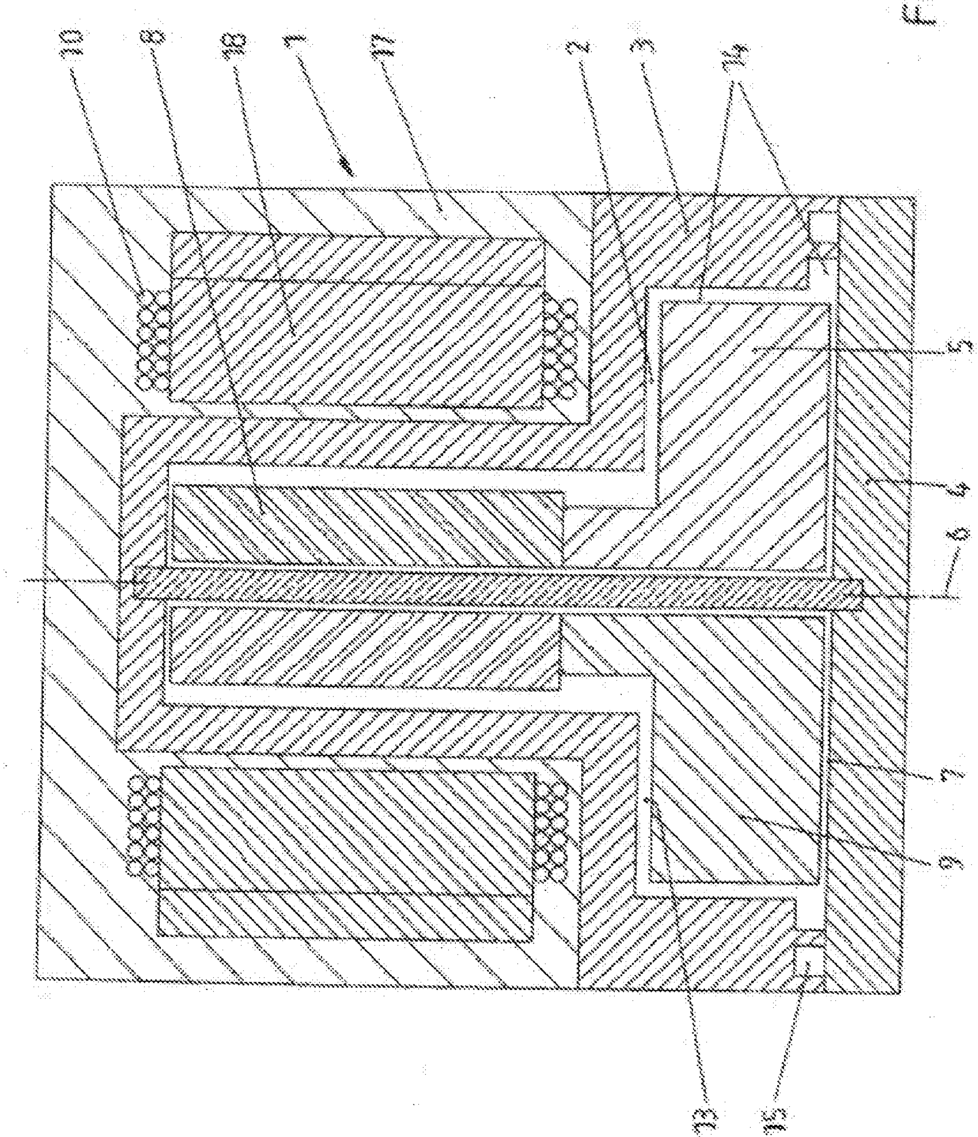
Fig 3



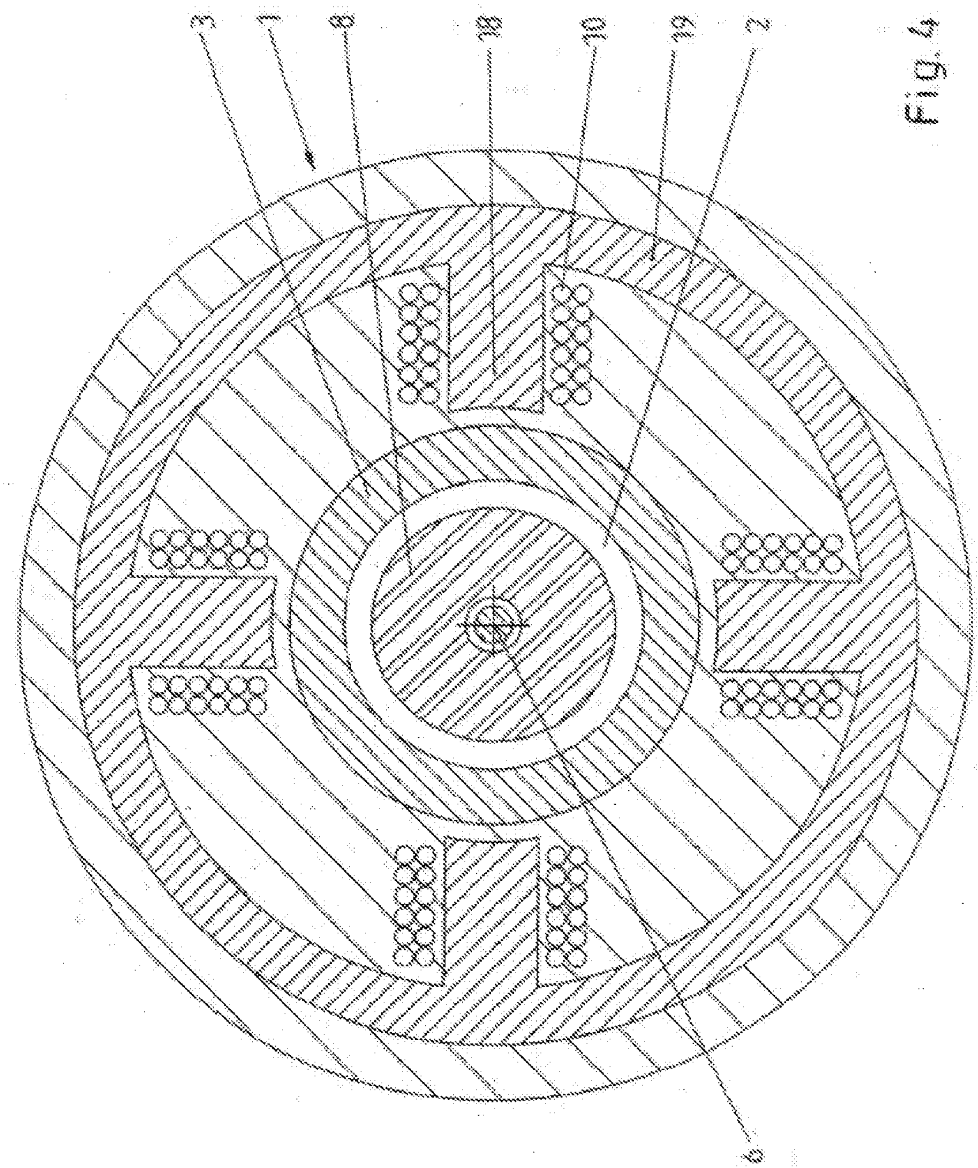


Fig. 4

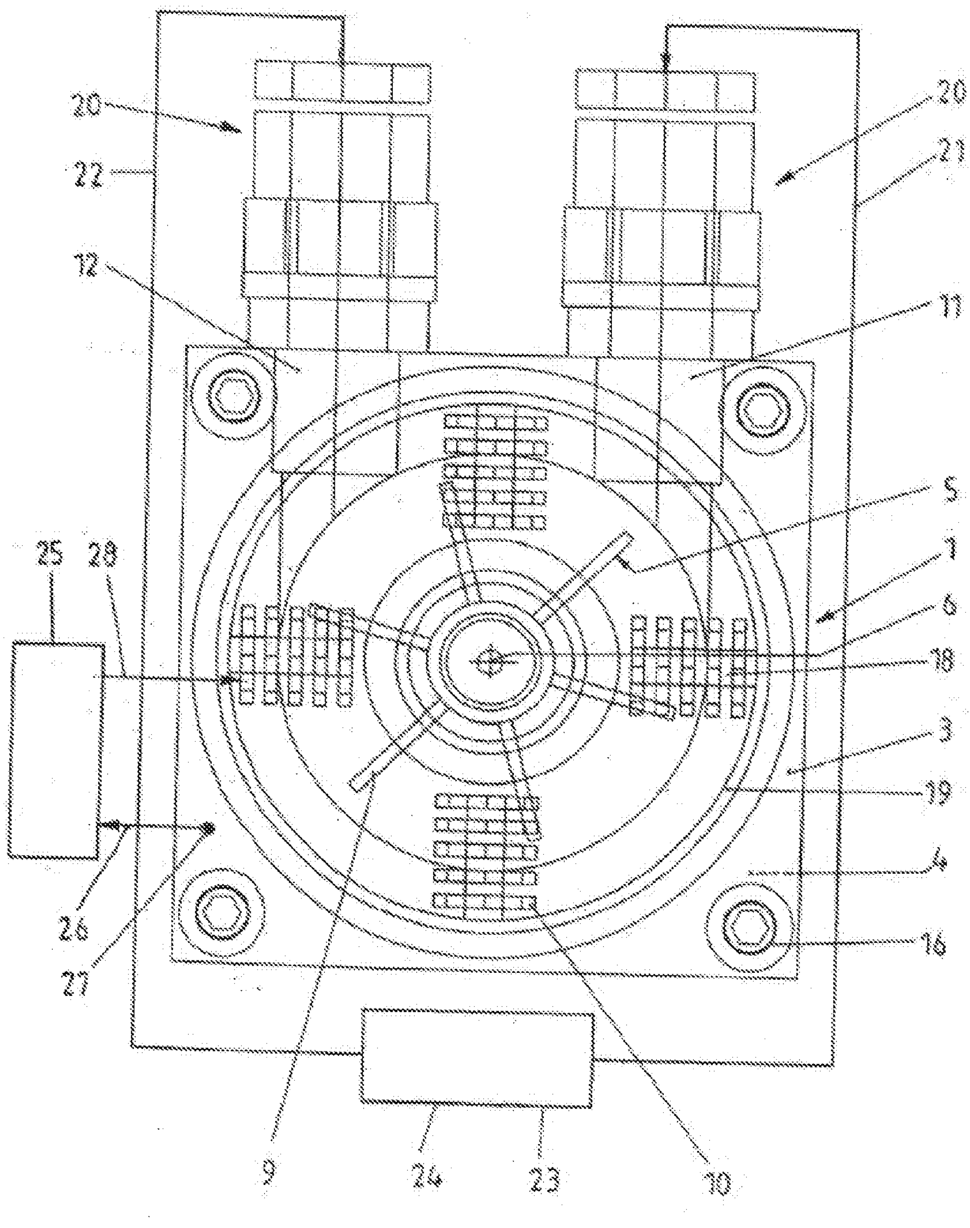


Fig. 5

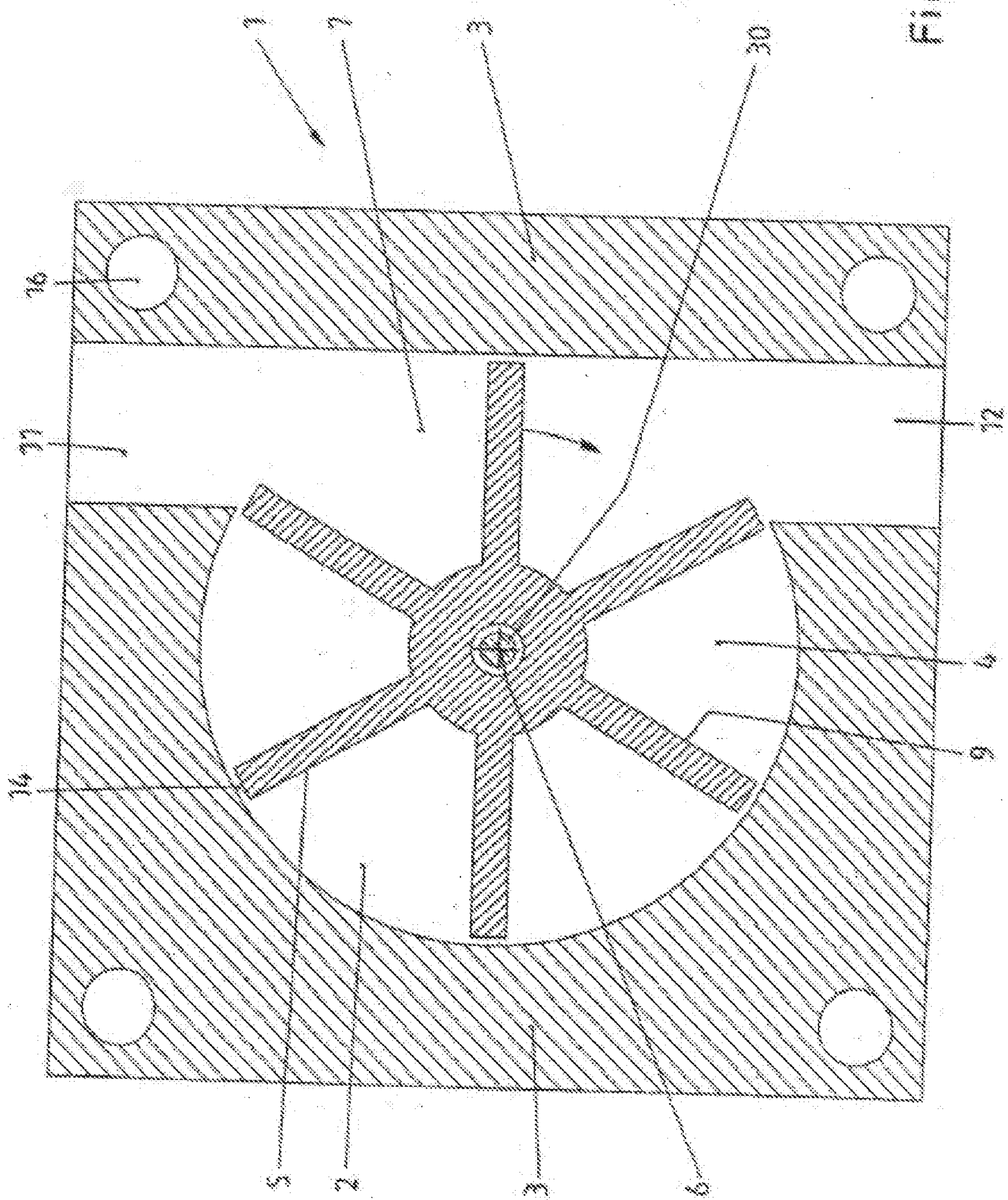


Fig. 6

Fig. 7

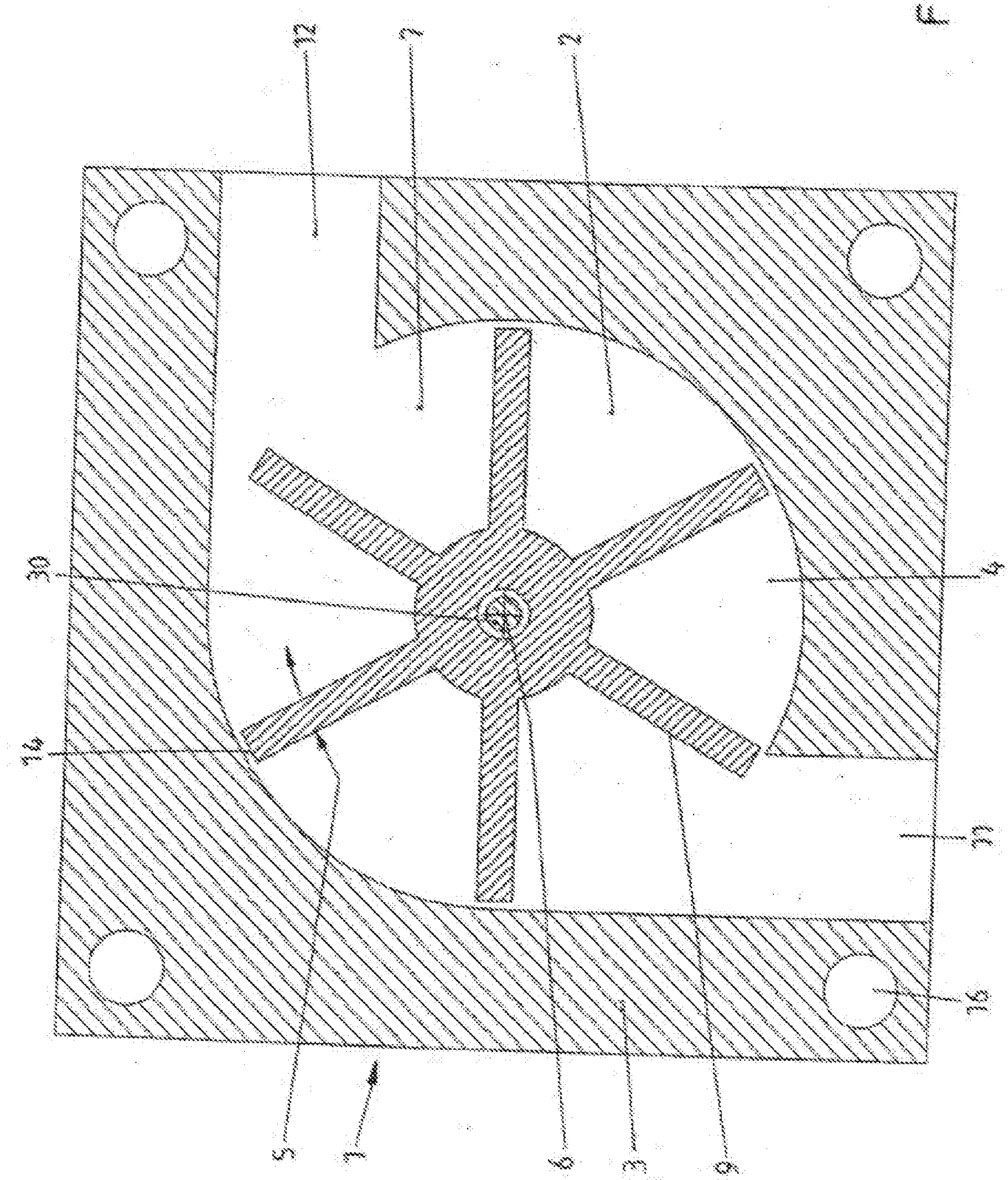


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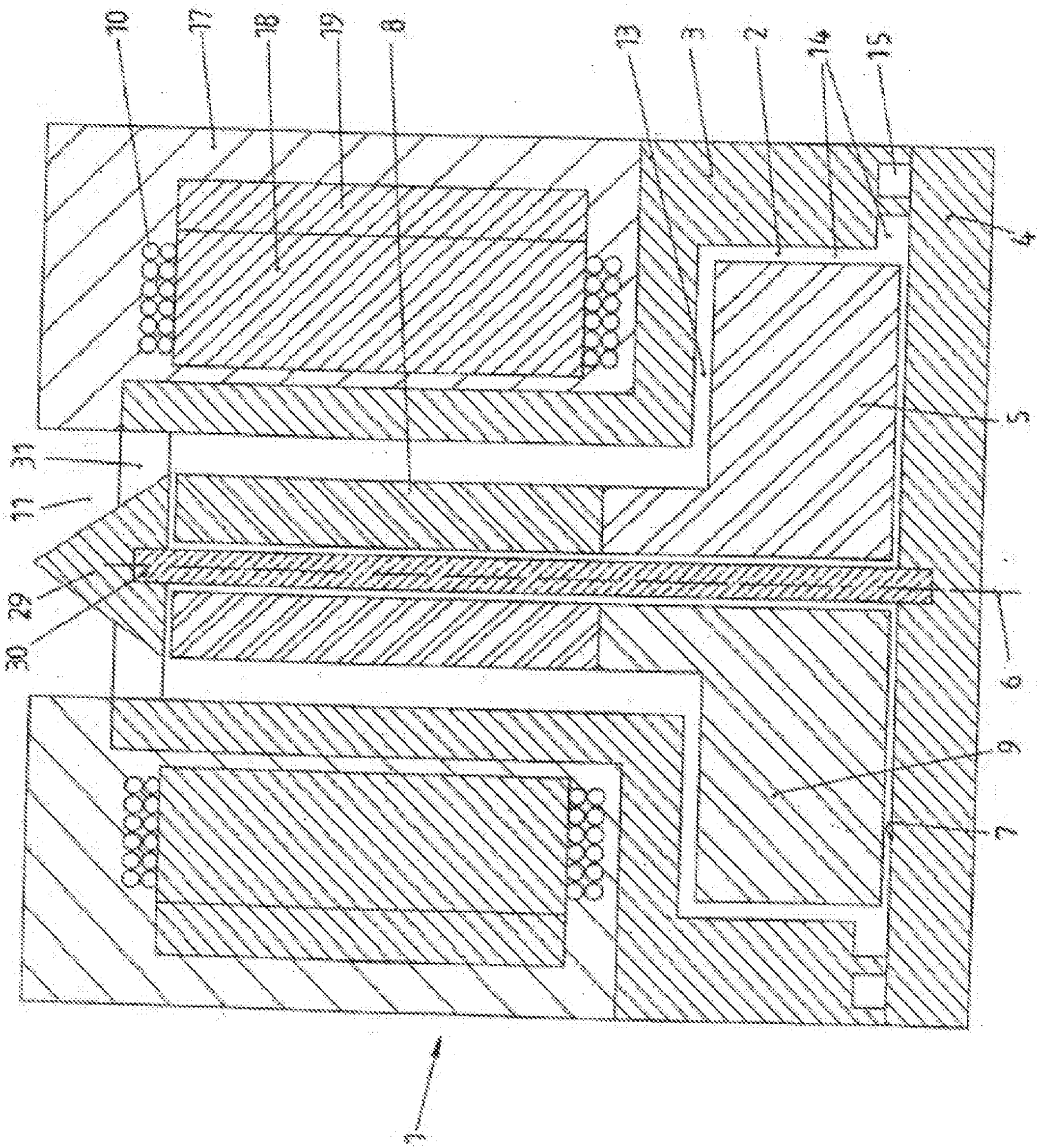
Fig.8



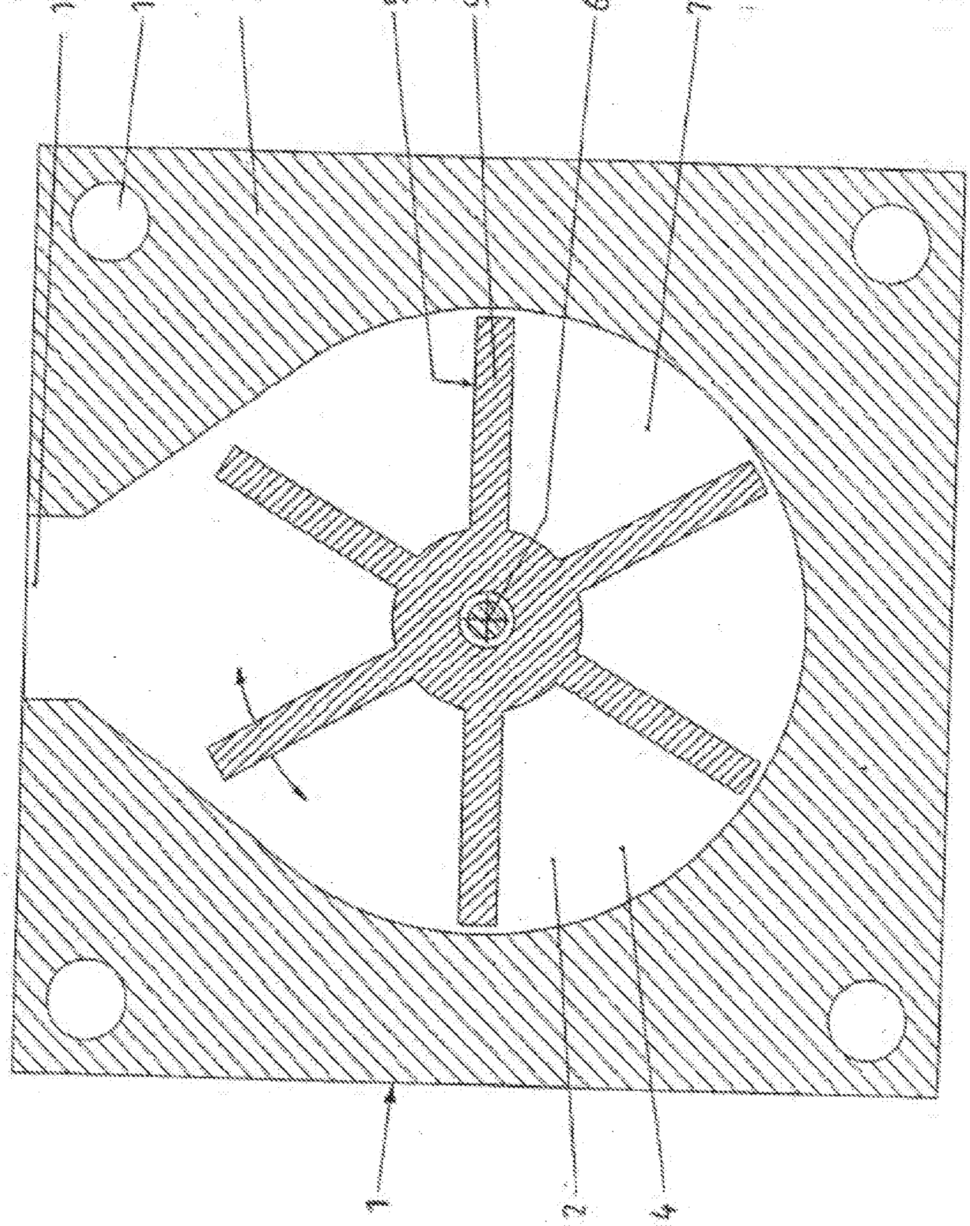


Fig. 9

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To whom it may concern:

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Anna Lee

Signature of Anna Lee

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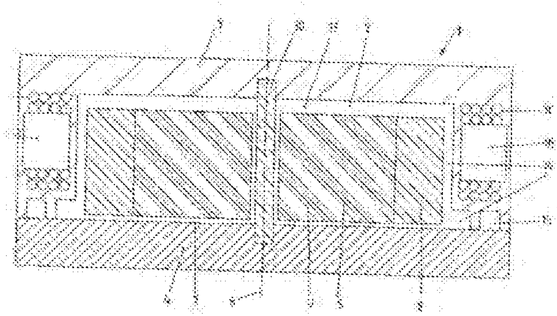
(54) Temperiervorrichtung zum Temperieren, insbesondere zum Kühlen eines elektronischen Bauteils, mit einer Temperierflüssigkeit

(57) Temperiervorrichtung mit einem Wärmeaustauschraum und mit einer ein Pumpenrad aufweisenden Kreiselpumpe zum Pumpen einer Temperierflüssigkeit durch den Wärmeaustauschraum, dadurch gekennzeichnet, dass das Pumpenrad (5) in dem Wärmeaustauschraum (2) angeordnet ist.



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Temperiervorrichtung zum Temperieren, insbesondere zum Kühlen eines elektronischen Bauteils, mit einer Temperierflüssigkeit

Die Erfindung bezieht sich auf eine Temperiervorrichtung mit einem Wärmeaustauschraum und mit einer ein Pumpenrad aufweisenden Kreiselpumpe zum Pumpen einer Temperierflüssigkeit durch den Wärmeaustauschraum.

Bei der Temperiervorrichtung kann es sich prinzipiell um eine Kühlvorrichtung, eine Temperaturstabilisiervorrichtung oder eine Heizvorrichtung handeln. Insbesondere geht es bei der Erfindung um eine Kühlvorrichtung, bei der die Temperierflüssigkeit eine Kühlflüssigkeit in Form von Kühlwasser ist. Die Kühlflüssigkeit nimmt dann in dem Wärmeaustauschraum Wärmeenergie auf. Anschließend kann die Kühlflüssigkeit abgeleitet werden. Bevorzugt ist es jedoch, der Kühlflüssigkeit die aufgenommene Wärme wieder zu entziehen und sie im Kreislauf zu führen.

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Das Anwendungsgebiet, auf dem die hier beschriebene Temperiervorrichtung insbesondere zur Anwendung kommen soll, ist das Kühlen von elektronischen Bauteilen in Rechneranlagen. Hochleistungsprozessoren in modernen Rechneranlagen setzen einerseits relativ viel elektrische Energie in Wärme um und sind andererseits in ihrer Leistungsfähigkeit und in ihrer Bauteilbeständigkeit relativ wärmeempfindlich. Sie müssen daher im Betrieb der Rechneranlagen gekühlt werden. Die derzeit noch übliche Kühlung in Rechneranlagen ist die Luftkühlung mit Ventilatoren, welche aber verschiedene Nachteile hat. Hierzu gehören die Geräuschentwicklung, der Eintrag von Staub in die Rechneranlagen und die begrenzte Leistungsfähigkeit der Kühlung.

Es ist daher schon dazu übergegangen worden, elektronische Bauteile mit Kühlflüssigkeit zu kühlen. So offenbart die DE 196 45 709 A1 eine Temperiervorrichtung der eingangs beschriebenen Art, die zum Kühlen eines Hauptprozessors in einem Computer dient. Die Temperiervorrichtung weist einen Kühlkopf auf, der aus einem dem Wärmeaustauschraum begrenzenden Gehäuse besteht. Das Gehäuse weist eine Platte auf, die den Wärmeaustauschraum mit einer Wärmehauptübertragungsfläche begrenzt. Diese Platte ist zur flächigen Anlage an dem zu kühlenden Hauptprozessor vorgesehen, so dass die überschüssige Wärme des Hauptprozessors durch diese Platte abgeführt wird. In dem Wärmeaustauschraum wird die überschüssige Wärme auf die Kühlflüssigkeit übertragen, die dem Wärmeaustauschraum über eine Zulaufleitung zugeführt wird und aus dem Wärmeaustauschraum über eine Ablaufleitung wieder abgeführt wird. Die Zulauf- und Ablaufleitungen sind in einem Wärmetauscher miteinander verbunden, in dem eine Tauchkreiselpumpe als Umwälzpumpe für die Kühlflüssigkeit vorgesehen ist. Der Wärmetauscher ist zur remoten Anordnung zu dem jeweiligen Computer vorgesehen. So wird eine Kühlvorrichtung aufgezeigt, die geräuscharm arbeitet und den Hauptprozessor eines Computers bereits relativ wirksam kühlt. Häufig wird eine ausreichende Kühlleistung jedoch nur dann erreicht, wenn die Kühlflüssigkeit den Wärmeaustauschraum mit relativ hoher Geschwindigkeit, d.h. hoher Durchsatzleistung durchströmt.

Aus der DE 101 23 307 A1 ist eine Kühlvorrichtung für elektronische Bauteile bekannt, bei der ein Wärmeaustauschraum zwischen einer Wärmeübertragungsplatte und einem einseitig offenen Hohlprofil ausgebildet ist. Der Wärmeaustauschraum wird von einer Kühlflüssigkeit durchströmt, die von einer remote angeordneten Flüssigkeitspumpe umgepumpt wird. Dabei sind über Verbindungsschläuche mehrere Gehäuse, die jeweils einen Wärmeaustauschraum umfassen, in Reihe untereinander und mit einem Wärmetauscher verbunden. Auch diese bekannte Temperiervorrichtung arbeitet geräuscharm. Zum Erzielen einer guten Kühlleistung muss jedoch auch hier eine relativ hohe Durchströmgeschwindigkeit der Kühlflüssigkeit eingestellt werden.

Der Erfindung liegt die Aufgabe zugrunde, eine Temperiervorrichtung der eingangs beschriebenen Art aufzuzeigen, die auch mit einem geringeren Durchsatz an Temperierflüssigkeit eine hohe Temperierleistung erzielt.

Erfindungsgemäß wird diese Aufgabe bei einer Temperiervorrichtung der eingangs beschriebenen Art dadurch gelöst, dass das Pumpenrad der Kreiselpumpe in dem Wärmeaustauschraum angeordnet ist.

Bei der neuen Temperiervorrichtung wird nicht mit einer entfernt von dem Wärmeaustauschraum angeordneten Pumpe für die Temperierflüssigkeit gearbeitet. Vielmehr ist eine Kreiselpumpe vorgesehen, deren Pumpenrad unmittelbar in dem Wärmeaustauschraum angeordnet ist. Auf diese Weise wird zumindest sichergestellt, dass im Bereich des Pumpenrads die Temperierflüssigkeit in dem Wärmeaustauschraum bewegt, d.h. immer wieder umverteilt wird. Die Umwälzung der Temperierflüssigkeit in dem Wärmeaustauschraum führt dazu, dass sie effektiver zur Temperierung genutzt wird. In der bevorzugten Ausführungsform der Erfindung ist die Kreiselpumpe insoweit modifiziert, dass das Pumpenrad nicht auf ein effektives Pumpen der Temperierflüssigkeit durch den Wärmeaustauschraum hindurch sondern auf ein Umwälzen der Temperierflüssigkeit in dem Wärmeaustauschraum optimiert ist. Ideal ist eine solche Bewegung der Temperierflüssigkeit in dem Wärmeaustauschraum, die sicherstellt, dass immer wieder noch unverbrauchte Anteile der Temperierflüssigkeit an die Wärmehauptübertragungsfläche gelangen. Dies bedeutet insbesondere, dass ein direkter Wärmeübertrag an der Wärmehauptübertragungsfläche auf die unverbrauchten Anteile der Temperierflüssigkeit erfolgen kann und keine Wärmeleitung durch eine immobile Grenzschicht der Temperierflüssigkeit hindurch erforderlich ist, welche sich wie eine thermische Isolierung der Wärmehauptübertragungsfläche auswirkt. Durch die Umwälzung der Temperierflüssigkeit in dem Wärmeaustauschraum kommt die neue Temperiervorrichtung mit einem sehr geringen Durchsatz an Temperierflüssigkeit aus. Gleichzeitig ist die Temperaturveränderung der Temperierflüssigkeit in dem Wärmeaustauschraum relativ groß. Dies ist aber nicht von Nachteil, sondern schafft vielmehr gute Voraussetzungen für einen hohen Wirkungsgrad eines Wärmetauschers für die Temperierflüssigkeit.

Um die Ausbildung einer nahezu unbeweglichen Grenzschicht von Temperierflüssigkeit an einer den Wärmeaustauschraum begrenzenden Wärmehauptübertragungsfläche zu verhindern, kann eine Drehachse des Pumpenrads senkrecht zu dieser Wärmehauptübertragungsfläche angeordnet sein. Dabei ist es bevorzugt, wenn das Pumpenrad direkt an die Wärmehauptübertragungsfläche angrenzt, um so eine etwaige Grenzschicht immer wieder von der Wärmehauptübertragungsfläche abzustreifen. Gleichzeitig kann der Wärmeaustauschraum auf der gegenüberliegenden Seite des Pumpenrads einen freien Querschnitt aufweisen. Auch um den Umfang des Pumpenrads herum kann ein freier Querschnitt des Wärmeaustauschraums vorgesehen sein. Diese freien Querschnitte stellen insgesamt Rückströmmöglichkeiten für die Temperierflüssigkeit entgegen der Förderrichtung der Kreiselpumpe sicher, in denen eine Verwirbelung der Temperierflüssigkeit in dem Wärmeaustauschraum erfolgt. Außerdem wird die reine Förderleistung der Kreiselpumpe zugunsten der Umwälzung der Temperierflüssigkeit in dem Wärmeaustauschraum reduziert. Besonders bevorzugt ist es, wenn der freie Querschnitt um den Umfang des Pumpenrads herum angrenzend an die Wärmehauptübertragungsfläche einen Bereich mit vergrößerter radialer Ausdehnung umfasst. So wird eine maximale Fläche der Wärmehauptübertragungsfläche von der Temperierflüssigkeit überströmt, ohne dass die Strömungsgeschwindigkeit der Temperierflüssigkeit in dem Wärmeaustauschraum durch insgesamt zu große freie Querschnitte reduziert wird.

Es kann auch nützlich sein, in der Wärmehauptübertragungsfläche Rückstromkanäle vorzusehen, um eine stark verwirbelnde Rückströmung im Bereich des Pumpenrads auch über die Wärmehauptübertragungsfläche streichen zu lassen.

Die Kreiselpumpe der neuen Temperiervorrichtung weist zum Antrieb des Pumpenrads vorzugsweise einen Elektromotor auf. Die Permanentmagnete dieses Elektromotors sind dabei vorzugsweise innerhalb des Wärmeaustauschraums angeordnet. Auf diese Weise kann eine Durchführung für eine das Pumpenrad antreibende Welle in dem Wärmeaustauschraum vermieden werden. Es versteht sich, dass bei Anordnung der Permanentmagnete in dem Wärmeaustauschraum die Permanentmagnete und das Pumpenrad vorzugsweise auf ein und derselben Welle angeordnet sind und nicht etwa noch ein Getriebe dazwischen geschaltet ist.

Ein besonders kompakter Aufbau ergibt sich, wenn die Permanentmagnete des Elektromotors in Schaufeln des Pumpenrads angeordnet sind. Wenn der Bauraum dies zulässt, kann der Elektromotor aber auch beispielsweise in einer Ebene oberhalb des Pumpenrads angeordnet sein.

Ein Zulauf und ein Ablauf für die Temperierflüssigkeit in den Wärmeaustauschraum können aus entgegengesetzten tangentialen Richtungen zur Drehachse des Pumpenrads in den Wärmeaustauschraum einmünden. Damit sich dabei eine definierte Förderrichtung für die Temperaturflüssigkeit ergibt, muss der Elektromotor für das Pumpenrad eine feste Drehrichtung aufweisen. Es kann sich beispielsweise um einen Gleichstrommotor mit fester Drehrichtung handeln. Bevorzugt ist ein Vierspulenmotor.

Die neue Temperiervorrichtung kann aber auch mit einem Elektromotor ohne feste Drehrichtung arbeiten. Wenn beispielsweise ein Zulauf für die Temperierflüssigkeit an der Drehachse des Pumpenrads und ein Ablauf für die Temperierflüssigkeit in radialer Richtung zu der Drehachse in den Wärmeaustauschraum einmündet, wird die Temperierflüssigkeit unabhängig von der Drehrichtung des Pumpenrads am Zulauf angesaugt und am Ablauf ausgestoßen.

Bei der neuen Temperiervorrichtung kann der Wärmeaustauschraum zwischen der Wärmehauptübertragungsfläche und einem Gehäuseformkörper aus Kunststoff ausgebildet sein. Der Gehäuseformkörper aus Kunststoff sorgt für eine rückwärtige Isolierung des Wärmeaustauschraums, so dass der gewünschte Wärmeübertrag tatsächlich vorwiegend an der Wärmehauptübertragungsfläche auftritt. Der Gehäuseformkörper umschließt dabei das Pumpenrad und die an dem Pumpenrad gelagerten Teile des Elektromotors zum Antrieb des Pumpenrads. Der Gehäuseformkörper kann einstückig sein. Beispielsweise kann es sich um einen Gussformkörper handeln. Dabei kann die Wärmehauptübertragungsfläche an einer mit dem Gehäuseformkörper verbundenen Kupferplatte vorgesehen sein. Bei der den Wärmeaustauschraum neben dem Gehäuseformkörper begrenzenden Wärmehauptübertragungsfläche kann es sich aber auch um eine Oberfläche des zu kühlenden elektronischen Bauteils handeln. Mit anderen Worten grenzt der Wärmeaustauschraum dann unmittelbar an das elektronische Bauteil oder einen anderen zu temperierenden Gegenstand an.

Für die Regelung der Drehzahl des Pumpenrads der neuen Temperiervorrichtung kann ein Temperatursensor an der Wärmehauptübertragungsfläche vorgesehen sein. Wenn die Wärmehauptübertragungsfläche an einer Kupferplatte vorgesehen ist, kann der Temperatursensor in dieser Kupferplatte angeordnet sein. Bei dem Temperatursensor kann es sich um einen solchen handeln, der auf einem Thermoelement basiert.

Der Temperatursensor und ein Elektromotor des Pumpenrads können an Schnittstellen eines Rechners angeschlossen sein, bei dem die Temperiervorrichtung zur Kühlung eines elektronischen Bauteils dient. Der Rechner kann so selbst die Temperatur regeln, die an der Oberfläche des zu kühlenden elektronischen Bauteils herrscht, um beispielsweise die Arbeitstemperatur eines Prozessors zu optimieren.

Wie bereits angesprochen wurde, kann der Wärmeaustauschraum über Zulauf- und Ablaufleitungen an einen passiven Wärmetauscher für die Temperierflüssigkeit angeschlossen sein. Da die Erfindung zu einer relativ starken Temperaturveränderung der Temperierflüssigkeit in dem Wärmeaustauschraum führt, reicht häufig ein einfacher Radiator aus, um beispielsweise die zum Kühlen eines elektronischen Bauteils verwendete Kühlflüssigkeit wieder abzukühlen.

Die Erfindung wird im folgenden anhand von Ausführungsbeispielen näher erläutert und beschrieben. Dabei zeigt

Fig. 1 einen Vertikalschnitt durch eine erste Ausführungsform der Temperiervorrichtung,

Fig. 2 einen Horizontalschnitt durch die Temperiervorrichtung gemäß Fig. 1,

Fig. 3 einen Vertikalschnitt durch eine weitere Ausführungsform der Temperiervorrichtung,

Fig. 4 einen Horizontalschnitt durch die Temperiervorrichtung gemäß Fig. 3,

Fig. 5 eine Ansicht von oben auf die Temperiervorrichtung gemäß den Fig. 3 und 4 mit Darstellung verschiedener innerer Bauteile der Temperiervorrichtung,

Fig. 6 einen zu Fig. 5 parallel verlaufenden Horizontalschnitt durch eine Abwandlung der Vorrichtung gemäß den Fig. 3 bis 5,

Fig. 7 einen Fig. 6 entsprechenden Horizontalschnitt durch eine weitere Abwandlung der Temperiervorrichtung gemäß den Fig. 3 bis 5,

Fig. 8 einen Vertikalschnitt durch eine dritte Ausführungsform der Temperiervorrichtung und

Fig. 9 einen Horizontalschnitt durch die Temperiervorrichtung gemäß Fig. 8.

Die Fig. 1 und 2 zeigen eine Temperiervorrichtung 1, bei der ein Wärmeaustauschraum 2 zwischen einem Gehäuseformkörper 3 und einer Kupferplatte 4 ausgebildet ist. Die Kupferplatte 4 ist zur flächigen Anlage an einem zu temperierenden Objekt, beispielsweise an einem zu kühlenden elektronischen Bauteil, vorgesehen. In dem Wärmeaustauschraum 2 ist ein Pumpenrad 5 einer Kreiselpumpe angeordnet, das um eine Drehachse 6, welche senkrecht zu einer Wärmehauptübertragungsfläche 7 der Kupferplatte 4 verläuft, drehbar gelagert ist. Zum Antrieb des Pumpenrads 5 sind Permanentmagnete 8 an den äußeren Enden von Schaufeln 9 des Pumpenrads angeordnet, und in den Gehäuseformkörper 3 sind Spulen 10 eingebettet, die zusammen einen Elektromotor 8, 10 ausbilden. Es handelt sich um einen Gleichstrommotor mit fester Drehrichtung, bei der das Pumpenrad 5 eine hier nicht dargestellte Temperierflüssigkeit über einen Zulauf 11 in dem Gehäuseformkörper 3 ansaugt, die Temperierflüssigkeit in dem Wärmeaustauschraum 2 umwälzt und durch einen Ablauf 12 in dem Gehäuseformkörper 3 wieder ausstößt. Dabei verhindert die Bewegung der Schaufeln 9 des Pumpenrads 5 über die Wärmehauptübertragungsfläche 7, dass sich dort eine immobile Grenzschicht der Temperierflüssigkeit ausbildet. Das Pumpenrad 5 ist überdies so relativ zu dem Gehäuseformkörper 3 angeordnet und dimensioniert, dass zwischen ihm und dem Gehäuseformkörper 3 freie Querschnitte 13 und 14 verbleiben, durch die hindurch eine Rückströmung der von den Schaufeln 9 des Pumpenrads 5 beaufschlagten Temperierflüssigkeit erfolgen kann, um eine Verwirbelung der Temperierflüssigkeit in dem Wärmeaustauschraum 2 zu fördern. Der freie Querschnitt 13 liegt dabei auf der der Wärmehauptübertragungsfläche 7 gegenüberliegenden Seite des Pumpenrads 5, während der freie Querschnitt 14 radial außerhalb des Bereichs des Pumpenrads 5 um den Umfang des Pumpenrads 5 herum verläuft und an der Wärmehauptübertragungsfläche 7 seine maximal radiale Ausdehnung aufweist, um eine möglichst große Fläche der Wärmehauptübertragungsfläche 7 mit der Temperierflüssigkeit zu überströmen. Die Fig. 1 und 2 geben weiterhin noch einen Dichtungskanal 15 und Befestigungsbohrungen 16 in dem Gehäuseformkörper 3 wieder. Der Dichtungskanal 15 dient zur Anordnung einer Dichtung zwischen dem Gehäuseformkörper 3 und der Kupferplatte 4. Die Befestigungslöcher 16 dienen zur Befestigung der Temperiervorrichtung 1 an einem zu temperierenden Objekt.

Die Ausführungsform der Temperiervorrichtung 1 gemäß den Fig. 3 bis 5 unterscheidet sich von derjenigen gemäß den Fig. 1 und 2 im wesentlichen darin, dass der Elektromotor 8, 10 nicht im unmittelbaren Bereich des Pumpenrads 5 sondern in einer darüber liegenden Ebene ausgebildet ist. So sind die Permanentmagnete 8 zwar unmittelbar mit dem Pumpenrad 5 verbunden, und sie liegen auch noch in dem

Wärmeaustauschraum 2, so dass keine Wellendurchführung durch den Gehäuseformkörper 3 erforderlich ist, die Permanentmagnete 8 sind aber in einem axialen Bereich der Drehachse 6 vorgesehen, in den die Schaufeln 9 des Pumpenrads 5 nicht hineinragen. Die Spulen 10 des Elektromotors 8, 10 sind daher außerhalb des Gehäuseformkörpers 3 angeordnet und in eine separate oder mit dem Gehäuseformkörper 3 dauerhaft verbundenen weiteren Formkörper 17 eingegossen. Die Spulen 10 weisen hier zusätzlich zu Kernen 18 auch noch einen gemeinsamen Rückschlussring 19 auf, der ebenfalls in den Formkörper 17 eingedeckt ist.

Fig. 5 ist eine Ansicht der Temperiervorrichtung gemäß den Fig. 3 und 4 von oben, wobei in dieser Ansicht auch eigentlich verdeckte innere Bauteile der Temperiervorrichtung 1 wiedergegeben sind. Weiterhin ist die bauliche Ausführung des Zulaufs 11 und des Ablaufs 12 gezeigt, die mit Leitungsschnellverbindern 20 ausgestattet sind. Über die Leitungsschnellverbinder 20 sind eine Zulaufleitung 21 und eine Ablaufleitung 22 angeschlossen, die über einen Wärmetauscher 23 in Form eines Radiators 24 miteinander verbunden sind. Weiterhin ist in Fig. 5 schematisch angedeutet, dass eine Steuerung 25 aufgrund eines Temperatursignals 26 von einem Temperatursensor 27 ein Ansteuersignal 28 für die Spulen 10 des Elektromotors 8, 10 generiert. Bei der Steuerung 25 kann es sich um einen Teil eines Rechners handeln, bei dem die Temperiervorrichtung 1 zur Kühlung eines elektronischen Bauteils, beispielsweise des Hauptprozessors des Rechners dient. Dabei können die Signale 26, 28 über geeignete Schnittstellen des Rechners geführt werden.

Fig. 6 zeigt eine Alternative bezüglich der Anordnung des Zulaufs 11 und des Ablaufs 12 zu dem Pumpenrad 5. Auch hier mündet der Zulauf 11 tangential in den Bereich des Pumpenrads 5, d.h. den Wärmeübertragungsraum 2 ein, und der Ablauf 12 tritt tangential aus dem Wärmeübertragungsraum 2 aus. Sie sind aber nicht an derselben Seite des Gehäuseformkörpers 3 sondern an die gegenüberliegenden Seiten vorgesehen.

Fig. 7 skizziert demgegenüber den Fall, in dem der Zulauf 11 und der Ablauf 12 an aneinander angrenzenden Seiten des Gehäuseformkörpers 3 angeordnet sind. Einen grundsätzlichen Funktionsunterschied zwischen den bisher beschriebenen Varianten bei der Anordnung des Zulaufs 11 und des Ablaufs 12 gibt es aber nicht.

Eine diesbezügliche Variante ist aber bei der Ausführungsform gemäß den Fig. 8 und 9 gegeben. Hier verläuft der Zulauf 11 axial in Richtung der Drehachse 6 von oben auf die Wärmehauptübertragungsfläche 7, aber zunächst an den Permanentmagneten 8 oberhalb des Pumpenrads 5 vorbei in den Wärmeaustauschraum 2. Der Ablauf 12 ist radial zu der Drehachse 6 im Bereich des Pumpenrads 5 angeordnet. Diese Anordnung des Zulaufs 11 und des Ablaufs 12 hat den Vorteil, dass unabhängig von der Drehrichtung des Pumpenrads 5 eine vorgegebene Förderrichtung der Temperierflüssigkeit durch den Wärmeaustauschraum 3 vorgegeben ist. Um den Zulauf 11 zu realisieren, sind um eine obere Führung 29 für eine Lagerstange 30, auf der das Flügelrad 5 und die Permanentmagnete 8 drehbar gelagert sind, Durchbrechungen 31 in dem Gehäuseformkörper 3 vorgesehen. Die Durchbrechungen 31 sind Teil des Zulaufs 11 für die Temperierflüssigkeit.

BEZUGSZEICHENLISTE

1 - Temperiervorrichtung
2 - Wärmeaustauschraum
3 - Gehäuseformkörper
4 - Kupferplatte
5 - Pumpenrad
6 - Drehachse
7 - Wärmehauptübertragungsfläche
8 - Permanentmagnet
9 - Schaufel
10 - Spule
11 - Zulauf
12 - Ablauf
13 - freier Querschnitt
14 - freier Querschnitt
15 - Dichtungskanal
16 - Befestigungsbohrung
17 - Formkörper
18 - Kern
19 - Rückschlussring
20 - Leitungsschnellverbinder
21 - Zulaufleitung
22 - Ablaufleitung
23 - Wärmetauscher
24 - Radiator
25 - Steuerung
26 - Temperatursignal
27 - Temperatursensor
28 - Ansteuersignal
29 - Führung
30 - Lagerstange
31 - Durchbrechung

SCHUTZANSPRÜCHE:

1. Temperiervorrichtung mit einem Wärmeaustauschraum und mit einer ein Pumpenrad aufweisenden Kreiselpumpe zum Pumpen einer Temperierflüssigkeit durch den Wärmeaustauschraum, **dadurch gekennzeichnet**, dass das Pumpenrad (5) in dem Wärmeaustauschraum (2) angeordnet ist.

2. Temperiervorrichtung nach Anspruch 1, **dadurch gekennzeichnet**, dass eine Drehachse (6) des Pumpenrads (5) senkrecht zu einer den Wärmeaustauschraum (2) begrenzenden Wärmehauptübertragungsfläche (7) angeordnet ist.

3. Temperiervorrichtung nach Anspruch 2, **dadurch gekennzeichnet**, dass das Pumpenrad (5) direkt an die Wärmehauptübertragungsfläche (7) angrenzt, während der Wärmeaustauschraum (2) auf der gegenüberliegenden Seite des Pumpenrads (5) einen freien Querschnitt (13) aufweist.

4. Temperiervorrichtung nach Anspruch 2 oder 3, **dadurch gekennzeichnet**, dass der Wärmeaustauschraum (2) um den Umfang des Pumpenrads (5) herum einen freien Querschnitt (14) aufweist, der angrenzend an die Wärmehaupt-übertragungsfläche (7) einen Bereich mit vergrößerter radialer Ausdehnung umfasst.

5. Temperiervorrichtung nach einem der Ansprüche 2 bis 4, **dadurch gekennzeichnet**, dass in der Wärmehauptübertragungsfläche (7) Rückstromkanäle vorgesehen sind.

6. Temperiervorrichtung nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet**, dass Permanentmagnete (8) eines das Pumpenrad antreibenden Elektromotors (8, 10) in dem Wärmeaustauschraum (2) angeordnet sind.

7. Temperiervorrichtung nach Anspruch 6, **dadurch gekennzeichnet**, dass die Permanentmagnete (8) und das Pumpenrad (5) auf einer gemeinsamen Welle angeordnet sind.

8. Temperiervorrichtung nach Anspruch 7, **dadurch gekennzeichnet**, dass die Permanentmagnete (8) in Schaufeln (9) des Pumpenrads (5) angeordnet sind.

9. Temperiervorrichtung nach einem der Ansprüche 1 bis 8, **dadurch gekennzeichnet**, dass ein Zulauf (11) und ein Ablauf (12) für die Temperierflüssigkeit aus entgegengesetzten tangentialen Richtungen zur Drehachse (6) des Pumpenrads in den Wärmeaustauschraum (2) einmünden.

10. Temperiervorrichtung nach einem der Ansprüche 1 bis 8, **dadurch gekennzeichnet**, dass ein Zulauf (11) für die Temperierflüssigkeit an der Drehachse (6) des Pumpenrads (5) und ein Ablauf (12) für die Temperierflüssigkeit in radialer Richtung zu der Drehachse (6) in den Wärmeaustauschraum (2) einmündet.

11. Temperiervorrichtung nach einem der Ansprüche 2 bis 5, **dadurch gekennzeichnet**, dass der Wärmeaustauschraum (2) zwischen der Wärmehauptübertragungsfläche (7) und einem Gehäuseformkörper (3) aus Kunststoff ausgebildet ist.

12. Temperiervorrichtung nach Anspruch 11, **dadurch gekennzeichnet**, dass die Wärmehauptübertragungsfläche (7) an einer mit dem Gehäuseformkörper (3) verbundenen Kupferplatte (4) vorgesehen ist.

13. Temperiervorrichtung nach einem der Ansprüche 2 bis 5, 11 und 12, **dadurch gekennzeichnet**, dass ein Temperatursensor für die Regelung der Drehzahl des Pumpenrads an der Wärmehauptübertragungsfläche vorgesehen ist.

14. Temperiervorrichtung nach Anspruch 13, **dadurch gekennzeichnet**, dass der Temperatursensor (27) und ein Elektromotor (8, 10) des Pumpenrads (5) an Schnittstellen eines Rechners angeschlossen sind, bei dem die Temperiervorrichtung (1) zur Kühlung eines elektronischen Bauteils dient.

15. Temperiervorrichtung nach einem der Ansprüche 1 bis 14, **dadurch gekennzeichnet**, dass der Wärmeaustauschraum (2) über Zulauf- und Ablaufleitungen (21, 22) an einen passiven Wärmetauscher (23) für die Temperierflüssigkeit angeschlossen ist.

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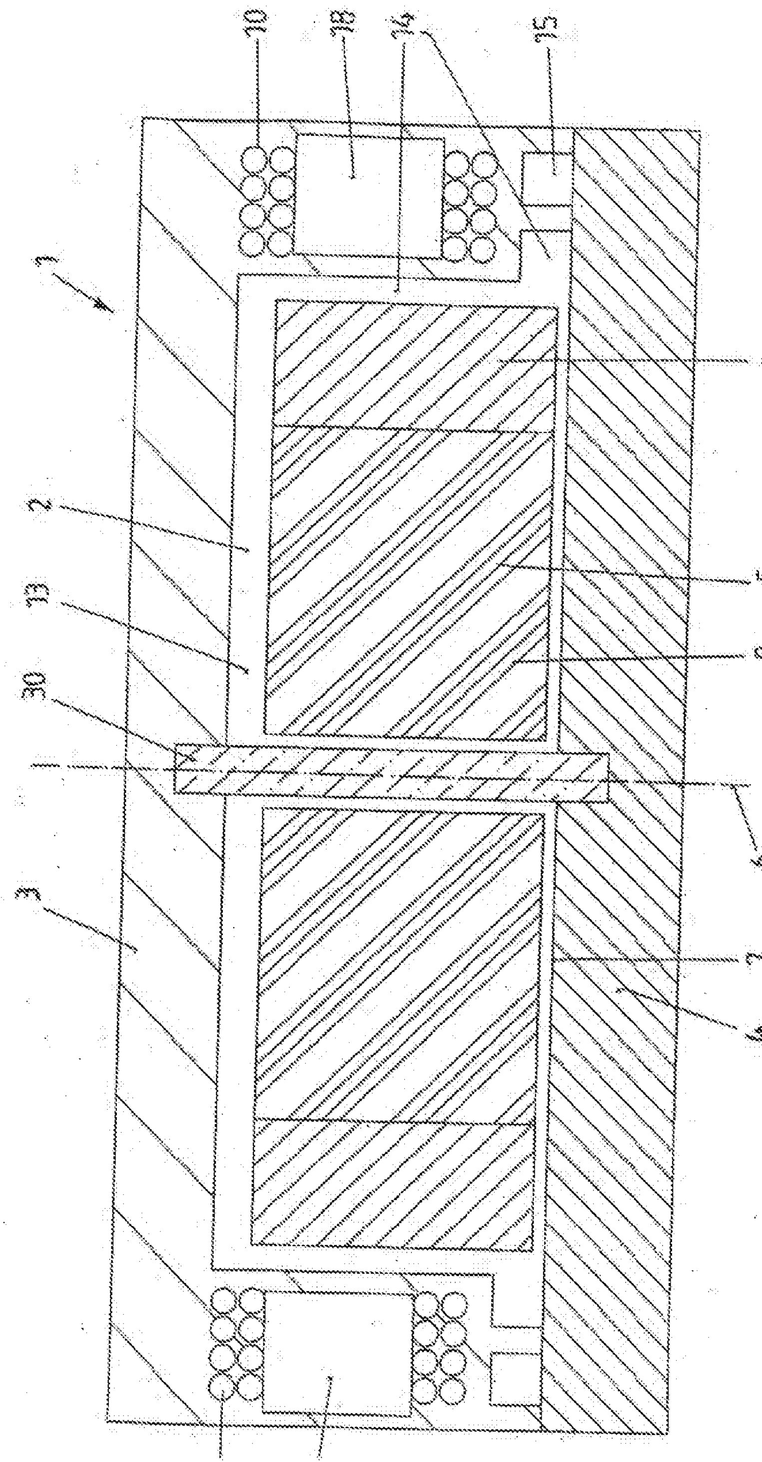

Fig. 1

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Fig. 2

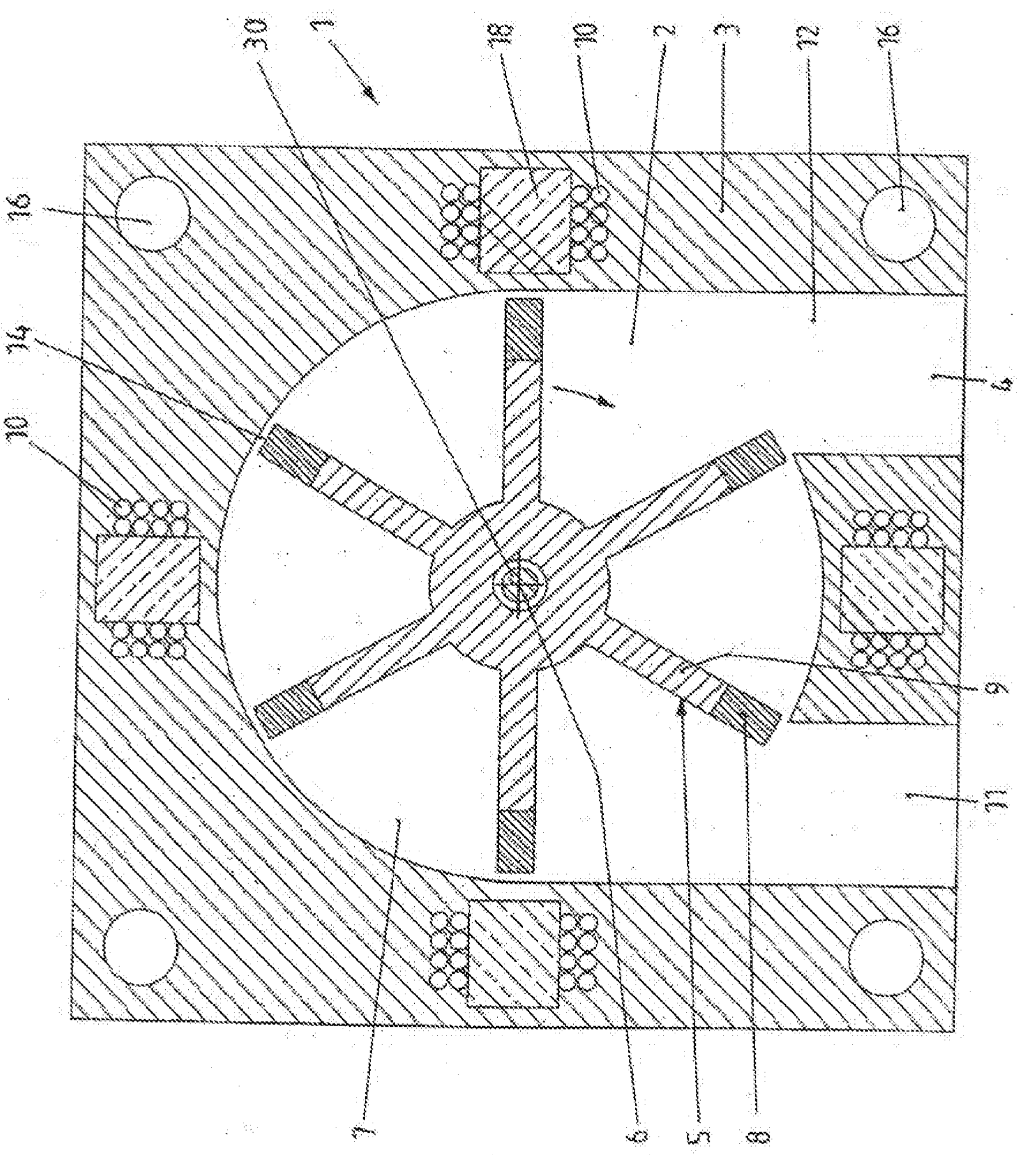

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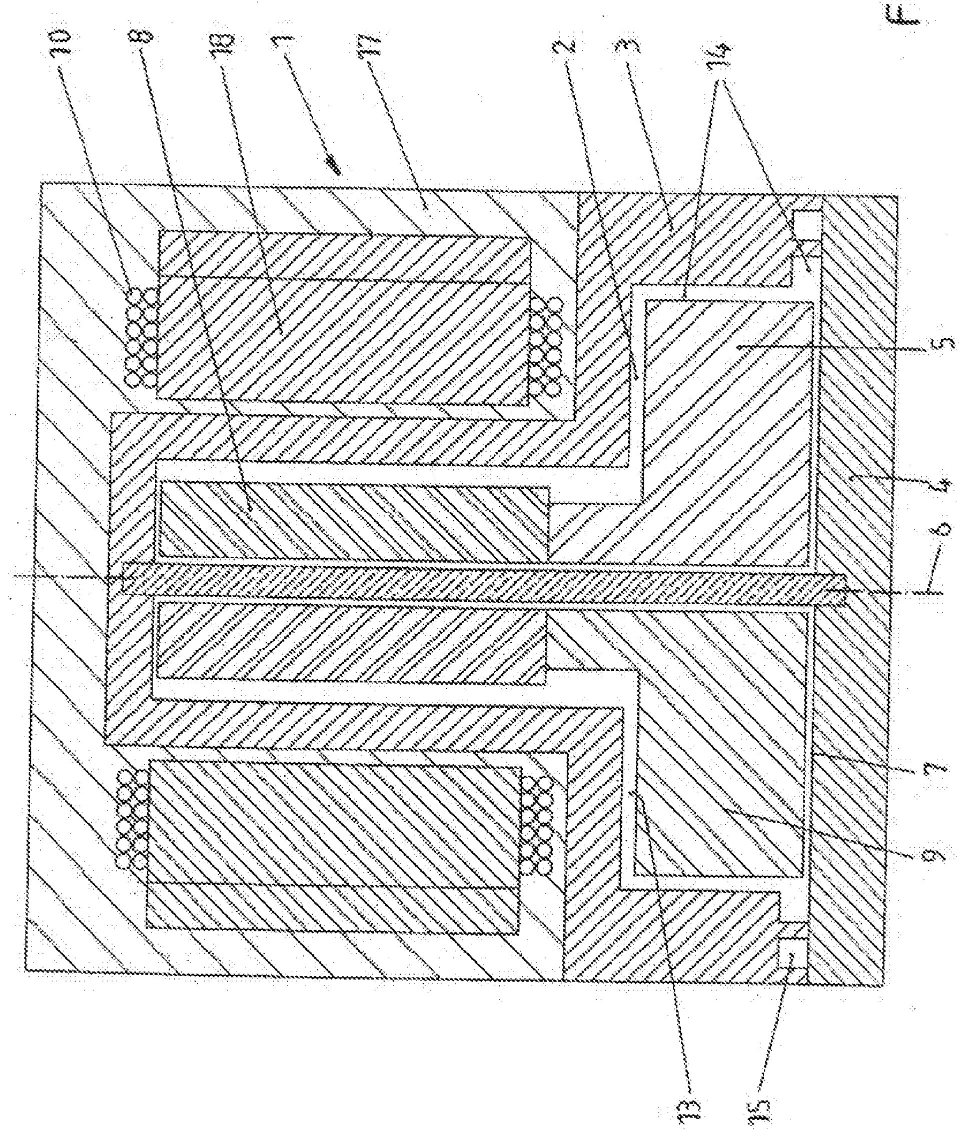
Fig. 3



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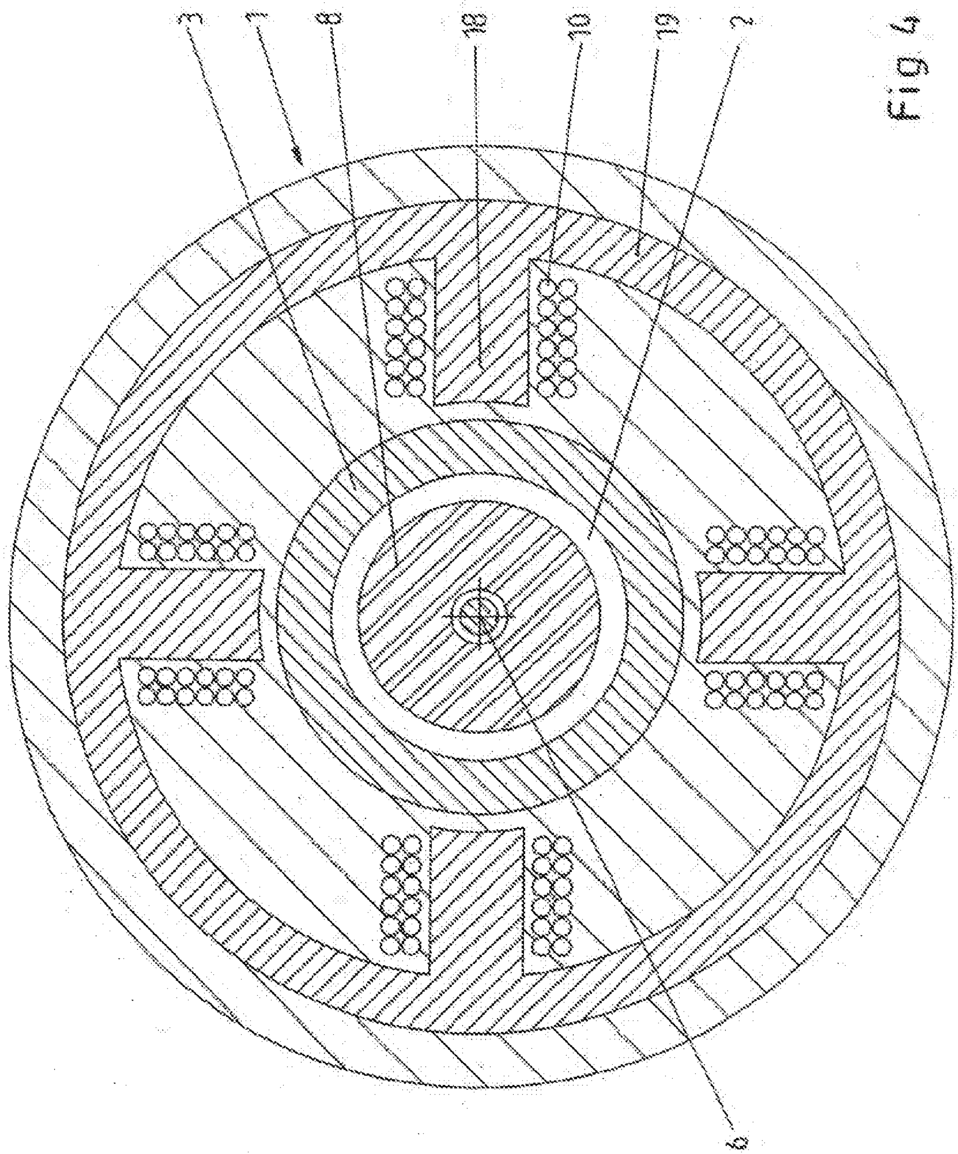

Fig 4

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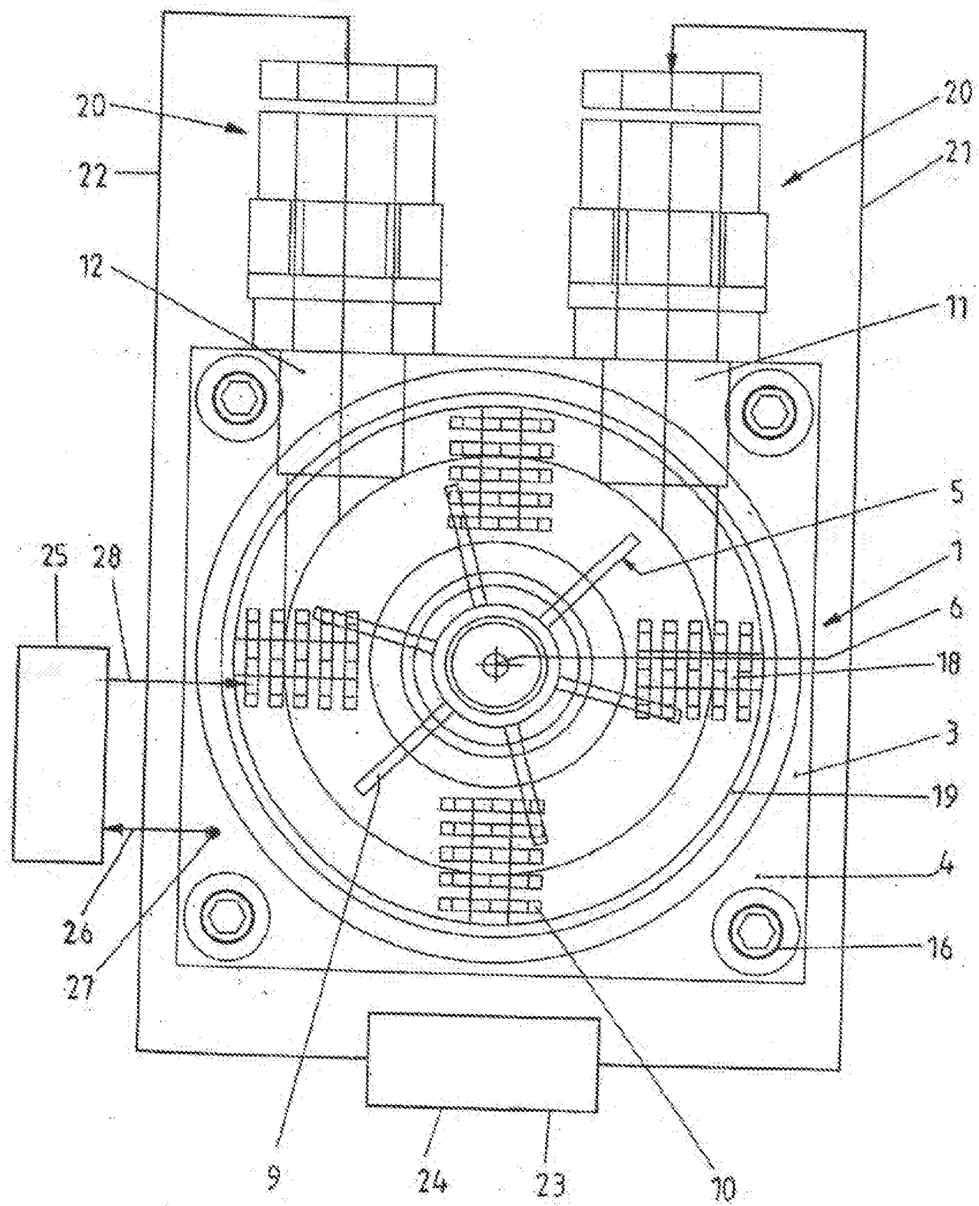

Fig. 5

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Fig. 6

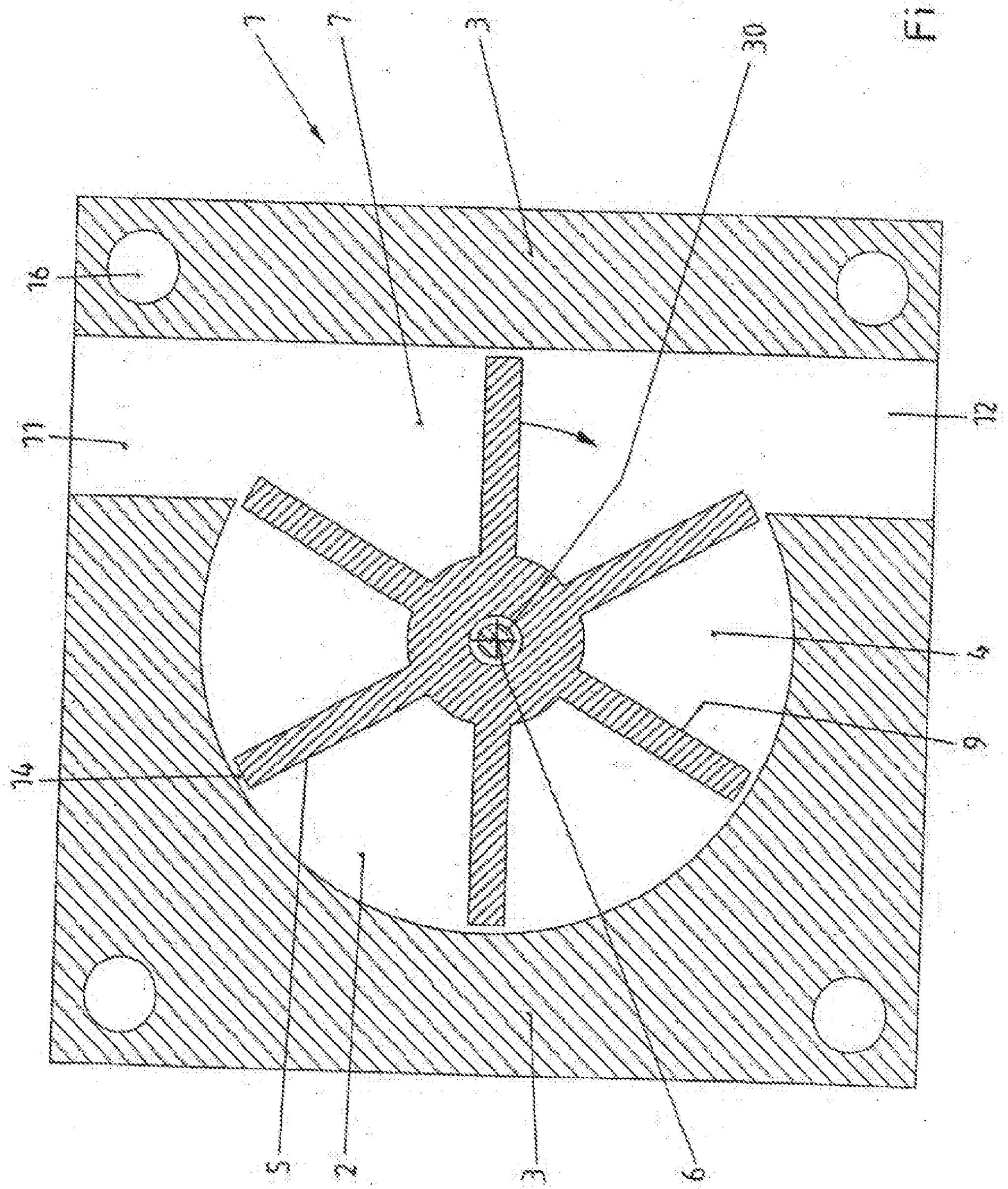

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Fig. 7

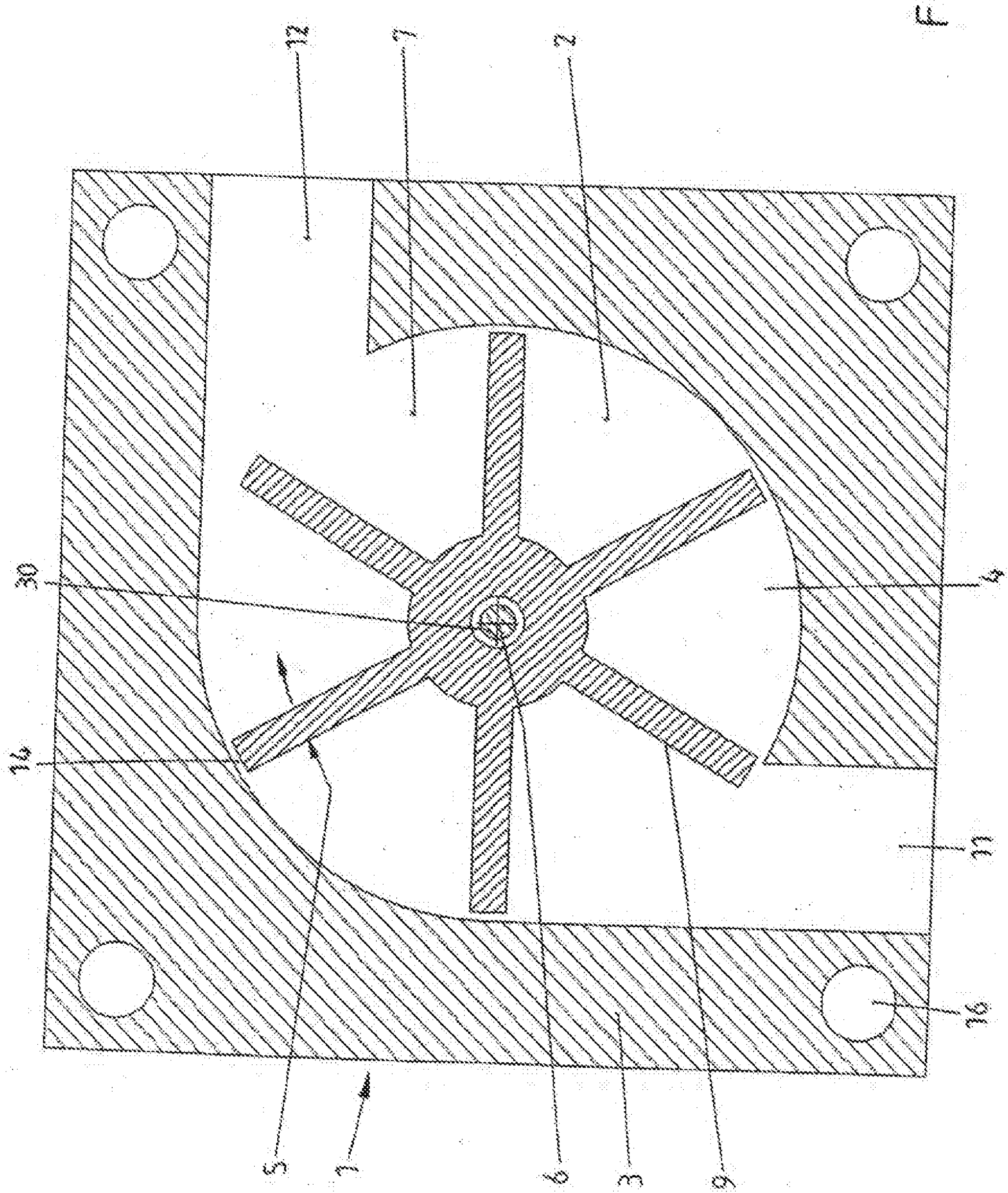

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Fig.8

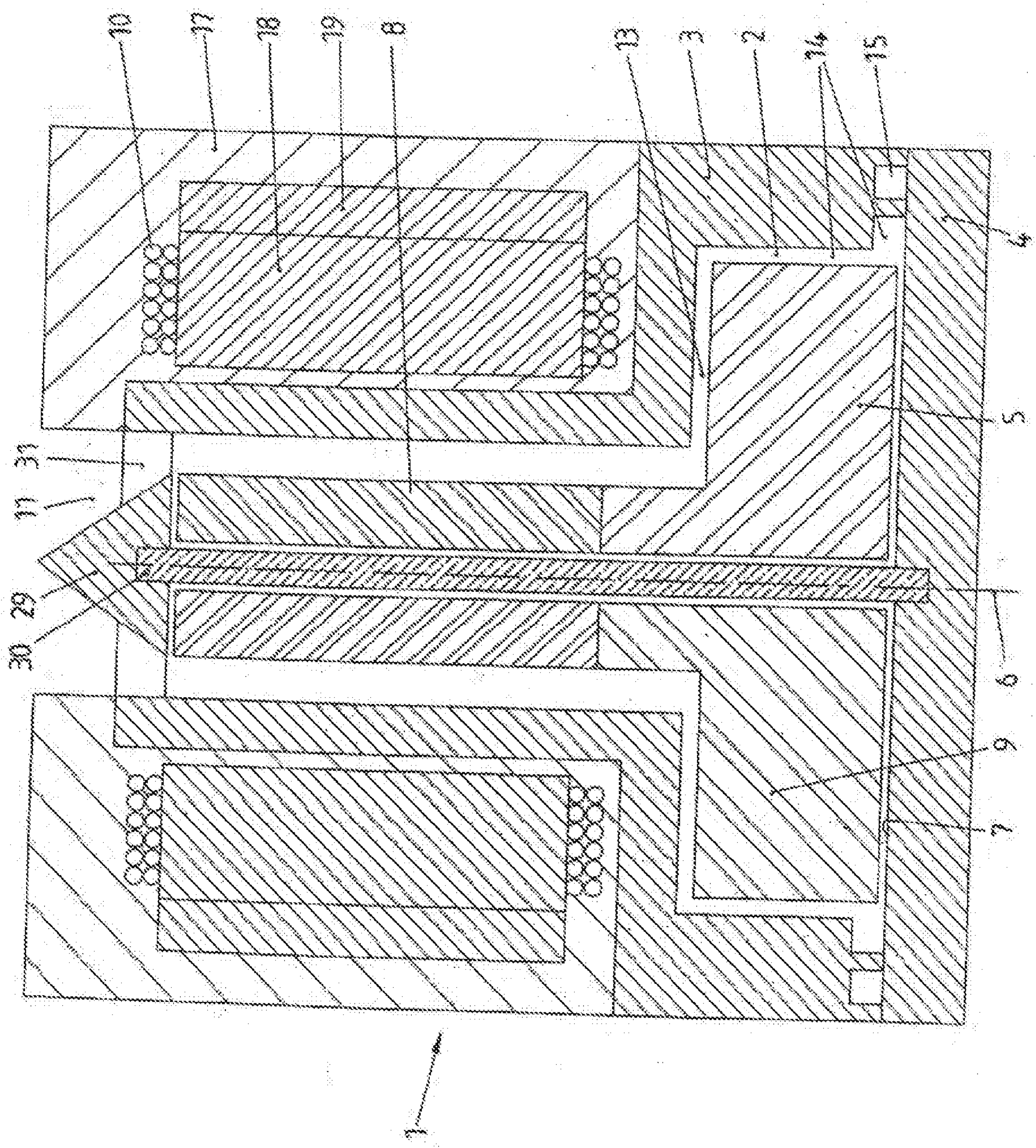

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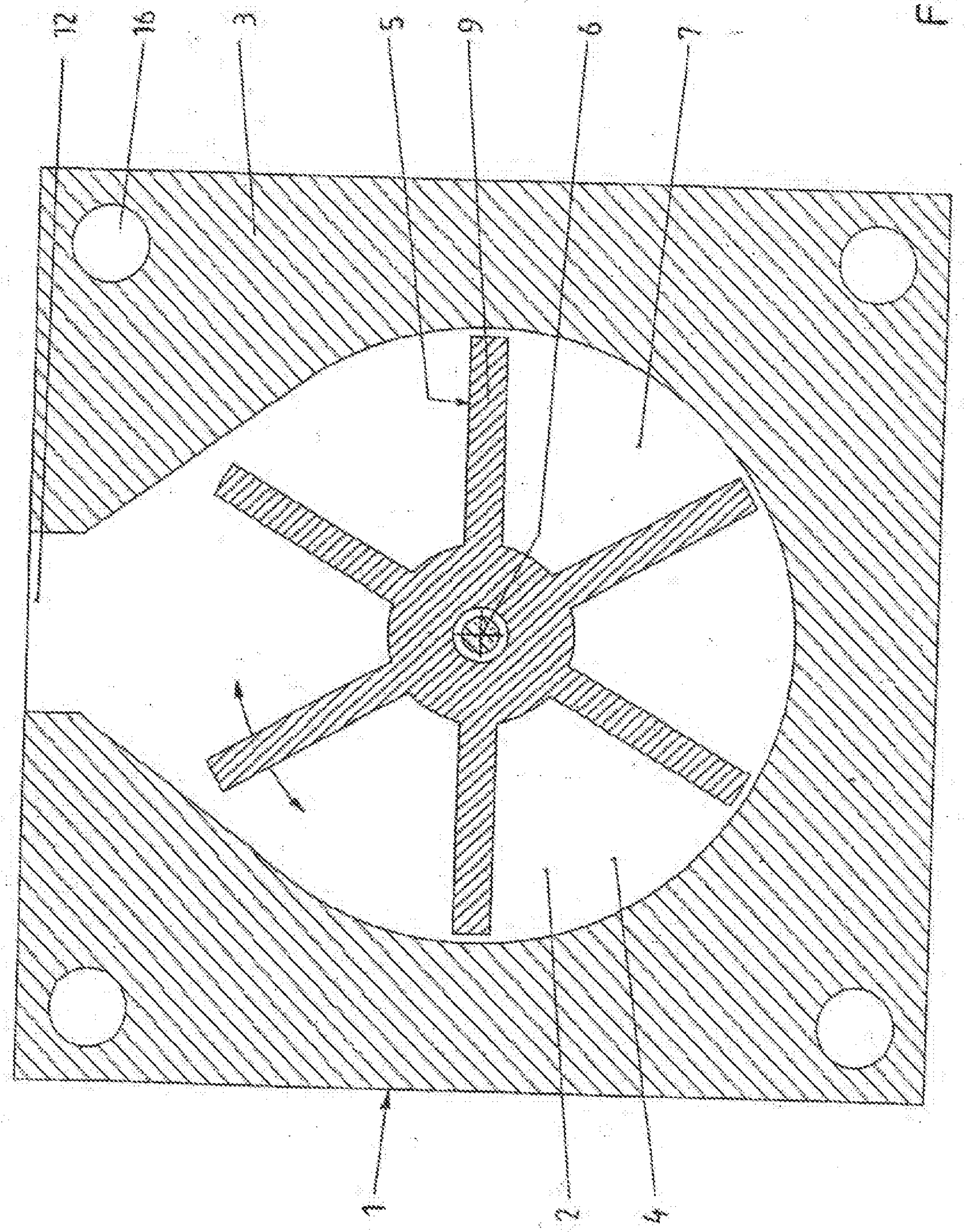
Fig. 9



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Espacenet

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COOLER FOR ELECTRONIC EQUIPMENT

No documents available for this priority number.

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Classification:	- **international:** ***F25D9/00; H01L23/473; H05K7/20;*** (IPC1-7): H01L23/473; H05K7/20 - **cooperative:** F28F2250/08
Application number:	JP20000345470 20001108
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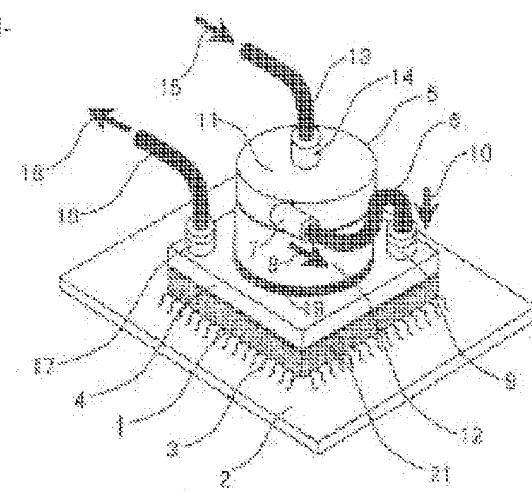
Abstract of JP2002151638 (A)

PROBLEM TO BE SOLVED: To provide a cooling structure for mounting in compact manner a liquid-cooled heat sink and a pump in a housing. SOLUTION: The pump 5 is mounted on the upper part of the liquid-cooled heat sink 4. The structure in which the pump 5 is integrated with the heat sink 4, to be handled as an integral structure. A liquid cooling system can be mounted compactly in an electronic equipment housing. Thus, the liquid cooling system having a high cooling performance, low noise and high reliability can be realized, without greatly changing the present air-cooled type electronic equipment housing structure.

図 1



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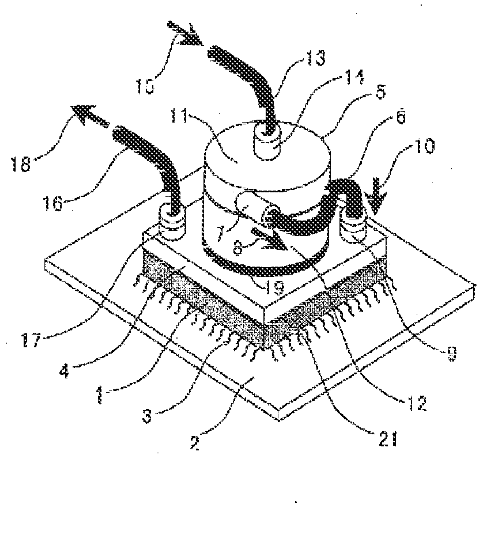
Ｆターム(参考)　5E322 AA07 AA11 AB02 AB06 DA01
FA01 FA05
5F036 AA01 BA05 BB01 BB43 BC35

(54)【発明の名称】　電子機器の冷却装置

(57)【要約】　（修正有）
【課題】液体冷却ヒートシンクとポンプとを筐体内にコンパクトに実装するための冷却構造。
【解決手段】ポンプ５が液体冷却ヒートシンク４の上部に搭載され、ポンプ５と液体冷却ヒートシンク４とを一体構造として取扱える構造にし、液体冷却システムを電子機器筐体内にコンパクトに搭載でき、現状の空冷方式の電子機器筐体構造を大きく変えることなく、冷却性能が高く、かつ低騒音で、信頼性の高い液体冷却システムを実現できる。

図　１



【特許請求の範囲】

【請求項１】配線基板と、該配線基板上に搭載されたＬＳＩ等の電子回路部品を含む発熱体と、該発熱体上に熱的に接触して搭載された液体冷却ヒートシンクと、液体冷媒を加圧して循環させるポンプとからなる電子機器の冷却装置であって、該ポンプが該液体冷却ヒートシンクの上部に搭載されることを特徴とする電子機器の冷却装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、配線基板上に搭載されたＬＳＩ等の発熱電子回路部品を、液体冷却するための冷却構造に係り、特に液体冷却ヒートシンクとポンプとをコンパクトに実装するための冷却構造に関する。

【０００２】

【従来の技術】近年、コンピュータや通信機器、マルチメディア機器等に代表される電子機器の発熱量は著しく増加する傾向にあり、特に演算処理を集中して行うＣＰＵや、画像処理用ＬＳＩ、パワーアンプ等の冷却は非常に重要な課題となってきた。

【０００３】また、冷却方式としては、従来から、空冷フィンとファンを組合せた空冷方式が数多く用いられてきた。しかしながら、空冷方式は、液冷方式に比較して冷却限界が低いため、最近、ＣＰＵ等の高発熱ＬＳＩのみを水等の液体冷媒により液冷する方式が検討されている。

【０００４】例えば、特開平8−32262号公報には、図4に示すような液冷方式が開示されている。発熱量の大きくない空冷可能なＬＳＩ５１と、発熱量が大きいため水冷ヒートシンク４０で冷却されるＬＳＩとが、同じ配線基板５０上に搭載されている。空冷可能なＬＳＩ５１は２つのファン４７により空冷される。冷却空気は４８に示すように外部から供給され、４９に示すように排気される。発熱量の大きいＬＳＩに搭載された水冷ヒートシンク４０はホース４１でを介して出口配管４２に連結され、４０で温められた冷却水は熱交換器４３においてファン４７の空気により冷却される。冷却された冷却水は冷媒配管４４を経由してポンプ４５に流れ、加圧された後に入口配管４６を通って再び水冷ヒートシンク４０に供給される。

【０００５】

【発明が解決しようとする課題】特開平8−32262号公報に開示された冷却構造では、ポンプ４５が配線基板５０や水冷ヒートシンク４０と離れて設置されているため、ポンプ４５を実装するスペースとポンプ４５に接続する配管スペースが筐体内に別途必要となり、電子機器筐体をコンパクトにすることができないという問題点があった。

【０００６】本発明の目的は、コンパクトで、低騒音で、冷却性能に優れ、かつ信頼性の高い電子機器の冷却構造を提供することである。

【０００７】

【課題を解決するための手段】上記目的を達成するため、本発明では、配線基板と、配線基板上に搭載されたＬＳＩ等の電子回路部品を含む発熱体と、発熱体上に熱的に接触して搭載された液体冷却ヒートシンクと、液体冷媒を加圧して循環させるポンプとからなる電子機器の冷却装置を前提とし、ポンプが液体冷却ヒートシンクの上部に搭載される構造とした。

【０００８】また、ポンプが液体冷却ヒートシンクの上部に固定され、さらにポンプと液体冷却ヒートシンクとを一体構造として取扱える構造とした。

【０００９】また、ポンプの液体冷媒吐出し部が液体冷却ヒートシンクに配管等で直接連結された構造とした。

【００１０】さらに、ポンプが直流電源で動作する構成とした。

【００１１】さらに、ポンプが振動吸収部材等を介して液体冷却ヒートシンクに固定される構造とした。

【００１２】

【発明の実施の形態】本発明の第一の実施例について図１を用いて説明する。ＬＳＩ等の電子回路部品を含む発熱体１は、配線基板２上に配線用ピン３や半田ボール等を介して電気的に接続されて搭載されている。発熱体１は、例えばコンピュータ用のＣＰＵや、画像処理用ＬＳＩ、ＦＥＴパワーアンプ等である。発熱体１上には、発熱体１を液冷するための液体冷却ヒートシンク４が、熱伝導コンパウンド２１や熱伝導グリース、または熱伝導シート等を介して熱的に接続されて搭載されている。さらに、液体冷却ヒートシンク４の上部には、液体冷媒を加圧して循環させるポンプ５が搭載されている。

【００１３】本実施例では、ポンプ５が振動吸収部材１９を介して液体冷却ヒートシンク４に固定される構造を採っている。そのためポンプ５の振動が直接ＣＰＵ等の電子部品に影響を及ぼし難い構造となっている。ポンプ５はフレキシブルなホース６により液体冷却ヒートシンク４と接続されている。ホース６は一端がポンプ５の冷媒吐出し部カプラ７に接続され、他端が液体冷却ヒートシンク４の給水カプラ９に接続されており、加圧された液体冷媒は８のように流れた後に１０のように直接液体冷却ヒートシンク４に流入する。液体冷媒は、液体冷却ヒートシンク４内に流入した後に、ヒートシンク内に構成された複数の流路に別れて蛇行状に流れ、発熱体１の熱を吸収する。加熱された液体冷媒は排水カプラ１７、ホース１６を経て、液体冷媒を冷却する熱交換部（図示せず）に１８に示すように流れる。熱交換部で冷却された液体冷媒は、１５のように戻ってきて、ホース１３、冷媒吸込み部カプラ１４を介してポンプ５に吸込まれ、再び加圧されて液体冷却ヒートシンク４に供給される。

【００１４】なお、前述したカプラ７，９，１４，１７によってホース６，１３，１６は脱着が容易になってい

るため、組立て性やメンテナンス性が良い構造を実現している。

【0015】上記のように、ポンプ５が液体冷却ヒートシンク４の上部に搭載される構造とすることにより、ポンプ５を別途設置するスペースを電子機器筐体内に用意する必要が無くなり、またポンプから液体冷却ヒートシンク４までのホースを短くできるので、液体冷却システムを電子機器筐体内にコンパクトに搭載できる。そのため、現状の空冷方式の電子機器筐体構造を大きく変えることなく、冷却性能が高く、かつ低騒音の液体冷却システムを搭載することが可能となる。

【0016】また、ポンプ５が液体冷却ヒートシンク４の上部に固定され、ポンプと液冷ヒートシンクとを一体構造として取扱えるようにすると、組立て時の部品点数が低減し、さらに、現状パソコン等で多用されているファン付き空冷ヒートシンクの代わりに、このポンプと液冷ヒートシンクの一体部品キットを組付けることができるため、液体冷却システムを無理なく電子機器に導入可能である。

【0017】また、ポンプ５の冷媒吐出し部７が液体冷却ヒートシンク４の給水カプラ９に配管等で直接連結された構造とした。そのため、ポンプ５から液体冷却ヒートシンク４までのホースを非常に短くできるので、ホースでの液体冷媒の流動損失を小さくでき、その結果ポンプ５の揚程能力を小さくでき、最終的にモータの能力をより小さくし、ポンプを小型化することができる。

【0018】ポンプ５は羽根車ケース１１とモータ１２から構成される。本実施例において、ポンプ５は羽根車ケース１１内に設置された羽根車を回転させて液体冷媒を加圧する遠心型の例を示したが、ダイヤフラムなどを用いて機械的容積変化により液体冷媒を加圧する容積型ポンプであっても良い。また、本実施例においては、モータと羽根車の軸が液体冷却ヒートシンク４の上面にほぼ垂直になるように搭載されており、よって、モータの底面が液体冷却ヒートシンク４の上面に振動吸収部材１９を介して面同士で接合されるため、モータの座りが良い構造を実現できる。

【0019】モータ１２は直流電源で駆動するＤＣモータである。ＤＣモータとすることにより、ＤＣ電圧を変化させて容易にモータの回転数を変えられるので、冷却能力の制御も可能になる。さらに、モータをＤＣブラシレスモータとすることにより、低騒音でかつ高寿命のポンプを実現することができる。

【0020】液体冷媒の流量が 0.1（リットル／分）のオーダーのように比較的小さい場合には、駆動電圧を例えば 1～1.5（Ｖ）程度の乾電池でも駆動可能なものとすれば、ポンプのバッテリー駆動が可能となり、信頼性の高い液体冷却システムを構築できる。また、液体冷媒の流量が１（リットル／分）のオーダーのように比較的大きい場合には、駆動電圧を例えば２～１２（Ｖ）程度の電子機器のＤＣ電源で供給可能な電圧とすると、ポンプ用の専用電源を用意する必要がないためコンパクトで安価に液体冷却システムを構築できる。ただし、本発明は、モータ１２を必ずしもＤＣモータに限定するものではなく、例えば１００（Ｖ）や 200（Ｖ）の交流電源で駆動するＡＣモータであっても構わない。

【0021】液体冷媒は入手が容易な水が良く、特に純水であると熱容量が大きいので冷却性能を高くでき、さらに腐食に強く、不純物が流路内に堆積し難いので信頼性の高い液体冷却システムを実現することができる。また、液体冷媒として、水にエチレングリコール等を添加した不凍液を使えば、寒冷時の液体冷媒凍結による流路部破損を防止できる。また、液体冷媒にパーフルオロカーボン等の非電導性冷媒を使えば、万一の液漏れ時にも電子回路のショート等の事故を防ぐことができる。

【0022】本発明の第二の実施例について図２を用いて説明する。本実施例においては、モータ５と羽根車の軸が液体冷却ヒートシンク４の上面にほぼ平行になるように搭載されている。それにより、モータ出力が高く、そのためモータの軸方向長さが長い高出力ポンプでも、液体冷却ヒートシンク４上にコンパクトに搭載できる。本実施例では、ポンプ５は液体冷却ヒートシンク４上にブラケット２０で固定されている。ブラケット２０は、材質が振動吸収部材であるか、その一部に振動吸収部材を用いることにより、ポンプ５の振動が直接ＣＰＵ等の電子部品に影響を及ぼし難い構造とすることができる。第二の実施例は、上記以外は第一の実施例と同様である。

【0023】本発明の第三の実施例について図３を用いて説明する。本実施例は、第一の実施例で示したポンプと液冷ヒートシンク一体型の液体冷却システムを、実際の電子機器筐体内に搭載した例を示している。

【0024】ＬＳＩ等の発熱体１は、マザーボードである配線基板２上に搭載されている。発熱体１上には、発熱体１を液冷するための液体冷却ヒートシンク４が搭載されている。さらに、液体冷却ヒートシンク４の上部には、ポンプ５が搭載されている。配線基板２上には、発熱体１以外に、メモリＬＳＩやドライバＬＳＩなどの空冷で冷却可能な発熱体２２ａ，２２ｂ，２２ｃや、ＩＯカード、メモリカード、ハードディスク等のカード実装基板２３等が搭載されている。配線基板２は、電子機器筐体のケース２４内に収められている。ケース２４には空冷用のファン３４が取付けられており、前記多数の空冷部品を冷却風２５で空冷している。

【0025】液体冷却ヒートシンク４で加熱された液体冷媒は、ホース１６で１８に示すように流れ、筐体ケースの側板３２に取付けられた熱交換器２７に接続カプラ２６を介して接続される。本実施例では、熱交換器２７の配管が側板３２に熱的に接触して取付けられており、液体冷媒は熱交換器内で２８や２９のように蛇行しなが

ら上方へ流れる。液体冷媒の熱は側板３２全体に熱伝導により広げられた後に、電子機器筐体周囲の自然対流による空気流３３やファン３４による冷却風２５により放熱される。

【００２６】冷却された液体冷媒は、３０のように流れ、接続カプラ３１を介して戻り側のホース１３に接続され、１５のようにポンプ５に戻り、再び加圧されて液体冷却ヒートシンク４に供給される。

【００２７】側板３２と熱交換器２７の構成方法の一例として、側板３２をアルミニウムやマグネシウムや銅等の金属材料で構成し、さらに熱交換器の配管を金属材料で構成し、両者をろう付けや半田付け等の金属接合や熱伝導性接着剤等で接続する方法がある。この場合、熱伝導を良好にできるので、液体冷却システムの冷却性能を向上させることができる。また、２枚の金属板を熱交換器の蛇行流路を空けた状態で接合させて、側板と熱交換器を一体成形するロールボンド等の製法を用いれば、より安価に熱交換器を製造できる。ただし、側板３２が樹脂製等の非金属材料であったり、熱交換器２７の配管が非金属材料であっても、本発明の効果は実現できるものである。

【００２８】以上から、本実施例の構成とすることにより、ポンプ５を別途設置するスペースを電子機器筐体内に用意する必要が無くなり、またポンプから液体冷却ヒートシンク４までのホースを短くできるので、液体冷却システムを電子機器筐体内にコンパクトに搭載できる。

【００２９】さらに、現状の空冷方式の電子機器筐体構造を大きく変えることなく、熱交換器２７を備えた側板３２と、ポンプ一体型液冷ヒートシンクと、２本の接続ホース１３，１６を追加するだけで、冷却性能が高く、かつ低騒音の液体冷却システムを実現することが可能となる。

【００３０】また、現状パソコン等で多用されているファン付き空冷ヒートシンクの代わりに、このポンプと液冷ヒートシンクの一体部品キットを組付けることができるため、液体冷却システムを無理なく電子機器に導入可能である。ポンプの電源がファン付き空冷ヒートシンクのファン用電源と互換性があれば、さらに導入が容易となることは言うまでもない。

【００３１】

【発明の効果】以上説明したように、本発明によれば、第一に、液体冷却システムを電子機器筐体内にコンパクトに搭載できる。

【００３２】第二に、現状の空冷方式の電子機器筐体構造を大きく変えることなく、冷却性能が高く、かつ低騒音で、信頼性の高い液体冷却システムを搭載することができる。

【００３３】第三に、組立て時の部品点数が低減し、かつ、ファン付き空冷ヒートシンクの代わりに、ポンプと液冷ヒートシンクの一体部品キットを組付けることができるため、液体冷却システムを無理なく電子機器に導入できる。

【００３４】第四に、ポンプの揚程能力を小さくでき、モータの能力をより小さくし、小型化できる。

【００３５】第五に、ポンプの回転数を変化させて冷却能力を制御可能な液体冷却システムとすることができる。

【図面の簡単な説明】

【図１】本発明の第一の実施例である電子機器の冷却装置の斜視図。

【図２】本発明の第二の実施例である電子機器の冷却装置の斜視図。

【図３】本発明の第三の実施例である電子機器の冷却装置の斜視図。

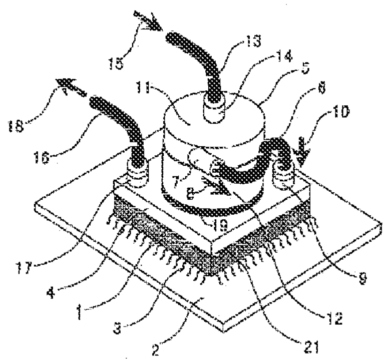
【図４】従来例の電子機器の冷却装置を示す斜視図。

【符号の説明】

１…発熱体、２…配線基板、３…配線用ピン、４…液体冷却ヒートシンク、５…ポンプ、６…ホース、７…冷媒吐出し部カプラ、８…液体冷媒の流れ、９…給水カプラ、１０…液体冷媒の流れ、１１…羽根車ケース、１２…モータ、１３…ホース、１４…冷媒吸込み部カプラ、１５…液体冷媒の流れ、１６…ホース、１７…排水カプラ、１８…液体冷媒の流れ、１９…振動吸収部材、２０…ブラケット、２１…熱伝導性コンパウンド、２２ａ…空冷で冷却可能な発熱体、２２ｂ…空冷で冷却可能な発熱体、２２ｃ…空冷で冷却可能な発熱体、２３…カード実装基板、２４…電子機器筐体のケース、２５…冷却風、２６…接続カプラ、２７…熱交換器、２８…蛇行する液体冷媒の流れ、２９…蛇行する液体冷媒の流れ、３０…液体冷媒の流れ、３１…接続カプラ、３２…側板、３３…空気流、３４…ファン、４０…水冷ヒートシンク、４１…ホース、４２…出口配管、４３…熱交換器、４４…冷媒配管、４５…ポンプ、４６…入口配管、４７…ファン、４８…冷却空気、４９…冷却空気、５０…配線基板、５１…空冷可能なＬＳＩ。

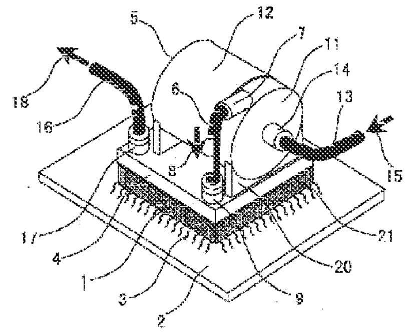
【図1】

図 1



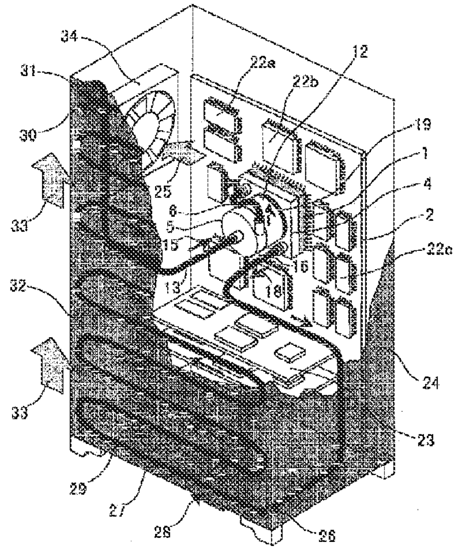
【図2】

図 2



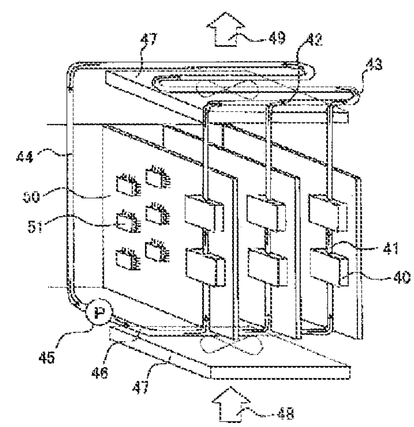
【図3】

図 3



【図4】

図 4



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(54) WATER COOLER FOR COMPUTER CENTRAL EPOCESSING UNIT HAVING IMPELLER

Abstract

A water cooler for a computer central processing unit (CPU) having an impeller, which introduces cooled water therein to circulate the cooled water therein, thereby cooling the CPU of the computer includes:

a circulator including a first inlet through which the cooled water is introduced, the first inlet being mounted on a top surface of the CPU, a discharge part having a recessed groove shape so that the water circulating within the water cooler is discharged and pooled, and a first outlet disposed on a surface of the discharge part to discharge the water pooled in the discharge part, wherein the circulator introduce the cooled water to circulate the introduced water therein, thereby discharging the water;

an impeller mounted on the discharge part of the circulator, and the impeller including a plurality of rotation blades on a bottom surface thereof to discharge the water within the discharge part to the first outlet by a rotation force; and

a driving motor mounted above the impeller, the driving motor receiving a power from the outside to transmit a driving force into the impeller, thereby driving the impeller.

Representative Drawing:

FIG. 1

Index
Cooler; Water cooler; CPU; Computer

Specification

Brief Description Of The Drawings

FIG. 1 is a view illustrating an inner structure of a computer on which a water cooler for a computer central processing unit (CPU) having an impeller is mounted according to the present invention.

FIG. 2a is a view illustrating a state in which a cooling unit is mounted on the CPU according to the present invention.

FIG. 2b is a view of a state in which a cooling unit according to another embodiment is mounted on the CPU according to the present invention.

FIG. 3 is an exploded perspective view of the cooling unit according to the present invention.

FIG. 4a is a cross-sectional view of a water jacket according to the present invention.

FIG. 4b is a cross-sectional view of a pump driver according to the present invention.

FIG. 4c is a perspective view of an impeller according to the present invention when viewed from a lower side.

FIG. 4d is a perspective view of a driving motor according to the present invention when viewed from the lower side.

FIG. 5a is a perspective view of a radiator according to the present invention.

FIG. 5b is a cross-sectional view of the radiator according to the present invention.

*** Descriptions about reference numerals in the drawings ***

10: CPU	20: Water jacket
20: Pump driver	30: Impeller
40: Waterproof jacket	45: Driving motor
50: Cooling unit	60: Radiator
70: Cooling fan	100: Computer body

Detailed Description Of The Invention

Object Of The Present invention

Field Of The Invention And Description Of The Related Art

The present invention relates to a water cooler for a computer central processing unit (CPU) having an impeller, and more particularly, to a water cooler for a computer CPU having an impeller, in which water cooled by a radiator is circulated into a water jacket attached to a top surface of the computer CPU of the computer to cool heat generated from the CPU.

Recently, with the rapid development in technologies, a data processing rate of a CPU is being rapidly improved. Meanwhile, since heat generated by an operation of a CPU is increased according to the data processing rate of the CPU, an amount of heat generated from the CPU may be increased as the data processing rate of the CPU is increased. In general, a CPU has optimal operation performance at a temperature approaching room temperature. If the temperature is excessively high, the data processing rate may be reduced, and also the possibility of error occurrence in processed results may be increased. Also, if the heat generated from the CPU is too high in temperature, the computer may be stopped in operation to cause a loss of working data. If this phenomenon is continuous, the expensive CPU may be damaged or broken.

Therefore, in order to solve these problems, heat generated from the CPU should be cooled. In a related art, an air cooling-type cooler has been used to reduce a temperature of a CPU by rotating a cooling fan.

The air cooling-type cooler is the most common cooler that has been used since a time point at which a processing rate of a CPU is beyond about 100 MHz. In detail, an air cooling-type cooler set constituted by a heatsink plate and a cooling fan is attached on the CPU, and then, the cooling fan is rotated at a high rate to reduce the temperature of the CPU. That is, heat generated from the CPU is transmitted to the heatsink plate, and the cooling fan is rotated to cool the heat in the radiator, thereby cooling the CPU.

In recent years, to remove an amount of heat that is increasingly generated as a CPU is improved in performance, there is a need for providing a large-scale air cooling-type cooler and operating the air cooling-type cooler at a high rate. Typically, the air cooling-type cooler requires a rotation rate of at least 5000 rpm. An air cooling-type cooler proposed in recent years is operated at a rate of about 6000 times per minute or more.

However, the air cooling-type cooler involves several problems as follows.

First, a cooler using high-performance cooling fan may be increased in noise. As the CPU is improved in performance, an amount of heat is increased. Thus, so as to improve performance of the cooler, a cooling fan which is rotated at higher rate is requested. However, due to a feature in which a noise is proportional to a rotation rate, the more the cooling fan is increased in rotation rate, the more noises generated from the cooling fan are increased. Thus, there is a problem that a user gets stresses by the noise.

Second, in a case of the air cooling-type cooler, since air within a case is circulated, cooling efficiency may be deteriorated. Commonly, when users use a computer, a case of a desktop is in a closed state. Here, although external air is slightly introduced, an amount of introduced air is incomplete. As a result, in the case of the air cooling-type cooler, internal air should be circulated to cool the CPU. Thus, if the computer is not used for a long time, internal air may be cooled to provide superior cooling efficiency. However, if the computer is used for a long time, and thus the internal air is increased in temperature by a CPU and all peripheral devices raise, warm air may be circulated to significantly decrease the cooling efficiency. Also, for overcome this problem, if the users use the computer in a state where the case is opened, noises generated from the cooler and the likes may be directly transmitted to the users. Particularly, in a case of the latest CPU that runs at about 2 GHz, an air cooling-type cooler set is reaching a limit.

Third, a CPU may exert optimal operation performance at room temperature. However, since a cooling fan in a conventional air cooling-type cooler is operated at the same rate in hot summer or cold winter, cooling efficiency may be deteriorated, or the CPU may be damaged. If the CPU is suddenly operated at a temperature below the freezing point, the CPU suddenly may generate heat to form dewdrops on a surface of the CPU due to sudden changes in temperature, thereby causing the damage of the CPU.

Technical Object Of The Invention

To solve the above-described problems, an object of the present invention is to provide a water cooler for computer CPU having an impeller which cools heat generated from the CPU by using cooled and circulating water.

That is, the present invention is to provide a water cooler for computer CPU in which water cooled while passing through a radiator passes through a water jacket attached to the CPU to decrease a temperature of the CPU, and water warmed by heat generated from the CPU is pumped to the radiator through a pump driver to circulate the water, thereby cooling the CPU.

Constitution And Operation Of The Invention

To achieve the above described purpose, a water cooler for a computer central processing unit (CPU) having an impeller, which introduces cooled water therein to circulate the cooled water therein, thereby cooling the CPU of the computer, the water cooler including: a circulator including a first inlet through which the cooled water is introduced, the first inlet being mounted on a top surface of the CPU, a discharge part having a recessed groove shape so that the water circulating within the water cooler is discharged and pooled, and a first outlet disposed on a surface of the discharge part to discharge the water pooled in the discharge part, wherein the circulator introduce the cooled water to circulate the introduced water therein, thereby discharging the water; an impeller mounted on the discharge part of the circulator, and the impeller including a plurality of rotation blades on a bottom surface thereof to discharge the water within the discharge part to the first outlet by a rotation force; and a driving motor mounted above the impeller, the driving motor receiving a power from the outside to transmit a driving force into the impeller, thereby driving the impeller.

Also, the water cooler further includes a coupling clip for mounting an assembly of the circulator, the impeller, and the driving motor on the CPU, and

the circulator includes:

a pump driver comprising the first inlet, the discharge part, and the first outlet; and a water jacket comprising a second inlet mounted on a top surface of the CPU and under the pump driver, the second inlet being disposed in an extension line of the first inlet to introduce the cooled water therein, a water passage formed in the water jacket so that the introduced cooled water is circulated, and a second outlet through which the circulated water is discharged, the second outlet being opened to a predetermined space formed in a lower portion of the discharge part, or

a water jacket comprising a second inlet mounted on a top surface of the CPU and under the pump driver, the second inlet being disposed in an extension line of the first inlet to introduce the cooled water therein, a water passage formed in the water jacket so that the introduced cooled water is circulated, and a second outlet through which the circulated water is discharged, the second outlet being opened to a predetermined space formed in a lower portion of the discharge part; an inflow pipe connecting the first inlet to the second inlet, the inflow pipe being exposed between the water jacket and the pump driver; and a discharge pipe connecting the discharge part to the second outlet, the discharge pipe being exposed between the water jacket and the pumper driver.

The water jacket is formed of an aluminium material, and particularly, a plurality of porous aluminium plate having a plurality of honeycomb-shaped holes are laminated and bonded to each other through a brazing method to form multiple water passages within the water jacket.

Also, the water cooler further includes a waterproof gasket covering at least a peripheral portion of the impeller on the circulator and a top surface of the impeller, and here, the waterproof gasket includes a silicon plate.

The driving motor comprises a plurality of magnet shafts exposed to a surface corresponding to the impeller, the impeller comprises a plurality of metal shafts at the same position as each of the magnet shafts, and each of the magnet shafts is interlocked with each of the metal shafts to transmit the driving force of the driving motor to the impeller, and each of the magnet shafts may include an AlNiCo magnet, and

each of the rotation blades of the impeller is a magnetic field emission type rotation blade of which a lower end is trimmed at a predetermined angle.

Also, the water cooler further includes: a radiator in which the water passing through the circulator is introduced to circulate the introduced water therein and cool the water, thereby discharging the cooled water, the radiator comprising a third inlet which introduces the water discharged through the first outlet, a plurality of water passages formed therein so that the introduced water is dispersed and circulated, and a third outlet discharging the water passing through each of the water passages; an inflow tube having one end connected to the first outlet and one end connected to the third inlet to introduce the water discharged through the first outlet into the third inlet; and a discharge tube having one end connected to the third outlet and one and connected to the first inlet to introduce the cooled water discharged through the third outlet into the first inlet.

The water cooler further includes a cooling fan disposed on a surface of the radiator, the cooling fan receiving a power from the outside to rotate, thereby cooling the water circulated within the radiator.

Here, the radiator is formed of an aluminium material; a plurality of panels in which water passages having a zigzag shape are formed therein are laminated and coupled to each other within the radiator.

Hereinafter, advantages, characteristics, and preferred embodiments of the present device will be described in more detail with reference to the accompanying drawings.

FIG. 1 is a view illustrating an inner structure of a computer on which a water cooler for a computer central processing unit (CPU) having an impeller is mounted according to the present invention. FIG. 1 is merely a view for describing a mounted state and an operation of a water cooler for a computer CPU having an impeller according to the present invention, and also, other inner components of the computer, which are not a subject of the present invention, are schematically illustrated, and their descriptions will be omitted below.

As shown in FIG. 1, a water cooler for a computer CPU having an impeller according to the present invention includes a cooling unit mounted on the CPU to cool heat generated from the CPU while cooled water passes therethrough and a radiator 60 receiving water warmed by the heat generated from the CPU while passing through the cooling unit to cool the warmed water. The cooling unit is mounted on a top surface of the CPU, and the radiator 60 is mounted on one surface within a computer body 100, preferably, inside a back surface of the main body. Also, a cooling fan 70 for cooling the water passing through the radiator is mounted on a front or rear side of the radiator 60.

The cooling unit includes a water jacket 20 mounted on the top surface of the CPU to allow the cooled water to pass therethrough, a pump driver 30 discharging the water warmed by heat generated from the CPU while passing through the water jacket through a rotation force of the impeller to pump the water up to the radiator 60, and a driving motor 40 driving the impeller. The water jacket, the pump driver, and the driving motor constituting the cooling unit may be laminated on and coupled to each other and then be mounted on the CPU by a coupling clip 55 in a mutually coupled state. The coupling clip 55 may have a "C" shape. The coupling clip has a lower portion attached and fixed to a main board or board that is disposed under the CPU and an upper portion coupled and attached to an upper end of the driving motor, thereby fixing the cooling unit. Also, since water may leak through a connection part between the pump driver and the impeller, a waterproof gasket 49 may cover and seal top surfaces of the pump driver and the impeller. Here, a silicon plate having an excellent waterproofing property may be used as the waterproof gasket.

Two tubes 66 and 68 connecting the pump driver 30 to the radiator 60 may be disposed between the cooling unit and the radiator to circulate the water passing through the water jacket 20 and cooling water. Thus, cooled water while passing through the radiator 60 may be discharged through a discharge tube 68 to flow into the water jacket 20 via the pump driver 30. The water passing through the water jacket may be introduced into the radiator an inflow tube 66 via the pump driving part. Since the inflow tube and the discharge tube are connected to inlets 32 and 62 and outlets 34 and 64 of the pump driver and the radiator, connected portions therebetween may be tightly clamped by using connecting bolts and nuts to prevent the water from leaking through the connected portions. Also, the discharge tube 68 may not be connected to the pump driver 30, but be directly connected to the water jacket 20 so that the cooling water discharged from the radiator 60 may be directly introduced into the water jacket without passing through the pump driver.

The radiator 60 may circulate water increasing in temperature while passing through the water jacket 20 to cool the water through an operation of the cooling fan 70. Here, the cooling fan 70 may be disposed on a front side of the radiator to circulate internal air of the computer body 100. Alternately, the cooling fan may be disposed on a rear side of the radiator, and a plurality of holes may be formed in a back surface of the computer body to allowing the cooling fan to circulate external air, thereby improving the cooling efficiency of the radiator. The cooling fan 70 may be disposed on various positions depending on conditions of a system.

FIG. 2a is a view illustrating a state in which a cooling unit is mounted on the CPU according to the present invention. As shown in FIG. 2a, the cooling unit 50 according to the present invention may be fixed and mounted on the CPU 10. Here, the water jacket 20, the pump driver 30, the waterproof gasket 40, and the driving motor 45 may be successively disposed on the CPU and then be fixed and mounted to the CPU by the coupling clip 55. Here, it is preferable that the water jacket, the pump driver, the waterproof gasket, and the driving motor may be fixed to each other by using a separate fixing unit such as a coupling screw.

As described above, the cooling water cooled in the radiator 60 may be introduced into the water jacket 20 via the pump driver 30 to cool the CPU 10 disposed under the water jacket. The water passing through the water jacket 20 may be discharged again into the radiator 60 through the pump driver 30 again. More particularly, the cooling water discharged from the radiator 60 through the discharge tube 66 may be introduced into the inlet 32 of the pump driver 30 and then be introduced into the inlet 22 of the water jacket 20 connected to the inlet of the pump driver. Also, the water passing through the water jacket 20 may be discharged to the pump driver 30 through the outlet 24 of the water jacket and then be discharged to the outlet 34 of the pump driver by an operation of the impeller to flow into the radiator 60 via the inflow tube 68.

A first water passage for introducing the cooling water introduced into the inlet from the radiator and a second water passage for transferring the water discharged from the water jacket to the outlet are formed inside the pump driver 30 to pass through the pump driver. Each of the water passages may be connected to the inlet 22 and the outlet 24 of the water jacket 20.

In the cooling unit 50 according to the present invention, as shown in FIG. 2, a bottom surface of the pump driver 30 may be closely attached to a top surface of the water jacket 20 to reduce a whole height of the cooling unit. Also, the waterproof gasket may surround the connected portions between the water jacket and the pump driver to prevent water from leaking between the pump driver 30 and the water jacket 20. As described above, the silicon plate may be used as the waterproof gasket.

Also, unlike the FIG. 2a, a connection pipe 28 may connect each of the water passages of a pump driver 30 to the inlet 22 and the outlet 24 of the water jacket 20. FIG. 2b illustrates a state in which the connection pipe is exposed between the water jacket and the pump driver.

FIG. 2b is a view of a state in which a cooling unit according to another embodiment is mounted on the CPU according to the present invention. FIG. 2b illustrates a state in which the connection pipe 28 between the pump driving part 30 and the water jacket 20 is exposed to the outside. In this case, a gap is formed by a height of the connection pipe between the water jacket and the pump driver.

As shown in FIG. 2b, in another embodiment of the cooling unit according to the present invention, the connection pipe 28 for circulating water between the pump driver 30 and water jacket 20 is formed by a predetermined height to form a gap having a predetermined distance between the pump driver and the water jacket. In this case, when the cooling unit 50 is mounted on a CPU 10, an upper end of a coupling clip 55 may be coupled and attached to a top surface of the water jacket 20 to fix and mount the cooling unit to the CPU. That is, since the pump driver 30 is connected and fixed to the water jacket 20 through the connection pipe 28, and a waterproof gasket 40 and a driving motor 45 are also be fixed to the top surface of the pump driver, the water jacket may be fixed by using the coupling clip to fix the cooling unit to the CPU. In this case, a separate fixing unit may be provided between the pump driver 30 and the water jacket 20. Also, the waterproof gasket for waterproofing may be disposed on the connected portions where the pump driver and the water jacket are connected to the connection pipe.

FIG. 3 is an exploded perspective view of the cooling unit according to the present invention. FIG. 4 is a view for explaining respective components of the cooling unit according to the present invention. FIG. 4a is a cross-sectional view of a water jacket 20, FIG. 4b is a cross-sectional view of a pump driver 30, FIG. 4c is a perspective view of an impeller when viewed from a lower side, and FIG. 4d is a perspective view of the driving motor according to the present invention when viewed from the lower side. In particular, FIG. 4a illustrates a section in which a portion of the top surface and a side surface of the water jacket are cut so as to illustrate the inside of the water jacket in detail. Referring to FIGS. 3 and 4, each component of the cooling unit according to the present invention will be described below.

The cooling unit 50 according to the present invention includes the water jacket 20 through which cooling water passes therein to cool the CPU 10, the pump driver 30 introducing the cooling water into the water jacket to discharge the water passing through the water jacket, the waterproof gasket 40 covering and sealing the top surface of the pump driver, the driving motor 45 providing a driving force to the pump driver, and the coupling clip for mounting the cooling unit 50 to the CPU 10. The impeller 36 for discharging water of the water jacket 20 is mounted on the discharge part 33 of the pump driver 30.

The water jacket 20 according to the present invention may be mounted on the top surface of the CPU 10 to receive cooling water cooled by and discharged from the radiator 60 via the pump driver 30, thereby cooling the CPU 10 while the cooling water passes therethrough. The water jacket also discharges again the water warmed by heat transmitted from the CPU while passing therethrough to the radiator 60 via the pump driver 30. The water jacket 20 includes the inlet 22 through which the cooling water is introduced through the pump driver and the outlet 24 through which the water is discharged to the pump driver. The inlet 22 of the water jacket is disposed in an extension line in a vertical direction of the inlet 32 of the pump driver to connect both inlets 32 and 22 to each other when the pump driver is connected to the water jacket. Also, the cooling water may be directly introduced from the radiator 60 into the water jacket 20. In this case, the discharge tube 66 of the radiator is directly connected to the inlet 22 of the water jacket. Also, the outlet 24 of the water jacket is exposed to a space 35a formed in a lower portion of the outlet 35 of the pump driver to discharge the water circulated within the water jacket to the outlet 35.

The water jacket 20 may be formed of an aluminium or copper material which has excellent thermal conductivity and heat exchange efficiency. Here, in consideration of manufacturing costs, it is preferable that the water jacket is formed of the aluminium material.

Also, a plurality of porous aluminium plates 26 may be laminated and then brazed to form multiple water passages within the water jacket 20. More particularly, honeycomb-shaped porous aluminium plates 26 may be piled to overlap each other, and then aluminium molecular powder may be scattered between the aluminium plates to bond the aluminium plates to each other. Thus, the bonded aluminium plate may be recognized as the same material. Therefore, the honeycomb-shaped multiple water passages may be formed within the water jacket 20. Therefore, the cooling water introduced into the water jacket may be dispersed to pass through the multiple water passages formed within the water jacket 20, thereby maximizing the heat exchange efficiency.

As described above, as the thermal conductivity and the heat exchange efficiency of the water jacket 20 are improved, heat of the cooling water passing through the water jacket may effectively take the heat from the CPU 10. As a result, the cooling water and the CPU may become in approximate thermal balance state. Therefore, a cooling effect of the CPU may be maximized.

The water increasing in temperature while passing through the water jacket 20 may be discharged to the outlet 35 of the pump driver 30 via the outlet 24 of the water jacket. Thus, the water may be discharged to the outlet 34 of the pump driver by an operation of the impeller 36 to flow into the radiator 60 via the inflow tube 68.

The pump driver 30 according to the present invention may be mounted on an upper portion of the water jacket 20 to introduce the cooling water discharged from the radiator 60 into the water jacket. Then, the water passing through the water jacket may be pumped and discharged to the radiator 60. The pump driver 30 includes the inlet 32 connected to the discharge tube 66 to introduce the cooling water discharged from the radiator 60, the outlet 34 through which the water passing through the water jacket 20 is discharged to the inflow tube 48, and the discharge part 35 in which the impeller 36 is mounted and having a groove shape so that the water discharged from the water jacket is pooled. The discharge part 35 may have a recessed groove shape so that a predetermined amount of water pumped from the water jacket by the operation of the impeller 36 is pooled. Also, the discharge part 35 may have the outlet 34 through the pooled water is discharged by the operation of the impeller 36 in one surface thereof. Also, the space 35a may be formed in a lower portion of the discharge part to expose and open the outlet 24 of the water jacket 20. Thus, the water within the water jacket may be discharged to the discharge part through the space. Thus, the water passing through the water jacket 20 may be pumped to the discharge part 35 by the operation of the impeller 36, and then be discharged to the outlet 34 of the pump driving part 30 to flow into the radiator 60 through the inflow tube 48.

The inlet 32 and the outlet 34 of the pump driver 30 are respectively connected to the discharge tube 46 and the inflow tube 48 to circulate water together with the radiator 60. Here, a connecting bolt 39a and a connecting nut 39b may be used to prevent water from leaking through the connected portions between the respective tubes and the inlets and outlets. To respectively connect the discharge tube 46 and the inflow tube 48 to the inlet 32 and the outlet 34, one end of the connecting bolt 39a may be coupled and attached to the inlet 32 and the outlet 34. Then, one end of the respective tubes may be inserted into the connecting nut 39b to pass. Thereafter, the end of the tube may be fitted into the other end of the connecting bolt which is not coupled and attached yet. Then, the connecting nut 39b may be coupled and attached to the connecting bolt 39a in which the tube is fitted. Here, it is appreciated that the inlet 62 and the outlet 64 of the radiator 60 may be connected to the respective tubes according to the above described method.

It is preferable that the pump driver 30 is formed of plastic. Alternatively, the pump driver be formed of the same material as the water jacket 20, i.e., the aluminum or copper material.

The impeller 36 according to the present invention may be mounted on the discharge part 35 of the pump driver 30. A plurality of rotation blades for pumping within the water jacket 20 to the discharge part 35 is disposed on a lower portion of the impeller. Also, the impeller 36 may include a plurality of metal shafts 36a to receive a driving force from the driving motor 45. Typically, the driving force of the motor is transmitted through the driving shaft. However, the present invention provides a magnetic pump system which includes a plurality of magnet shafts 45a for transmitting the driving force to the driving motor 45 and a plurality of metal shafts 36a for receiving the driving force of the driving motor 45 through the magnet shafts. Here, it is appreciated that the metal shafts may be disposed on the driving motor instead of the magnets, and the magnet shaft may be disposed on the impeller. The plurality of magnet shafts 45a and the plurality of metal shafts 36a may be disposed on the driving motor 45 and the impeller 36 in a longitudinal direction and have the same mount position with respect to each other. Thus, the impeller 36 may be interlocked with the driving motor by a magnetic force without installing a separate driving shaft to the driving motor 45, thereby being rotated by driving force the driving motor. As described above, when the magnetic pump system is used, noises due to friction with the driving shaft may be removed.

The impeller 36 includes a circulation type rotation blade 37 or a magnetic field emission type rotation blade, preferably, includes the magnetic field emission type rotation blade. The circulation type rotation blade 37 may have a side surface having a rectangular shape. The magnetic field emission type rotation blade may have a side surface having a trapezoidal or triangular shape which is formed by being trimmed at a predetermined angle. Here, the trimming angle of the rotation blade may be set at any predetermined angle.

The circulation type rotation blade may operate normally only when the discharge part 35 is fully filled with water. If water is mixed with air in the discharge part, the circulation type rotation blade may abnormally operate and thus be stopped in operation. Thus, in the case where the circulation type rotation blade is used, if air is mixed into the water jacket 20, the impeller 36 may stop during the operating. On the other hand, in the case of the magnetic field emission type rotation blade, even though the discharge part 35 is filled with air, the magnetic field emission type rotation blade may operate normally to discharge the water. Thus, even if the water jacket 20 is filled with air, there is no problem to use.

When the impeller 36 is mounted on the discharge part 35 of the pump driver 30 to operate, water may leak through a gap of a peripheral portion of the impeller to damage internal devices of the computer. Thus, to solve this problem, the waterproof gasket 40 is mounted on the top surface of the pump driver and the impeller to seal the pump driver and the impeller. A silicon plate having an excellent waterproofing property may be used as the waterproof gasket. The water proof gasket may cover at least the peripheral portion of the impeller. Therefore, the upper portion of the pump driver 30 and the impeller 36 may be completely sealed to realize complete waterproof. Also, since the driving motor 45 does not contact the impeller by the waterproof gasket 40, the driving unit may be completely separated from the circulation unit. As described above, according to the present invention, since the driving motor 45 and the impeller 36 may be interlocked with each other by the magnetic force, but do not physically contact each other, the driving unit may be separated from the circulation unit, and thus the noises may be decreased.

The driving motor 45 according to the present invention may receive a power from the outside to generate a driving force, thereby operating the impeller 36. To transmit the driving force to the impeller, the plurality of magnet shafts 45a exposed to a bottom surface thereof. The magnet shafts 45a may be disposed on the same position as those of the metal shafts 36a mounted on the impeller 36. The magnet shafts may be interlocked with the metal shaft of the impeller to transmit the driving force generated from the driving motor to the impeller.

A brushless DC (BLDC) motor may be used as the driving motor 45. Also, a permanent magnet, especially, an AlNiCo magnet may be used as the magnet shaft 45a.

The AlNiCo magnet may be formed of aluminum, nickel, and cobalt as main materials. The AlNiCo magnet may be used for a speaker, a gauge, a microphone, a reed switch, an amplifier, and the likes. Since the AlNiCo magnet has a extremely small change in amount of magnetic flux according to the temperature, temperature-resistance stability (a maximum temperature of about 550℃) and hardness are very high. On the other hand, since the AlNiCo magnet has low coercivity, a magnetic force of the AlNiCo magnet may be easily decreased by an external magnetic field. Actually, although the AlNiCo magnet has a very strong attraction force, if the AlNiCo magnet is repeatedly attached and detached, the magnetic force of the AlNiCo may be weak to rarely generate the magnetic force. Therefore, since the driving motor 45 according to the present invention is rarely separated after the installation thereof, it is preferable to use the AlNiCo magnet having the strong attraction force.

To smoothly pump water in the water jacket 20 to the radiator, the driving motor 45 should be maintained at a rotation rate of about 1000 rpm or more, and preferably, a rotation rate of about 2000 rpm. In the conventional air-cooling type cooler, since the cooling fan 6 should be rotated at a rotation rate of at least 3000 rpm or more, there is a problem with the serious noise. However, since the driving motor 45 according to the present invention is rotated at a rotation rate corresponding only a half of that of the conventional cooling fan, noises due to the driving motor may be significantly reduced. Also, unlike the conventional cooling fan, since it is unnecessary to provide a blade on the driving motor, noises due to the blade may not occur.

FIG. 5 is a view of the radiator according to the present invention, FIG. 5a is a perspective view of the radiator, and FIG. 5b is a cross-sectional view of the radiator. In particular, FIG. 5b illustrates a section in which a portion of the top surface and the side surface of the radiator are cut so as to illustrate the inside of the radiator 60 in detail. As shown in FIGS. 5a and 5b, the inlet 62 to which the inflow tube 66 for introducing water passing through the water jacket 20 is connected and the outlet 64 to which the discharge tube 68 for discharging cooling water is connected are disposed on a front surface of the radiator 60 according to the present invention. A plurality of panels 65 in which the water passages 65a are formed in a zigzag shape are disposed in parallel to form the multiple water passages within the radiator 60. Also, the radiator may be increased in size to maximize the cooling efficiency.

Each of the panels 65 disposed inside the radiator 60 may be formed of an aluminum or copper material which has excellent thermal conductivity and heat exchange efficiency. In consideration of price, it is preferred that the panel may be formed of the aluminum material.

The inlet 62 and outlet 64 disposed on the front surface of the radiator 60 may communicate with each of the water passages 65a formed in each of the panels 65. Thus, water introduced into the inlet 62 may be dispersed into each of the water passages 65a to flow and pass through the water passages, thereby being mixed at the outlet 64 and discharged through the outlet. As described above, since the radiator 60 according to the present invention may disperse and cool the introduced water, the cooling efficiency may be improved.

Also the cooling fan 70 for cooling the water passing through each of the water passages 61a within the radiator is mounted on the front or back surface of the radiator 60. When the cooling fan 70 is mounted on the front surface of the radiator, the cooling fan may circulate air within the computer body to cool the components mounted to the inside of the computer body.

The water cooler for computer CPU according to the present invention may inject or exchange internal water through the radiator 60. That is, a separate injection hole may be formed in the radiator 60, or a separate hose may be connected to the inlet and outlet of the radiator to inject or exchange water. Thus, water may be injected even through air is mixed in the water jacket 20.

Effect Of The Invention

As described above, the water cooler for the computer CPU according to the present invention may provide the superior cooling efficiency when compared to that of the conventional air cooling-type cooler to allow the CPU to exert optimal performance as well as rarely generate the noise during the operating, thereby significantly improving user's working environment.

That is to say, the water cooler for the computer CPU having an impeller according to the present invention may have effects as follows.

First, since the CPU is cooled by using water, the CPU may be improved in cooling efficiency.

Second, due to a feature of water, the CPU may be cooled to a temperature approaching room temperature to exert the optimal performance and reduce the possibility of CPU defects.

Third, since the water jacket is formed of the aluminum or copper material which has excellent thermal conductivity and heat exchange efficiency and has the inner structure having the porous honeycomb shape to disperse the cooling water and pass therethrough, the heat generated from the CPU may be effectively exchanged to maximize the cooling efficiency.

Fourth, since the magnetic pumping system is used to reduce the frictional sound due to the friction of the driving shaft, and the driving motor is rotated at a rotation rate corresponding to a half of that of the conventional air-cooling type cooler, the noises generated during the operating may be significantly reduced.

Lastly, the water cooler may be commonly applied to a CPU provided by Intel or AMD through only slight modification in standard without separately modifying in structure and shape.

The preferred embodiment of the present invention is described with the specific terms, however, the detailed description may be amended or modified according to viewpoints and applications, not being out of the scope, technical idea and other objects of the present invention.

What is claimed is:

1. A water cooler for a computer central processing unit (CPU) having an impeller, which introduces cooled water therein to circulate the cooled water therein, thereby cooling the CPU of the computer, the water cooler comprising:

a circulator comprising a first inlet through which the cooled water is introduced, the first inlet being mounted on a top surface of the CPU, a discharge part having a recessed groove shape so that the water circulating within the water cooler is discharged and pooled, and a first outlet disposed on a surface of the discharge part to discharge the water pooled in the discharge part, wherein the circulator introduces the cooled water to circulate the introduced water therein, thereby discharging the water;

an impeller mounted on the discharge part of the circulator, and the impeller comprising a plurality of rotation blades on a bottom surface thereof to discharge the water within the discharge part to the first outlet by a rotation force; and

a driving motor mounted above the impeller, the driving motor receiving a power from the outside to transmit a driving force into the impeller, thereby driving the impeller.

2. The water cooler of claim 1, further comprising

a coupling clip for mounting an assembly of the circulator, the impeller, and the driving motor on the CPU.

3. The water cooler of claim 1, wherein the circulator comprises:

a pump driver comprising the first inlet, the discharge part, and the first outlet; and

a water jacket comprising a second inlet mounted on a top surface of the CPU and under the pump driver, the second inlet being disposed in an extension line of the first inlet to introduce the cooled water therein, a water passage formed in the water jacket so that the introduced cooled water is circulated, and a second outlet through which the circulated water is discharged, the second outlet being opened to a predetermined space formed in a lower portion of the discharge part.

4. The water cooler of claim 1, wherein the circulator comprises:

a water jacket comprising a second inlet mounted on a top surface of the CPU and under the pump driver, the second inlet being disposed in an extension line of the first inlet to introduce the cooled water therein, a water passage formed in the water jacket so that the introduced cooled water is circulated, and a second outlet through which the circulated water is discharged, the second outlet being opened to a predetermined space formed in a lower portion of the discharge part;

an inflow pipe connecting the first inlet to the second inlet, the inflow pipe being exposed between the water jacket and the pump driver; and

a discharge pipe connecting the discharge part to the second outlet, the discharge pipe being exposed between the water jacket and the pumper driver.

5. The water cooler of claim 4, further comprising

a coupling clip for mounting the water jacket on the CPU.

6. The water cooler of claim 3 or 4, wherein the water jacket is formed of an aluminum material.

7. The water cooler of claim 3 or 4, wherein a plurality of porous aluminum plate having a plurality of honeycomb-shaped holes are laminated and bonded to each other through a brazing method to form multiple water passages within the water jacket.

8. The water cooler of claim 1, further comprising a waterproof gasket covering at least a peripheral portion of the impeller on the circulator and a top surface of the impeller.

9. The water cooler of claim 8, wherein the waterproof gasket comprises a silicon plate.

10. The water cooler of claim 1, wherein the driving motor comprises a plurality of magnet shafts exposed to a surface corresponding to the impeller,
the impeller comprises a plurality of metal shafts at the same position as each of the magnet shafts, and
each of the magnet shafts is interlocked with each of the metal shafts to transmit the driving force of the driving motor to the impeller.

11. The water cooler of claim 10, wherein each of the magnet shafts comprises an NiNdB magnet.

12. The water cooler of claim 1, wherein each of the rotation blades of the impeller is a magnetic field emission type rotation blade of which a lower end is trimmed at a predetermined angle.

13. The water cooler of claim 1, further comprising:
a radiator in which the water passing through the circulator is introduced to circulate the introduced water therein and cool the water, thereby discharging the cooled water, the radiator comprising a third inlet which introduces the water discharged through the first outlet, a plurality of water passages formed therein so that the introduced water is dispersed and circulated, and a third outlet discharging the water passing through each of the water passages;
an inflow tube having one end connected to the first outlet and one end connected to the third inlet to introduce the water discharged through the first outlet into the third inlet; and
a discharge tube having one end connected to the third outlet and one end connected to the first inlet to introduce the cooled water discharged through the third outlet into the first inlet.

14. The water cooler of claim 13, further comprising
a cooling fan disposed on a surface of the radiator, the cooling fan receiving a power from the outside to rotate, thereby cooling the water circulated within the radiator.

15. The water cooler of claim 13, wherein a plurality of panels in which water passages having a zigzag shape are formed therein are laminated and coupled to each other within the radiator.

16. The water cooler of claim 13, wherein the radiator is formed of an aluminium material.

FIG. 1

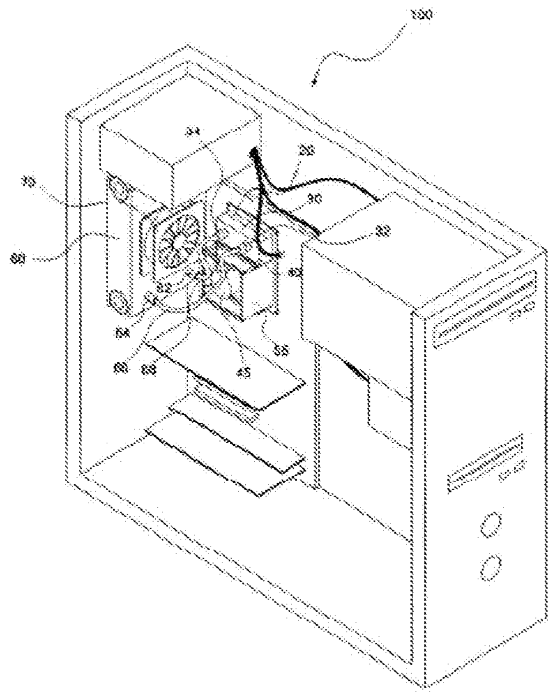


FIG. 2

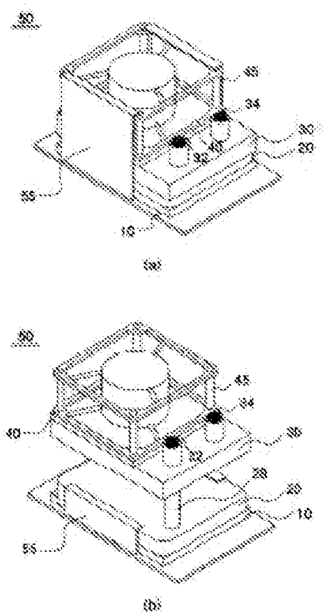


FIG. 3

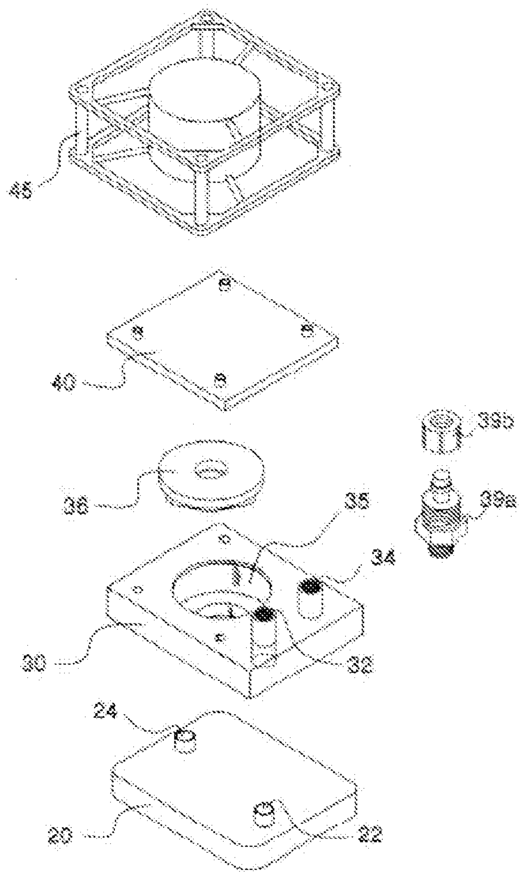


FIG. 4

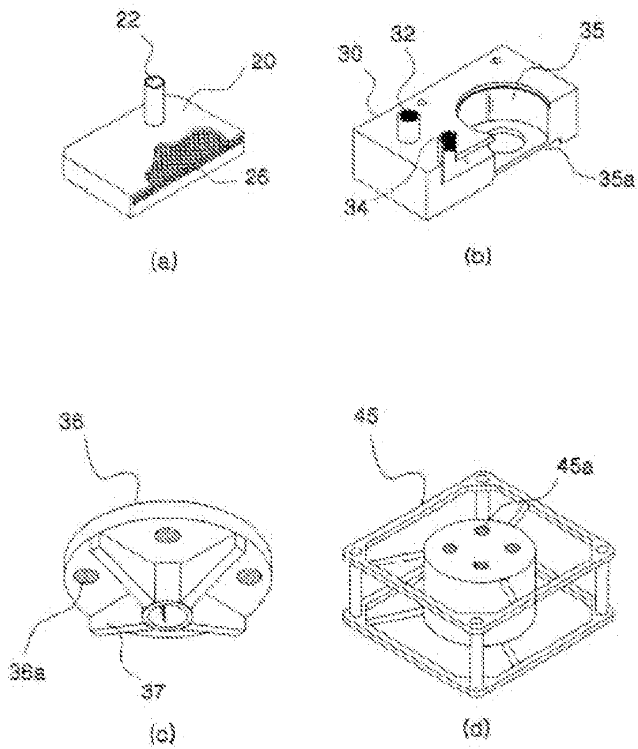
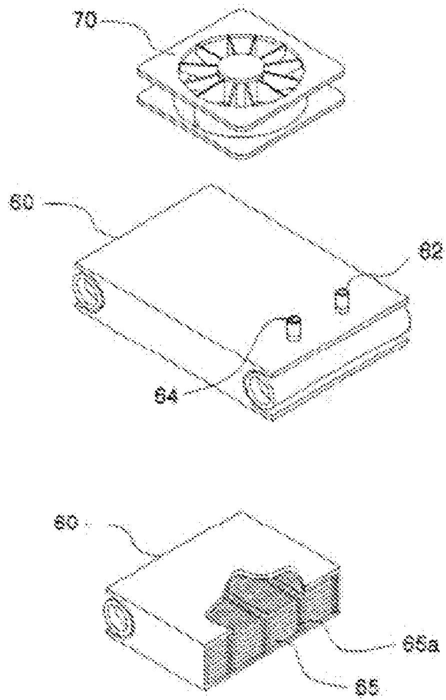


FIG. 5



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TRANSLATOR CERTIFICATION

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State of New York

Date: July 12, 2013

To whom it may concern:

This is to certify that the attached translation from Korean into English is an accurate representation of the documents received by this office.

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Anna Lee, Project Manager in this company, certifies that Steve Yang, who translated these documents, is fluent in Korean and standard North American English and qualified to translate. Anna Lee attests to the following:

"To the best of my knowledge, the aforementioned documents are a true, full and accurate translation of the specified documents."

Anna Lee

Signature of Anna Lee

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(54) 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치

요약

본 발명은, 라디에이터에 의해 냉각된 물을 컴퓨터의 중앙처리장치 상면에 부착 구비되는 워터재킷 내부로 순환시켜, 중앙처리장치로부터 발생되는 열을 냉각시키는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치에 관한 것으로서,

중앙처리장치의 상면에 장착 구비되어 냉각된 물을 유입받아 내부로 순환시킨 후 배출하고, 냉각된 물이 유입되는 제 1 유입구, 내부를 순환한 물이 배출되어 고이도록 움푹 들어간 홈 형상으로 이루어진 배출부 및 배출부의 일측면에 구비되어 배출부에 고인 물이 배출되는 제 1 배출구를 구비하는 순환부;

순환부의 배출부에 장착 구비되어, 저면에 복수의 회전날개를 구비하여 회전력에 의해 배출부의 물을 제 1 배출구로 배출시키는 임펠러; 및

임펠러의 상부에 장착 구비되며, 외부로부터 전원을 공급받아 임펠러에 구동력을 전달하여 임펠러를 구동시키는 구동모터를 구비하는 것을 특징으로 한다.

대표도

도 1

색인어

쿨러; 수냉식 쿨러; 중앙처리장치; 컴퓨터

명세서

도면의 간단한 설명

도 1 은 본 발명에 따른 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치가 장착된 컴퓨터의 내부 구조도.

도 2a 는 본 발명에 따른 냉각부를 중앙처리장치에 장착한 상태를 나타내는 상태도.

도 2b 는 본 발명에 따른 냉각부의 또 다른 실시례를 중앙처리장치에 장착한 상태를 나타내는 상태도.

도 3 은 본 발명에 따른 냉각부의 분해 사시도.

도 4a 는 본 발명에 따른 워터재킷의 단면도.

도 4b 는 본 발명에 따른 펌프구동부의 단면도.

도 4c 는 본 발명에 따른 임펠러를 밑에서 바라본 사시도.

도 4d 는 본 발명에 따른 구동모터를 밑에서 바라본 사시도.

도 5a 는 본 발명에 따른 라디에이터의 사시도.

도 5b 는 본 발명에 따른 라디에이터의 단면도.

*** 도면의 주요 부분에 대한 부호 설명 ***

10 : 중앙처리장치 20 : 워터재킷

30 : 펌프구동부 36 : 임펠러

40 : 방수개스킷 46 : 구동모터

50 : 냉각부 60 : 라디에이터

70 : 쿨링팬 100 : 컴퓨터 본체

발명의 상세한 설명

발명의 목적

발명이 속하는 기술 및 그 분야의 종래기술

본 발명은 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치에 관한 것으로서, 더욱 상세히 설명하면, 라디에이터에 의해 냉각된 물을 컴퓨터의 중앙처리장치 상면에 부착 구비되는 워터재킷 내부로 순환시켜, 중앙처리장치로부터 발생되는 열을 냉각시키는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치에 관한 것이다.

근래들어 기술의 비약적인 발전에 힘입어 중앙처리장치(CPU)의 데이터 처리속도 또한 급속도로 향상되고 있다. 한편, 중앙처리장치의 동작에 따라 발생되는 열은 중앙처리장치의 처리속도에 따라 증가하게 되므로, 중앙처리장치의 처리속도가 빨라짐에 따라 중앙처리장치로부터 발생되는 열의 양도 증가하게 되었다. 일반적으로 중앙처리장치는 상온에 가까

올수록 최적의 동작성능을 보여주며, 지나치게 온도가 높아질 경우에는 처리속도가 감소될 뿐만 아니라 처리결과의 오류 발생 가능성이 높아진다. 또한, 중앙처리장치의 발열량이 너무 높을 경우 컴퓨터의 기능이 정지하는 상황을 초래하게 되어 작업중이던 데이터의 손실이 발생될 수 있으며, 이러한 현상이 지속될 경우 고가의 중앙처리장치가 고장 또는 파손되는 결과가 초래될 수도 있다.

따라서, 이러한 문제점을 해결하기 위하여 중앙처리장치로부터 발생되는 열을 식혀주어야 하는데, 종래에는 쿨링팬의 회전에 의해 중앙처리장치의 온도를 낮추어주는 공랭식 쿨러를 사용하였다.

중앙처리장치의 처리속도가 대략 100 MHz를 넘어서는 시점부터 사용해왔던 이러한 공랭식 쿨러는 가장 보편적인 냉각장치로서, 중앙처리장치의 위에 방열판과 쿨링팬으로 이루어진 공랭식 쿨러세트를 부착한 후 쿨링팬을 고속으로 회전시켜 중앙처리장치의 온도를 하강시키는 방식이다. 즉, 중앙처리장치로부터 발생되는 열이 방열판으로 전달되고 쿨링팬이 회전하면서 방열판의 열을 식힘으로써 중앙처리장치를 냉각시키게 된다.

한편, 근래들어 중앙처리장치의 성능이 향상되면서 더불어 증가하는 발열량을 해소하기 위하여 이러한 공랭식 쿨러는 더욱더 크고 빠른 속도로 동작하여야 필요성이 대두되었는데, 통상적으로 최소 5000 rpm 이상의 속도를 요구한다. 최근에 제안된 공랭식 쿨러는 쿨링팬이 분당 6000회 이상의 속도로 동작한다.

그러나, 이러한 공랭식 쿨러세트는 여러가지 문제점을 내포하고 있었는데, 공랭식 쿨러의 문제점에 대하여 설명하면 이하와 같다.

첫째, 고성능의 쿨링팬을 사용하는 쿨러일수록 소음이 증가하는 문제점이 있었다. 중앙처리장치의 성능향상에 따라 발열량이 증가할수록 쿨러의 성능향상을 위하여 더욱 빠른 속도로 회전하는 쿨링팬을 사용하여야 한다. 그러나, 회전속도에 비례하는 소음이 유발되는 회전체의 특성상, 쿨링팬의 속도가 증가할수록 쿨링팬으로부터 발생되는 소음이 증가하게 된다. 사용자에게 소음으로 인한 스트레스를 주는 문제점이 있었다.

둘째, 공랭식 쿨러의 경우 케이스 내부의 공기를 순환시키게 되므로 냉각효율이 떨어지는 문제점이 있었다. 통상적으로, 사용자들이 컴퓨터를 사용함에 있어서 본체 케이스를 닫은 상태에서 사용하게 된다. 이때, 외부로부터 약간의 공기가 유입되기는 하지만 그 양이 미비하여, 결국 공랭식 쿨러의 경우 내부공기를 순환시켜 중앙처리장치를 냉각시키게 된다. 따라서, 컴퓨터를 오랜시간 사용하지 않아서 내부공기가 냉각된 상태에서는 냉각효과가 좋을 수 있으나, 컴퓨터를 계속 사용함에 따라 중앙처리장치 및 각종 주변기기로 인해 케이스 내부공기의 온도가 상승할 경우 결국 더운 공기를 순환시키게 되어 냉각효율이 급속도로 떨어지는 문제점이 있었다. 또한, 이를 방지하기 위하여 케이스를 오픈시켜 놓고 컴퓨터를 사용할 경우 쿨러 등으로부터 발생되는 소음이 여과없이 그대로 사용자에게 전달되는 문제점이 있었다. 특히, 최근의 2GHz 급의 중앙처리장치의 경우 공랭식 쿨러세트가 성능의 한계에 부딪치고 있는 실정이다.

셋째, 중앙처리장치는 상온에서 최적의 성능을 발휘할 수 있는데, 종래의 공랭식 쿨러세트는 기온이 높은 여름이나 기온이 낮은 겨울이나 동일한 속도로 쿨링팬을 회전시켜 냉각하므로 냉각효율이 떨어지거나 중앙처리장치를 파손시킬 수 있는 문제점이 있었다. 만일, 어는점 이하의 온도에서 갑작스러운 중앙처리장치의 작업호출이 있을 경우, 중앙처리장치가 갑자기 열을 발생시키게 되므로 중앙처리장치의 표면에 갑작스러운 온도차이로 인한 이슬이 맺힐 수 있어 중앙처리장치 파손의 원인이 될 수 있다.

발명이 이루고자 하는 기술적 과제

본 발명은 상기와 같은 문제점을 해결하고자 제시된 것으로서, 본 발명의 목적은 냉각 순환하는 물을 이용하여 중앙처리장치로부터 발생되는 열을 식혀주는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치를 제공하는 것이다.

즉, 라디에이터를 통과하면서 냉각된 물을 중앙처리장치에 부착된 워터재킷으로 통과시켜 중앙처리장치의 온도를 낮추고, 중앙처리장치로부터 발생된 열에 의해 덥혀진 물을 펌프구동부를 통해 라디에이터로 끌어올려 냉각 순환시키는 컴퓨터 중앙처리장치용 수냉식 냉각처리장치를 제공하는 것을 목적으로 한다.

발명의 구성 및 작용

상기의 목적을 달성하기 위하여, 본 발명에 따른 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치는, 냉각된 물을 유입받아 내부로 순환시켜 컴퓨터의 중앙처리장치를 냉각시키는 컴퓨터 중앙처리장치용 수냉식 냉각장치로서, 중앙처리장치의 상면에 장착 구비되어 냉각된 물을 유입받아 내부로 순환시킨 후 배출하고, 냉각된 물이 유입되는 제 1 유입구, 내부를 순환한 물이 배출되어 고이도록 움푹 들어간 홈 형상으로 이루어진 배출부 및 배출부의 일측면에 구비되어 배출부에 고인 물이 배출되는 제 1 배출구를 구비하는 순환부; 순환부의 배출부에 장착 구비되며, 저면에 복수의 회전날개를 구비하여 회전력에 의해 배출부의 물을 제 1 배출구로 배출시키는 임펠러; 및 임펠러의 상부에 장착 구비되며, 외부로부터 전원을 공급받아 임펠러에 구동력을 전달하여 임펠러를 구동시키는 구동모터를 구비하는 것을 특징으로 한다.

또한, 순환부, 임펠러 및 구동모터의 결합체를 중앙처리장치에 장착시키는 결합클립을 더 구비하도록 하며,

순환부는,

제 1 유입구, 배출부 및 제 1 배출구를 구비하는 펌프구동부; 및 펌프구동부의 하부로 중앙처리장치의 상면에 장착 구비되며, 제 1 유입구의 연장선 상에 구비되어 냉각된 물이 유입되는 제 2 유입구, 유입된 냉각된 물이 순환하도록 내부에 형성된 수로 및 순환한 물이 배출되며 배출부 하부에 형성된 소정의 공간으로 개방 형성된 제 2 배출구를 구비하는 워터재킷을 구비하거나,

제 1 유입구, 배출부 및 제 1 배출구를 구비하는 펌프구동부; 펌프구동부의 하부로 중앙처리장치의 상면에 장착 구비되며, 제 1 유입구의 연장선 상에 구비되어 냉각된 물이 유입되는 제 2 유입구, 유입된 냉각된 물이 순환하도록 내부에 형성된 수로 및 순환한 물이 배출되며 배출부 하부에 형성된 소정의 공간으로 개방 형성된 제 2 배출구를 구비하는 워터재킷; 제 1 유입구와 제 2 유입구 사이를 연결하며, 워터재킷과 펌프구동부 사이에 노출 형성되는 유입파이프; 및 배출부와 제 2 배출구 사이를 연결하며, 워터재킷과 펌프구동부 사이에 노출 형성되는 배출파이프를 구비하도록 하며, 이 경우, 결합클립이 워터재킷을 중앙처리장치에 장착시키도록 하는 것이 바람직하다.

워터재킷은 알루미늄 재질로 형성하도록 하며, 특히, 워터재킷의 내부로는 다수의 구멍이 벌집모양으로 형성된 복수의 다공성 알루미늄 판을 적층시킨 후 브레이징 기법을 통해 접합하여 다중수로가 형성되도록 한다.

또한, 순환부와 임펠러의 상면 중 적어도 임펠러의 주변부를 덮도록 형성된 방수개스킷을 더 구비할 수 있으며, 이때, 방수개스킷은 실리콘 플레이트로 형성하도록 하며,

구동모터가 임펠러와 대응하는 면에 노출 형성되는 복수의 자석축을 구비하고, 임펠러가 각 자석축과 동일위치에 복수의 금속축을 구비하여, 각 자석축과 각 금속축이 상호 연동되어 구동모터의 구동력을 임펠러에 전달하도록 하되, 자석축은 알리코 자석으로 형성하는 것이 바람직하고,

임펠러의 각 회전날개는 하단부가 소정 각도로 휘인 자출형으로 형성하도록 한다.

또한, 순환부를 통과한 물을 유입받아 내부로 순환시켜 냉각한 후 냉각된 물을 배출하고, 제 1 배출구로 배출되는 물을 유입받는 제 3 유입구, 유입된 물이 분산되어 순환하도록 내부에 형성된 복수의 수로 및 각 수로를 통과한 물을 배출하

는 제 3 배출구를 구비하는 라디에이터; 제 1 배출구에 일단이 연결되고 제 3 유입구에 일단이 연결되어 제 1 배출구로 배출되는 물을 제 3 유입구로 유입시키는 유입튜브; 및 제 3 배출구에 일단이 연결되고 제 1 유입구에 일단이 연결되어 제 3 배출구로 배출되는 냉각된 물을 제 1 유입구로 유입시키는배출튜브를 더 구비할 수 있으며,

라디에이터의 일면에 장착되며, 외부로부터 전원을 공급받아 회전하여 라디에이터의 내부를 순환하는 물을 냉각시키는 쿨링팬을 더 구비할 수 있다.

이때, 라디에이터는 알루미늄 재질로 형성하도록 하며, 라디에이터의 내부로는 내부에 지그재그 형태로 수로가 형성된 복수의 패널이 적층되어 결합 배치되도록 한다.

이하에서는, 첨부한 도면을 참조하여 본 발명의 장점, 특징 및 바람직한 실시례에 대해 상세히 설명한다.

도 1 은 본 발명에 따른 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치가 장착된 컴퓨터의 내부 구조도이다. 도 1 은 본 발명에 따른 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치의 장착상태와 동작을 설명하기 위한 것으로서, 본 발명의 대상이 아닌 다른 컴퓨터 내부 구성요소에 대하여는 개략적으로 도시하였으며, 이하에서는 설명을 생략하도록 한다.

도 1 에 도시한 바와 같이, 본 발명에 따른 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치는, 중앙처리장치에 장착되어 냉각된 물을 통과시켜 중앙처리장치로부터 발생되는 열을 식히기 위한 냉각부와, 냉각부를 통과하면서 중앙처리장치로부터 발생된 열을 전달받아 덥혀진 물을 냉각시키기 위한 라디에이터 (60) 로 이루어진다. 냉각부는 중앙처리장치의 상면에 장착 구비되고, 라디에이터 (60) 는 컴퓨터 본체(100) 내부의 일측면에 장착되며 바람직하게는 본체 배면의 내부에 장착하도록 한다. 또한, 라디에이터(60) 의 전방 또는 후방으로는 라디에이터를 통과하는 물을 냉각시키기 위한 쿨링팬(70) 이 장착된다.

냉각부는, 중앙처리장치의 상면에 장착되며 냉각된 물이 통과하는 워터재킷 (20) 과, 워터재킷을 통과하면서 중앙처리장치로부터 열을 전달받아 덥혀진 물을 임펠러의 회전력을 통해 배출하여 라이에이터(60) 로 끌어올리는 펌프구동부(30) 및 임펠러를 구동시키는 구동모터(45) 로 이루어진다. 냉각부를 구성하는 워터재킷, 펌프구동부 및 구동모터는 상호 적층 결합 배치되며, 상호 결합된 상태에서 결합클립(55) 에 의해 중앙처리장치에 장착된다. 결합클립(55) 은 'ㄷ' 자 형상으로 이루어지며, 하부가 메인보드 또는 중앙처리장치 하부의 기판에 부착 고정되고 상부가 구동모터의 상단에 걸착됨으로써 냉각부를 고정하게 된다. 또한, 펌프구동부와 임펠러의 연결부분에서 물이 새어나올 가능성이 있으므로, 펌프구동부와 임펠러의 상면을 방수개스킷(40) 으로 덮어서 밀폐시키도록 한다. 이때, 방수개스킷으로는 방수성이 가장 뛰어난 실리콘 플레이트를 사용하도록 한다.

냉각부와 라디에이터 사이에는 워터재킷(20) 을 통과한 물과 냉각수를 상호 순환시키기 위하여, 펌프구동부(30) 와 라디에이터(60) 를 상호 연결하는 두개의 튜브(66, 68) 가 구비된다. 따라서, 라디에이터(60) 를 통과하면서 냉각된 물은 배출튜브(66) 를 통해 배출되어 펌프구동부(30) 를 거쳐 워터재킷(20) 으로 유입되고, 워터재킷을 통과한 물은 펌프구동부를 거쳐 유입튜브(68) 를 통해 라디에이터로 유입된다. 유입튜브 및 배출튜브를 펌프구동부와 라디에이터의 유입구(32, 62) 및 배출구(34, 64) 에 연결함에 있어서, 연결부위에서 물이 새지 않도록 연결볼트 및 너트를 이용하여 단단하게 조이도록 한다. 또한, 배출튜브(66) 를 펌프구동부(30) 에 연결하지 않고 워터재킷(20) 에 곧바로 연결하여, 라디에이터(60) 로부터 배출된 냉각수가 펌프구동부를 거치지 않고 워터재킷으로 바로 유입되도록 할 수 있음은 물론이다.

라디에이터(60)는 워터재킷(20)을 통과하면서 온도가 올라간 물을 순환시키면서 쿨링팬(70)의 작동에 의하여 냉각시킨다. 이때, 쿨링팬(70)을 라디에이터의 전방에 구비하여 컴퓨터 본체(100) 내부공기를 순환시키도록 하거나, 또는 라디에이터의 후방에 구비하고 컴퓨터 본체의 배면에 다수의 구멍을 형성함으로써 쿨링팬이 외부 공기를 순환시켜 라디에이터의 냉각효율을 높이도록 할 수 있다. 쿨링팬 (70)의 위치는 시스템의 상황에 따라 자유로이 변형 가능한 것이다.

도 2a 는 본 발명에 따른 냉각부를 중앙처리장치에 장착한 상태를 나타내는 결합상태도이다. 도 2a 에 도시한 바와 같이, 본 발명에 따른 냉각부(50)는 중앙처리장치(10)의 상부에 고정 장착되는데, 중앙처리장치의 상부로 워터재킷(20), 펌프구동부(30), 방수개스킷(40) 및 구동모터(45)의 순서로 차례대로 배치된 후 결합클립(55)에 의해 중앙처리장치에 고정 장착된다. 이때, 워터재킷, 펌프구동부, 방수개스킷 및 구동모터 상호간에는 결합나사와 같은 별도의 고정수단을 이용하여 상호 고정하도록 하는 것이 바람직하다.

상기한 바와 같이, 라디에이터(60)에서 냉각된 냉각수는 펌프구동부(30)를 거쳐 워터재킷(20)으로 유입되어 워터재킷 하부에 배치되는 중앙처리장치(10)를 냉각시키고, 워터재킷(20)을 통과한 물은 펌프구동부(30)를 통해 다시 라디에이터 (60)로 배출된다. 보다 구체적으로는, 라디에이터(60)로부터 배출튜브(66)를 통해 배출된 냉각수는 펌프구동부(30)의 유입구(32)로 유입된 후 펌프구동부의 유입구와 상호 연결된 워터재킷(20)의 유입구(22)로 유입된다. 또한, 워터재킷(20)을 통과한 물은 워터재킷의 배출구(24)를 통해 펌프구동부(30)로 배출된 후 임펠러의 작동에 의해 펌프구동부의 배출구(34)로 배출되어 유입튜브(68)를 거쳐 라디에이터 (60)로 유입되게 된다.

펌프구동부(30) 내부에는 라디에이터로부터 유입구로 유입된 냉각수를 워터재킷(20)으로 유입시키기 위한 제 1 수로와 워터재킷으로부터 배출된 물을 배출구로 연결시키기 위한 제 2 수로가 관통 형성되어 있으며, 각 수로는 워터재킷(20)의 유입구(22) 및 배출구(24)와 상호 연결된다.

본 발명에 따른 냉각부(50)는, 도 2a 에 도시한 바와 같이, 펌프구동부(30)의 저면과 워터재킷(20)의 상면이 상호 밀착 형성됨으로써 냉각부 전체의 높이를 줄일 수 있게 되었다. 또한, 펌프구동부(30)와 워터재킷(20) 사이로 물이 새어 나오는 것을 방지하기 위하여 워터재킷과 펌프구동부의 접촉부위를 방수개스킷으로 감쌀 수 있으며, 상기한 바와 같이, 방수개스킷으로는 실리콘 플레이트를 사용하도록 한다.

또한, 도 2a 와 달리 펌프구동부(30)의 각 수로와 워터재킷(20)의 유입구 (22) 및 배출구(24) 간을 연결파이프(28)를 이용하여 연결하고, 연결파이프가 워터재킷과 펌프구동부 사이에 노출되도록 형성할 수도 있는데, 이에 대하여는 도 2b 에 도시되어 있다.

도 2b 는 본 발명에 따른 냉각부의 또 다른 실시례를 중앙처리장치에 장착한 상태를 나타내는 상태도로서, 펌프구동부(30)와 워터재킷(20) 사이의 연결파이프 (28)가 외부로 노출되도록 형성한 경우를 도시한 것이다. 이 경우, 워터재킷과 펌프구동부 사이에는 연결파이프의 높이만큼 유격이 생기게 된다.

도 2b 에 도시한 바와 같이, 본 발명에 따른 냉각부의 또 다른 실시예는 펌프구동부(30)와 워터재킷(20) 사이에 물을 순환시키는 연결파이프(28)를 소정 높이로 형성하여 펌프구동부와 워터재킷 사이에 소정 거리의 유격이 생기도록 한다. 이 경우에는, 냉각부(50)를 중앙처리장치(10)에 장착함에 있어서, 결합클립(55)의 상단이 워터재킷(20)의 상면에 결착되도록 함으로써 중앙처리장치에 고정 장착하도록 한다. 즉, 펌프구동부(30)는 연결파이프(28)를 통해 워터재킷(20)과 연결 고정되며 방수개스킷(40)과 구동모터(45) 또한 펌프구동부의 상면에 고정되므로, 워터재킷을 결합클립을 이용하여 고정함으로써 냉각부를 중앙처리장치에 고정할 수 있다. 이 경우에도 펌프구동부(30)와 워터재킷(20) 사이에 별도의 고정수단을 구비할 수 있음은 물론이다. 또한, 펌프구동부 및 워터재킷이 연결파이프와 연결되는 연결부위에 방수를 위하여 방수개스킷을 구비할 수 있다.

도 3 은 본 발명에 따른 냉각부의 분해 사시도이고, 도 4 는 본 발명에 따른 냉각부의 각 구성부분을 설명하기 위한 도로서, 도 4a 는 워터재킷(20)의 단면도이고, 도 4b 는 펌프구동부(30)의 단면도이며, 도 4c 는 임펠러(36)를 밑에서 바라본 사시도이고, 도 4d 는 구동모터(45)를 밑에서 바라본 사시도이다. 특히, 도 4a 는 워터재킷 내부의 모습을 보다 상세하게 도시하기 위하여, 워터재킷의 상면 일부와 측면을 절개한 단면을 도시하였다. 도 3 및 도 4 를 참조하여 본 발명에 따른 냉각부의 각 구성부분에 대하여 설명하면 이하와 같다.

본 발명에 따른 냉각부(50)는, 내부로 냉각수를 통과시켜 중앙처리장치(10)를 냉각시키는 워터재킷(20), 워터재킷으로 냉각수를 유입시키고 워터재킷을 통과한 물을 배출시키는 펌프구동부(30), 펌프구동부(30)의 상면을 덮어 밀폐시키는 방수개스킷(40), 펌프구동부에 구동력을 제공하는 구동모터(45) 및 냉각부(50)를 중앙처리장치(10)에 장착시키는 결합클립으로 이루어지며, 펌프구동부(30)의 배출부 (35)에는 워터재킷(20)의 물을 배출시키는 임펠러(36)가 장착된다.

본 발명에 따른 워터재킷(20)은 중앙처리장치(10)의 상면에 장착되어, 라디에이터(60)에서 냉각되어 배출된 냉각수를 펌프구동부(30)를 거쳐 유입받아 내부로 통과시키면서 중앙처리장치(10)를 냉각시키고, 내부를 통과하면서 중앙처리장치로부터 전달받은 열에 의해 덥혀진 물을 펌프구동부(30)를 통해 라디에이터(60)로 다시 배출한다. 워터재킷(20)에는 펌프구동부로부터 냉각수가 유입되는 유입구(22)와 펌프구동부로 물이 배출되는 배출구(24)가 구비된다. 워터재킷의 유입구(22)는 펌프구동부의 유입구(32)의 수직방향의 연장선 상에 위치하도록 하여 펌프구동부와 워터재킷의 결합시 양 유입구(32, 22)가 연결되도록 한다. 또한, 라디에이터(60)로부터의 냉각수가 워터재킷(20)으로 바로 유입되도록 구성할 수도 있는데, 이 경우 라디에이터의 배출튜브(66)를 워터재킷의 유입구(22)에 바로 연결하도록 한다. 또한, 워터재킷의 배출구(24)는 펌프구동부의 배출부(35) 하부에 형성되는 공간(35a)에 노출됨으로써 워터재킷을 순환한 물이 배출부(35)로 배출될 수 있도록 한다.

워터재킷(20)은 열전도도와 열교환율이 뛰어난 알루미늄 또는 구리재질을 사용하도록 하며, 제작비용 등을 고려할 때 알루미늄 재질을 사용하는 것이 바람직하다.

또한, 워터재킷(20)의 내부로는, 복수의 다공성 알루미늄 판(26)을 겹친 후 브레이징 처리를 하여 다중수로를 구성하도록 한다. 보다 구체적으로는, 벌집 모양의 다공성 알루미늄 판(26)을 겹쳐서 쌓은 후 알루미늄 판 사이에 알루미늄 분자가루를 뿌려서 접합하도록 한다. 이를 통해, 접합된 알루미늄 판이 상호 동일재질로 인식되며, 워터재킷(20)의 내부로 벌집모양의 다중수로가 형성된다. 따라서, 워터재킷으로 유입된 냉각수는 워터재킷의 내부에 형성된 다중수로로 분산 통과하게 되어 열교환 효율을 극대화할 수 있게 된다.

이와 같이, 워터재킷(20)의 열전도도와 열교환 효율을 높임으로써, 워터재킷을 통과하는 냉각수는 중앙처리장치(10)의 열을 효과적으로 빼앗게 되어, 결국에는 냉각수와 중앙처리장치의 온도가 상호 평형에 가까워지게 된다. 따라서, 중앙처리장치의 냉각효과를 극대화할 수 있다.

워터재킷(20)을 통과하면서 온도가 올라간 물은, 워터재킷의 배출구(24)를 통해 펌프구동부(30)의 배출부(35)로 배출된 후 임펠러(36)의 작동에 의해 펌프구동부의 배출구(34)로 배출되어 유입튜브(68)를 통해 라디에이터(60)로 유입된다.

본 발명에 따른 펌프구동부(30)는 워터재킷(20)의 상부에 장착되어, 라디에이터(60)로부터 배출된 냉각수를 워터재킷으로 유입시키고, 워터재킷을 통과한 물을 끌어올려 라디에이터(60)로 배출한다. 펌프구동부(30)는, 배출튜브(66)

와 연결되어 라디에이터(60)로부터 배출된 냉각수가 유입되는 유입구(32), 워터재킷(20)을 통과한 물이 유입튜브(68)로 배출되는 배출구(34) 및 워터재킷으로부터 배출된 물이 고이도록 홈 형상을 이루며 내부에 임펠러(36)가 장착되는 배출부(35)를 구비한다. 배출부(35)는 임펠러(36)의 동작에 의해 워터재킷으로부터 끌어올려진 물이 일정량 고일 수 있도록 움푹 파인 홈 형상으로 이루어지며, 일측면으로 고인 물이 임펠러(36)의 동작에 의해 배출되는 배출구(34)가 형성된다. 또한, 배출부의 하부로는 워터재킷(20)의 배출구(24)가 노출되어 개방될 수 있도록 공간(35a)이 형성되며, 상기 공간을 통해 워터재킷의 물이 배출부로 배출되게 된다. 따라서, 워터재킷(20)을 통과한 물은 임펠러(36)의 작동에 의해 배출부(35)로 끌어올려진 후 펌프구동부(30)의 배출구(34)로 배출되어 유입튜브(68)를 통해 라디에이터(60)로 유입된다.

펌프구동부(30)의 유입구(32)와 배출구(34)는 배출튜브(66)와 유입튜브(68)에 연결되어 라디에이터(60)와 물을 순환시키게 되는데, 각 튜브와 유입구 및 배출구 사이의 연결부위에서 물이 새는 것을 방지하기 위하여 연결볼트(39a)와 연결너트(39b)를 사용하도록 한다. 배출튜브(66) 및 유입튜브(68)를 유입구(32) 및 배출구(34)에 연결하기 위하여는, 유입구(32)와 배출구(34)에 연결볼트(39a)의 일단을 결착하고, 각 튜브의 일단을 연결너트(39b)에 삽입 통과시켜 연결볼트의 결착되지 않은 일단에 끼운 후, 연결너트(39b)를 튜브가 끼워진 연결볼트(39a)에 결착하도록 한다. 이때, 라디에이터(60)의 유입구(62)와 배출구(64) 또한, 상기 방법에 의해 각 튜브와 연결할 수 있음은 물론이다.

펌프구동부(30)의 재질로는 플라스틱을 사용하는 것이 바람직하며, 워터재킷 (20)과 동일하게 알루미늄 또는 구리 재질을 사용할 수도 있다.

본 발명에 따른 임펠러(36)는 펌프구동부(30)의 배출부(35)에 장착되며, 하부에는 워터재킷(20)의 물을 배출부(35)로 끌어올려 배출구(34)로 배출하기 위한 복수의 회전날개(37)를 구비한다. 또한, 임펠러(36)는 구동모터(45)로부터 구동력을 전달받기 위하여 복수의 금속축(36a)을 구비한다. 통상적으로 모터의 구동력은 구동축에 의해 전달되지만, 본 발명은 구동모터(45)에 구동력을 전달하기 위한 복수의 자석축(45a)을 구비하고 임펠러(36)에는 상기 자석축을 통해 구동모터 (45)의 구동력을 전달받기 위한 복수의 금속축(36a)을 구비하는 마그네틱 펌프방식을 사용하도록 한다. 이때, 구동모터에 자석 대신 금속축을 구비하고 임펠러에 자석축을 구비할 수 있음은 물론이다. 상기 자석축(45a)과 금속축(36a)은 각각 구동모터(45)와 임펠러(36)에 종방향으로 복수개 구비되며, 상호 장착위치가 동일하도록 형성된다. 따라서, 임펠러(36)는 구동모터(45)와 별도의 구동축을 설치하지 않으면서 자력에 의해 구동모터에 연동되어 구동모터의 구동력에 의해 회전하게 된다. 이와 같이, 마그네틱 펌프방식을 사용할 경우, 구동축과의 마찰로 인한 소음을 없앨 수 있다.

임펠러(36)의 회전날개(37)는 순환형 또는 자흡형으로 형성할 수 있는데, 바람직하게는 자흡형으로 형성하도록 한다. 순환형은 회전날개(37)의 측면 모양이 직사각형으로 이루어진 것이며, 자흡형은 회전날개를 일정 각도로 꺾어서 형성한 것으로 회전날개의 측면 모양이 사다리꼴 또는 삼각형을 이루게 된다. 이때, 회전날개를 꺾는 각도는 임의의 각도로 정할 수 있다.

순환형의 경우, 배출부(35)에 물이 가득 차 있을 때에만 정상적으로 동작하게 되며, 배출부에 물과 함께 에어가 섞여 있을 경우 정상적으로 동작하지 않고 정지하게 된다. 따라서, 회전날개로 순환형을 사용할 경우 워터재킷(20)에 에어가 섞여 있으면 임펠러(36)가 중간에 정지할 수 있어 사용이 불편한 단점이 있다. 이에 반해, 자흡형은 배출부(36)에 에어가 차 있는 상태에서도 정상적으로 작동하면서 물을 배출하게 된다. 따라서, 워터재킷(20)에 에어가 차 있는 경우에도 문제없이 사용할 수 있다.

임펠러(36)가 펌프구동부(30)의 배출부(35)에 장착되어 동작하게 되면, 임펠러 주변부의 틈을 통해 물이 새어나올 수

있으며, 이 경우 컴퓨터 내부 장치를 손상시키게 된다. 따라서, 이를 방지하기 위하여 펌프구동부와 임펠러의 상면으로 방수개스킷(40)이 장착하여 밀폐시키도록 한다. 방수개스킷으로는 방수성이 뛰어난 실리콘 플레이트를 사용하도록 하며, 임펠러의 적어도 임펠러의 주변부를 덮을 수 있도록 한다. 따라서, 펌프구동부(30)와 임펠러(36)의 상부를 완전히 밀폐시켜 완전 방수시킬 수 있다. 또한, 방수개스킷(40)에 의해 구동모터(45)와 임펠러가 상호 접촉하지 않게 되므로 구동부와 순환부가 완전 분리되게 된다. 상기한 바와 같이, 본 발명은 구동모터(45)와 임펠러(36) 간을 구동축에 의한 물리적인 접촉이 아닌 자력에 의해 연동시키므로, 구동부와 순환부를 분리시킬 수 있으며, 이를 통해 소음을 줄일 수 있게 된다.

본 발명에 따른 구동모터(45)는 외부로부터 전원을 공급받아 구동력을 발생하여 임펠러(36)를 작동시키며, 구동력을 임펠러에 전달하기 위하여 저면으로 노출된 복수의 자석축(45a)을 구비한다. 상기 각 자석축(45a)은 임펠러(36)에 장착 구비되는 금속축(36a)의 장착위치와 동일한 위치에 구비되며, 임펠러의 금속축과 연동하여 구동모터로부터 발생되는 구동력을 임펠러에 전달하게 된다.

구동모터(45)로는 BLDC(Brushless DC) 모터를 사용하도록 하며, 자석축(45a)은 영구자석, 특히 알리코 자석으로 형성하도록 한다.

알리코 자석은 알루미늄(Aluminium), 니켈(Nickel) 및 코발트(Cobalt)를 주원료로 하며, 스피커, 계기류, 마이크, 리드스위치, 램프 등에 주로 사용되는 자석이다. 알리코 자석은 온도에 따른 자속량의 변화가 극히 적어 온도에 대한 안정성이 높으며(최대 850℃), 자속밀도와 경도가 높은 장점이 있는 반면, 보자력이 약해 외부자계에 의해 쉽게 감자가 일어난다는 단점이 있다. 실제로 알리코 자석은 착자시킨 직후에는 매우 흡착력이 강하지만 붙였다 떼었다를 반복할 경우 자력이 거의 없어질 정도로 약해진다. 따라서, 본 발명에 따른 구동모터(45)는 설치 후 분리할 경우가 거의 발생되지 않으므로 흡착력이 강한 알리코 자석을 사용하는 것이 바람직하다고 할 수 있다.

워터재킷(20)의 물을 라디에이터로 원활하게 끌어올리기 위하여는, 구동모터(45)의 회전속도는 2000rpm 이상을 유지하도록 하며, 바람직하게는 2800rpm 정도를 유지하도록 한다. 종래의 공랭식 쿨러의 경우 쿨링팬이 최소 5000rpm 이상으로 회전하여야 하므로 소음이 심한 문제점이 있었으나, 본 발명에 따른 구동모터(45)는 종래의 쿨링팬의 절반 수준의 속도로 회전하면 되므로 구동모터 작동으로 인한 소음 발생을 현저하게 줄일 수 있다. 또한, 종래의 쿨링팬과 달리 구동모터에는 날개가 필요없으므로 날개로 인한 소음 발생을 없앨 수 있다.

도 5 는 본 발명에 따른 라디에이터를 나타낸 도로서, 5a 는 라디에이터의 사시도이고, 도 5b 는 라디에이터의 단면도이다. 특히, 도 5b 는 라디에이터(60)의 내부 모습을 보다 상세하게 나타내기 위하여, 라디에이터의 상면 일부와 측면을 절개한 단면을 도시하였다. 도 5a 및 도 5b 에 도시한 바와 같이, 본 발명에 따른 라디에이터(60)의 정면으로는, 워터재킷(20)을 통과한 물이 유입되는 유입튜브(68)가 연결되는 유입구(62)와 냉각수를 배출하기 위한 배출튜브(66)가 연결되는 배출구(64)가 구비되며, 라디에이터(60)의 내부로는, 수로(65a)가 지그재그 형태로 내부에 형성된 복수의 패널(65)이 병렬로 배치되어 다중수로가 형성된다. 또한, 라디에이터의 크기를 크게 하여 냉각효율을 극대화 할 수 있다.

라디에이터(60)의 내부에 구비되는 각 패널(65)은 열 전도도와 열 교환율이 뛰어난 알루미늄 또는 구리재질을 사용하도록 하며, 가격 측면을 고려할 때 알루미늄 재질을 사용하는 것이 바람직하다.

라디에이터(60)의 정면에 구비되는 유입구(62)와 배출구(64)는 상기 각 패널(65)에 형성된 각 수로(65a)와 도통되어 있다. 따라서, 유입구(62)로 유입된 물은 각 수로(65a)로 분산되어 유입 통과한 후 배출구(64)로 통합되어 배출된다. 이와 같이, 본 발명에 따른 라디에이터(60)는 유입된 물을 분산시켜 동시에 냉각시키므로 냉각효율을 높일 수 있다.

또한, 라디에이터(60)의 정면 또는 배면으로는 라디에이터 내부의 각 수로(65a)를 통과하는 물을 냉각시키기 위한 쿨링팬(70)이 장착된다. 쿨링팬(70)이 라디에이터의 정면에 장착될 경우에는 컴퓨터 본체 내부의 공기를 순환시킴으로써 내부에 장착되는 구성요소들을 냉각시킬 수 있다.

본 발명에 따른 컴퓨터 중앙처리장치용 수냉식 냉각장치는 라디에이터(60)를 통해 내부의 물을 주입 또는 교체할 수 있다. 즉, 라디에이터(60)에 별도의 주입구를 구비하거나 라디에이터의 유입구와 배출구에 별도의 호스를 연결하여 물을 주입하거나 교체할 수 있다. 따라서, 워터재킷(20)에 공기가 섞여 있는 상태에서도 물을 주입할 수 있다.

발명의 효과

이상 설명한 바대로, 본 발명에 따른 컴퓨터 중앙처리장치용 수냉식 냉각장치는 종래의 공랭식 쿨러에 비하여 탁월한 냉각효과를 제공하여 중앙처리장치가 최적의 성능을 발휘할 수 있을 뿐만 아니라, 작동시 소음이 거의 발생하지 않으므로 사용자의 작업환경을 개선할 수 있는 현저한 효과가 있다.

다시말해서, 본 발명에 따른 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치는,

첫째로, 물을 이용하여 냉각하므로 중앙처리장치의 냉각효율을 높일 수 있고,

둘째로, 물의 특성상 중앙처리장치를 상온에 가깝게 냉각하여 중앙처리장치가 최적의 성능을 발휘할 수 있도록 하고, 중앙처리장치의 고장가능성을 배제할 수 있으며,

셋째로, 워터재킷의 재질로 열 전도도와 열 교환율이 뛰어난 알루미늄 또는 구리재질을 사용하고, 내부구조를 다공성 벌집구조로 형성하여 냉각수가 분산 통과하게 함으로써 중앙처리장치로부터 발생되는 열을 효과적으로 교환하여 냉각효율을 극대화할 수 있으며,

넷째로, 마그네틱 펌프 방식을 사용하여 구동축의 마찰로 인한 마찰음을 없애고, 구동모터의 회전속도를 종래의 공랭식 쿨러에 비해 절반 수준으로 줄일 수 있으므로 작동시 발생되는 소음을 현저하게 줄일 수 있으며,

마지막으로, 별도의 구조적 또는 형태적 변형없이 규격 등의 약간의 변형만으로 인텔 또는 AMD에서 제공하는 중앙처리장치에 공히 적용이 용이한 효과가 있다.

본 발명의 바람직한 실시례가 특정 용어들을 사용하여 기술되어 왔지만, 그러한 기술은 오로지 설명을 하기 위한 것이며, 다음의 청구범위의 기술적 사상 및 범위로부터 이탈되지 않고서 여러 가지 변경 및 변화가 가해질 수 있는 것으로 이해되어져야 한다.

(57) 청구의 범위

청구항 1.

냉각된 물을 유입받아 내부로 순환시켜 컴퓨터의 중앙처리장치를 냉각시키는 컴퓨터 중앙처리장치용 수냉식 냉각장치로서,

상기 중앙처리장치의 상면에 장착 구비되며, 상기 냉각된 물이 유입되는 제 1 유입구, 상기 내부를 순환한 물이 배출되어 고이도록 움푹 들어간 홈 형상으로 이루어진 배출부 및 상기 배출부의 일측면에 구비되어 상기 배출부에 고인 물이 배출되는 제 1 배출구를 구비하며, 상기 냉각된 물을 유입받아 내부로 순환시킨 후 배출하는 순환부;

상기 순환부의 상기 배출부에 장착 구비되며, 저면에 복수의 회전날개를 구비하여 회전력에 의해 상기 배출부의 물을 상기 제 1 배출구로 배출시키는 임펠러; 및

상기 임펠러의 상부에 장착 구비되며, 외부로부터 전원을 공급받아 상기 임펠러에 구동력을 전달하여 상기 임펠러를 구동시키는 구동모터를 구비하는 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

청구항 2.

제 1 항에 있어서,

상기 컴퓨터 중앙처리장치용 수냉식 냉각장치가,

상기 순환부, 상기 임펠러 및 상기 구동모터의 결합체를 상기 중앙처리장치에 장착시키는 결합클립을 더 구비하는 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

청구항 3.

제 1 항에 있어서,

상기 순환부가,

상기 제 1 유입구, 상기 배출부 및 상기 제 1 배출구를 구비하는 펌프구동부; 및

상기 펌프구동부의 하부로 상기 중앙처리장치의 상면에 장착 구비되며, 상기 제 1 유입구의 연장선 상에 구비되어 상기 냉각된 물이 유입되는 제 2 유입구, 상기 유입된 냉각된 물이 순환하도록 내부에 형성된 수로 및 상기 순환한 물이 배출되며 상기 배출부 하부에 형성된 소정의 공간으로 개방 형성된 제 2 배출구를 구비하는 워터재킷을 구비하는 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

청구항 4.

제 1 항에 있어서,

상기 순환부가,

상기 제 1 유입구, 상기 배출부 및 상기 제 1 배출구를 구비하는 펌프구동부;

상기 펌프구동부의 하부로 상기 중앙처리장치의 상면에 장착 구비되며, 상기 제 1 유입구의 연장선 상에 구비되어 상기 냉각된 물이 유입되는 제 2 유입구, 상기 유입된 냉각된 물이 순환하도록 내부에 형성된 수로 및 상기 순환한 물이 배출되며 상기 배출부 하부에 형성된 소정의 공간으로 개방 형성된 제 2 배출구를 구비하는 워터재킷;

상기 제 1 유입구와 상기 제 2 유입구 사이를 연결하며, 상기 워터재킷과 상기 펌프구동부 사이에 노출 형성되는 유입파이프; 및

상기 배출부와 상기 제 2 배출구 사이를 연결하며, 상기 워터재킷과 상기 펌프구동부 사이에 노출 형성되는 배출파이프를 구비하는 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

청구항 5.

제 4 항에 있어서,

상기 컴퓨터 중앙처리장치용 수냉식 냉각장치가,

상기 워터재킷을 상기 중앙처리장치에 장착시키는 결합클립을 더 구비하는 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

청구항 6.

제 3 항 또는 제 4 항 중 어느 한 항에 있어서,

상기 워터재킷이 알루미늄 재질로 이루어진 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

청구항 7.

제 3 항 또는 제 4 항 중 어느 한항에 있어서,

상기 워터재킷의 내부로,

다수의 구멍이 벌집모양으로 형성된 복수의 다공성 알루미늄 판을 적층시킨 후 브레이징 기법을 통해 접합하여 다층수로가 형성된 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

청구항 8.

제 1 항에 있어서,

상기 컴퓨터 중앙처리장치용 수냉식 냉각장치가,

상기 순환부와 상기 임펠러의 상면 중 적어도 상기 임펠러의 주변부를 덮도록 형성된 방수개스킷을 더 구비하는 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

청구항 9.

제 8 항에 있어서,

상기 방수개스킷이 실리콘 플레이트로 이루어진 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

청구항 10.

제 1 항에 있어서,

상기 구동모터가 상기 임펠러와 대응하는 면에 노출 형성되는 복수의 자석축을 구비하고,

상기 임펠러가 상기 각 자석축과 동일위치에 복수의 금속축를 구비하여,

상기 각 자석축과 상기 각 금속축이 상호 연동되어 상기 구동모터의 구동력을 상기 임펠러에 전달하는 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

청구항 11.

제 10 항에 있어서,

상기 자석축이 알리코 자석으로 이루어진 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

청구항 12.

제 1 항에 있어서,

상기 임펠러의 상기 각 회전날개가,

하단부가 소정 각도로 꺾인 자을형인 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

청구항 13.

제 1 항에 있어서,

상기 컴퓨터 중앙처리장치용 수냉식 냉각장치가,

상기 순환부를 통과한 물을 유입받아 내부로 순환시켜 냉각한 후 상기 냉각된 물을 배출하고, 상기 제 1 배출구로 배출되는 물을 유입받는 제 3 유입구, 상기 유입된 물이 분산되어 순환하도록 내부에 형성된 복수의 수로 및 상기 각 수로를 통과한 물을 배출하는 제 3 배출구를 구비하는 라디에이터;

상기 제 1 배출구에 일단이 연결되고 상기 제 3 유입구에 일단이 연결되어 상기 제 1 배출구로 배출되는 물을 상기 제 3 유입구로 유입시키는 유입튜브; 및

상기 제 3 배출구에 일단이 연결되고 상기 제 1 유입구에 일단이 연결되어 상기 제 3 배출구로 배출되는 냉각된 물을 상기 제 1 유입구로 유입시키는배출튜브를 더 구비하는 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

청구항 14.

제 13 항에 있어서,

상기 컴퓨터 중앙처리장치용 수냉식 냉각장치가,

상기 라디에이터의 일면에 장착되며, 외부로부터 전원을 공급받아 회전하여 상기 라디에이터의 내부를 순환하는 상기 물을 냉각시키는 쿨링팬을 더 구비하는 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

청구항 15.

제 13 항에 있어서,

상기 라디에이터의 내부로,

내부에 지그재그 형태로 수로가 형성된 복수의 패널이 적층되어 결합 배치되는 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

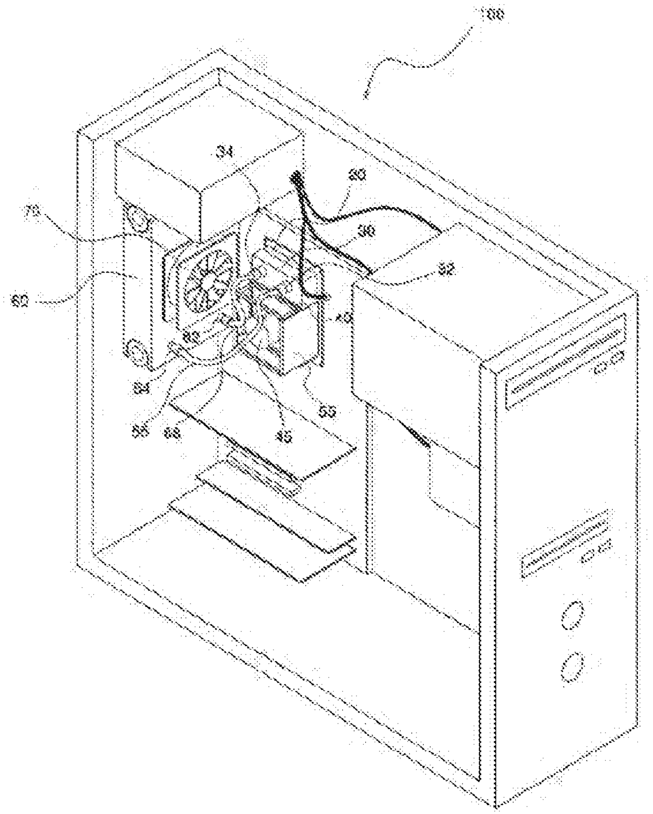
청구항 16.

제 13 항에 있어서,

상기 라디에이터가 알루미늄 재질로 이루어진 것을 특징으로 하는 임펠러를 구비하는 컴퓨터 중앙처리장치용 수냉식 냉각장치.

도면

도면 1



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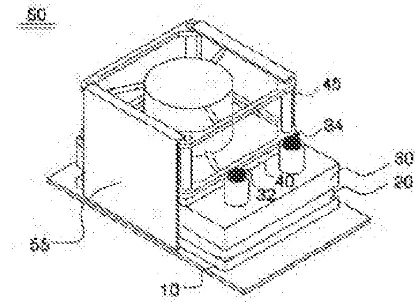
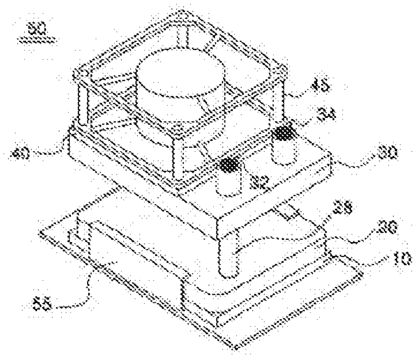


(a)



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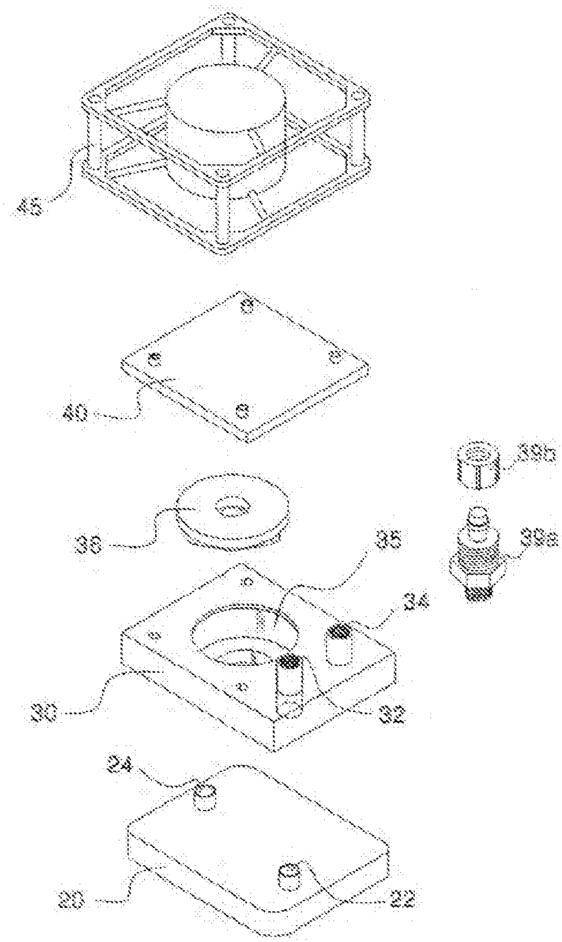
도면 3



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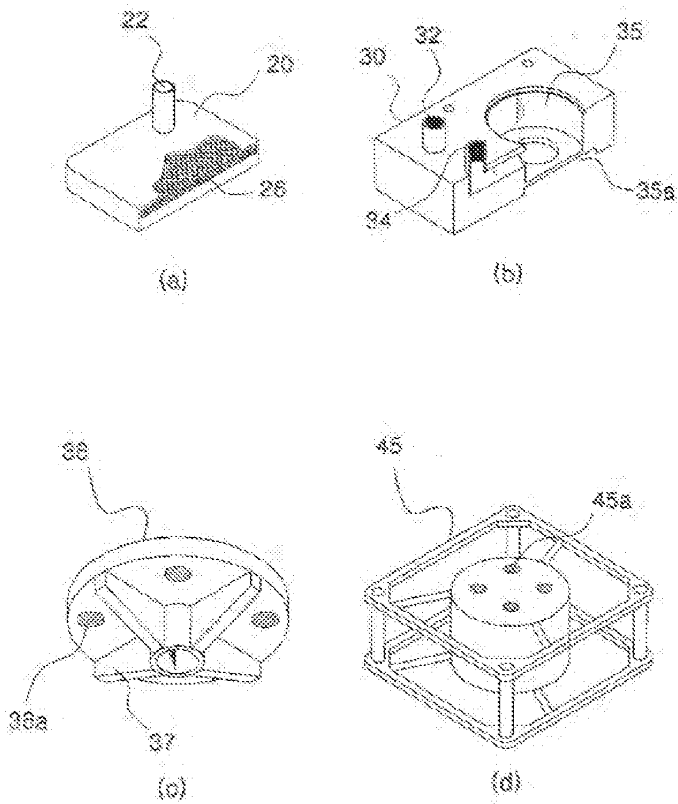

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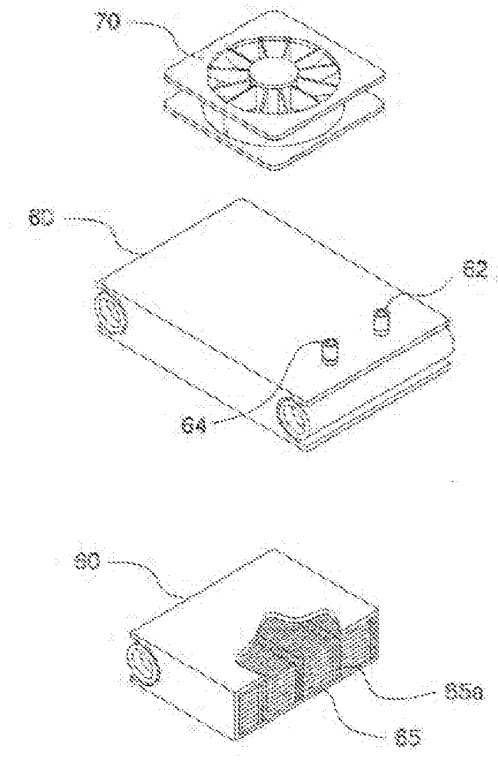

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Basic Requirements

Examination Examiner: Kim Dong-seong

Technology Evaluation Request: None

(54) WATER COOLER FOR COMPUTER CENTRAL PROCESSING UNIT HAVING IMPELLER

Abstract

A water cooler for a computer central processing unit (CPU) having an impeller, which introduces cooled water therein to circulate the cooled water therein, thereby cooling the CPU of the computer includes:

a circulator including a first inlet through which the cooled water is introduced, the first inlet being mounted on a top surface of the CPU, a discharge part having a recessed groove shape so that the water circulating within the water cooler is discharged and pooled, and a first outlet disposed on a surface of the discharge part to discharge the water pooled in the discharge part, wherein the circulator introduce the cooled water to circulate the introduced water therein, thereby discharging the water;

an impeller mounted on the discharge part of the circulator, and the impeller including a plurality of rotation blades on a bottom surface thereof to discharge the water within the discharge part to the first outlet by a rotation force; and

a driving motor mounted above the impeller, the driving motor receiving a power from the outside to transmit a driving force into the impeller, thereby driving the impeller.

Representative Drawing:

FIG. 1

Index

Cooler; Water cooler; CPU; Computer

Specification

Brief Description Of The Drawings

FIG. 1 is a view illustrating an inner structure of a computer on which a water cooler for a computer central processing unit (CPU) having an impeller is mounted according to the present device.

FIG. 2a is a view illustrating a state in which a cooling unit is mounted on the CPU according to the present device.

FIG. 2b is a view of a state in which a cooling unit according to another enbodiment is mounted on the CPU according to the present device.

FIG. 3 is an exploded perspective view of the cooling unit according to the present device.

FIG. 4a is a cross-sectional view of a water jacket according to the present device.

FIG. 4b is a cross-sectional view of a pump driver according to the present device.

FIG. 4c is a perspective view of an impeller according to the present device when viewed from a lower side.

FIG. 4d is a perspective view of a driving motor according to the present device when viewed from the lower side.

FIG. 5a is a perspective view of a radiator according to the present device.

FIG. 5b is a cross-sectional view of the radiator according to the present device.

*** Descriptions about reference numerals in the drawings ***

10: CPU	20: Water jacket
30: Pump driver	36: Impeller
40: Waterproof jacket	45: Driving motor
50: Cooling unit	60: Radiator
70: Cooling fan	100: Computer body

Detailed Description Of The Device

Object Of The Present Device

Field Of The Device And Description Of The Related Art

The present device relates to a water cooler for a computer central processing unit (CPU) having an impeller, and more particularly, to a water cooler for a computer CPU having an impeller, in which water cooled by a radiator is circulated into a water jacket attached on a top surface of the computer CPU of the computer to cool heat generated from the CPU.

Recently, with the rapid development in technologies, a data processing rate of a CPU is being rapidly improved. Meanwhile, since heat generated by an operation of a CPU is increased according to the data processing rate of the CPU, an amount of heat generated from the CPU may be increased as the data processing rate of the CPU is increased. In general, a CPU has optimal operation performance at a temperature approaching room temperature. If the temperature is excessively high, the data processing rate may be reduced, and also the possibility of error occurrence in processed results may be increased. Also, if the heat generated from the CPU is too high in temperature, the computer may be stopped in operation to cause a loss of working data. If this phenomenon is continuous, the expensive CPU may be damaged or broken.

Therefore, in order to solve these problems, heat generated from the CPU should be cooled. In a related art, an air cooling-type cooler has been used to reduce a temperature of a CPU by rotating a cooling fan.

The air cooling-type cooler is the most common cooler that has been used since a time point at which a processing rate of a CPU is beyond about 100 MHz. In detail, an air cooling-type cooler set constituted by a heatsink plate and a cooling fan is attached on the CPU, and then, the cooling fan is rotated at a high rate to reduce the temperature of the CPU. That is, heat generated from the CPU is transmitted to the heatsink plate, and the cooling fan is rotated to cool the heat in the radiator, thereby cooling the CPU.

In recent years, to reduce an amount of heat that is increasingly generated as a CPU is improved in performance, there is a need for providing a large-scale air cooling-type cooler and operating the air cooling-type cooler at a high rate. Typically, the air cooling-type cooler requires a rotation rate of at least 5000 rpm. An air cooling-type cooler proposed in recent years is operated at a rate of about 6000 times per minute or more.

However, the air cooling-type cooler involves several problems as follows.

First, a cooler using high-performance cooling fan may be increased in noise. As the CPU is improved in performance, an amount of heat is increased. Thus, so as to improve performance of the cooler, a cooling fan which is rotated at higher rate is requested. However, due to a feature in which a noise is proportional to a rotation rate, the more the cooling fan is increased in rotation rate, the more noises generated from the cooling fan are increased. Thus, there is a problem that a user gets stresses by the noise.

Second, in a case of the air cooling-type cooler, since air within a case is circulated, cooling efficiency may be deteriorated. Commonly, when users use a computer, a case of a desktop is in a closed state. Here, although external air is slightly introduced, an amount of introduced air is incomplete. As a result, in the case of the air cooling-type cooler, internal air should be circulated to cool the CPU. Thus, if the computer is not used for a long time, internal air may be cooled to provide superior cooling efficiency. However, if the computer is used for a long time, and thus the internal air is increased in temperature by a CPU and all peripheral devices raise, warm air may be circulated to significantly decrease the cooling efficiency. Also, for overcome this problem, if the users use the computer in a state where the case is opened, noises generated from the cooler and the likes may be directly transmitted to the users. Particularly, in a case of the latest CPU that runs at about 2 GHz, an air cooling-type cooler set is reaching a limit.

Third, a CPU may exert optimal operation performance at room temperature. However, since a cooling fan in a conventional air cooling-type cooler is operated at the same rate in hot summer or cold winter, cooling efficiency may be deteriorated, or the CPU may be damaged. If the CPU is suddenly operated at a temperature below the freezing point, the CPU suddenly may generate heat to form dewdrops on a surface of the CPU due to sudden changes in temperature, thereby causing the damage of the CPU.

Technical Object Of The Device

To solve the above-described problems, an object of the present device is to provide a water cooler for computer CPU having an impeller which cools heat generated from the CPU by using cooled and circulating water.

That is, the present device is to provide a water cooler for computer CPU in which water cooled while passing through a radiator passes through a water jacket attached to the CPU to decrease a temperature of the CPU, and water warmed by heat generated from the CPU is pumped to the radiator through a pump driver to circulate the water, thereby cooling the CPU.

Constitution And Operation Of The Device

To achieve the above described purpose, a water cooler for a computer central processing unit (CPU) having an impeller, which introduces cooled water therein to circulate the cooled water therein, thereby cooling the CPU of the computer, the water cooler including: a circulator including a first inlet through which the cooled water is introduced, the first inlet being mounted on a top surface of the CPU, a discharge part having a recessed groove shape so that the water circulating within the water cooler is discharged and pooled, and a first outlet disposed on a surface of the discharge part to discharge the water pooled in the discharge part, wherein the circulator introduce the cooled water to circulate the introduced water therein, thereby discharging the water; an impeller mounted on the discharge part of the circulator, and the impeller including a plurality of rotation blades on a bottom surface thereof to discharge the water within the discharge part to the first outlet by a rotation force; and a driving motor mounted above the impeller, the driving motor receiving a power from the outside to transmit a driving force into the impeller, thereby driving the impeller.

The circulator includes:

a pump driver including the first inlet, the discharge part, and the first outlet; and a water jacket including a second inlet mounted on a top surface of the CPU and under the pump driver, the second inlet being disposed in an extension line of the first inlet to introduce the cooled water therein, a water passage formed in the water jacket so that the introduced cooled water is circulated, and a second outlet through which the circulated water is discharged, the second outlet being opened to a predetermined space formed in a lower portion of the discharge part, or

a water jacket including a second inlet mounted on a top surface of the CPU and under the pump driver, the second inlet being disposed in an extension line of the first inlet to introduce the cooled water therein, a water passage formed in the water jacket so that the introduced cooled water is circulated, and a second outlet through which the circulated water is discharged, the second outlet being opened to a predetermined space formed in a lower portion of the discharge part; an inflow pipe connecting the first inlet to the second inlet, the inflow pipe being exposed between the water jacket and the pump driver; and a discharge pipe connecting the discharge part to the second outlet, the discharge pipe being exposed between the water jacket and the pumper driver.

Also, the water jacket is formed of an aluminum material, and a plurality of porous aluminum plate having a plurality of honeycomb-shaped holes are laminated and bonded to each other through a brazing method to form multiple water passages within the water jacket, and

each of the rotation blades of the impeller is a magnetic field emission type rotation blade of which a lower end is trimmed at a predetermined angle.

Preferably, the water cooler further includes

a waterproof gasket formed of a waterproofing material to cover at least a peripheral portion of the impeller on the circulator and a top surface of the impeller.

a radiator in which the water passing through the circulator is introduced to circulate the introduced water therein and cool the water, thereby discharging the cooled water, the radiator including a plurality of water passages formed by laminating and coupling a plurality of panels in which water passages having a zigzag shape are formed therein to each other, wherein the radiator includes a third inlet which introduces the water discharged through the first outlet to disperse and introduce the water into each of the water passages and a third outlet discharging the water passing through each of the water passages; an inflow tube having one end connected to the first outlet and one end connected to the third inlet to introduce the water discharged through the first outlet into the third inlet; and a discharge tube having one end connected to the third outlet and one end connected to the first inlet to introduce the cooled water discharged through the third outlet into the first inlet.

Also, the driving motor includes a plurality of magnet shafts exposed to a surface corresponding to the impeller, the impeller includes a plurality of metal shafts at the same position as each of the magnet shafts, and each of the magnet shafts is interlocked with each of the metal shafts to transmit the driving force of the driving motor to the impeller.

Hereinafter, advantages, characteristics, and preferred embodiments of the present device will be described in more detail with reference to the accompanying drawings.

FIG. 1 is a view illustrating an inner structure of a computer on which a water cooler for a computer central processing unit (CPU) having an impeller is mounted according to the present device. FIG. 1 is merely a view for describing a mounted state and an operation of a water cooler for a computer CPU having an impeller according to the present device, and also, other inner components of the computer, which are not a subject of the present device, are schematically illustrated, and their descriptions will be omitted below.

As shown in FIG. 1, a water cooler for a computer CPU having an impeller according to the present device includes a cooling unit mounted on the CPU to cool heat generated from the CPU while cooled water passes therethrough and a radiator 60 receiving water warmed by the heat generated from the CPU while passing through the cooling unit to cool the warmed water. The cooling unit is mounted on a top surface of the CPU, and the radiator 60 is mounted on one surface within a computer body 100, preferably, inside a back surface of the main body. Also, a cooling fan 70 for cooling the water passing through the radiator is mounted on a front or rear side of the radiator 60.

The cooling unit includes a water jacket 20 mounted on the top surface of the CPU to allow the cooled water to pass therethrough, a pump driver 30 discharging the water warmed by heat generated from the CPU while passing through the water jacket through a rotation force of the impeller to pump the water up to the radiator 60, and a driving motor 45 driving the impeller. The water jacket, the pump driver, and the driving motor constituting the cooling unit may be laminated on and coupled to each other and then be mounted on the CPU by a coupling clip 55 in a mutually coupled state. The coupling clip 55 may have a "ㄷ" shape. The coupling clip has a lower portion attached and fixed to a main board or board that is disposed under the CPU and an upper portion coupled and attached to an upper end of the driving motor, thereby fixing the cooling unit. Also, since water may leak through a connection part between the pump driver and the impeller, a waterproof gasket 40 may cover and seal top surfaces of the pump driver and the impeller. Here, a silicon plate having an excellent waterproofing property may be used as the waterproof gasket.

Two tubes 66 and 68 connecting the pump driver 30 to the radiator 60 may be disposed between the cooling unit and the radiator to circulate the water passing through the water jacket 20 and cooling water. Thus, cooled water while passing through the radiator 60 may be discharged through a discharge tube 66 to flow into the water jacket 20 via the pump driver 30. The water passing through the water jacket may be introduced into the radiator an inflow tube 68 via the pump driving part. Since the inflow tube and the discharge tube are connected to inlets 32 and 62 and outlets 34 and 64 of the pump driver and the radiator, connected portions therebetween may be tightly clamped by using connecting bolts and nuts to prevent the water from leaking through the connected portions. Also, the discharge tube 66 may not be connected to the pump driver 30, but be directly connected to the water jacket 20 so that the cooling water discharged from the radiator 60 may be directly introduced into the water jacket without passing through the pump driver.

The radiator 60 may circulate water increasing in temperature while passing through the water jacket 20 to cool the water through an operation of the cooling fan 70. Here, the cooling fan 70 may be disposed on a front side of the radiator to circulate internal air of the computer body 100. Alternately, the cooling fan may be disposed on a rear side of the radiator, and a plurality of holes may be formed in a back surface of the computer body to allowing the cooling fan to circulate external air, thereby improving the cooling efficiency of the radiator. The cooling fan 70 may be disposed on various positions depending on conditions of a system.

FIG. 2a is a view illustrating a state in which a cooling unit is mounted on the CPU according to the present device. As shown in FIG. 2a, the cooling unit 50 according to the present device may be fixed and mounted on the CPU 10. Here, the water jacket 20, the pump driver 30, the waterproof gasket 40, and the driving motor 45 may be successively disposed on the CPU and then be fixed and mounted to the CPU by the coupling clip 55. Here, it is preferable that the water jacket, the pump driver, the waterproof gasket, and the driving motor may be fixed to each other by using a separate fixing unit such as a coupling screw.

As described above, the cooling water cooled in the radiator 60 may be introduced into the water jacket 20 via the pump driver 30 to cool the CPU 10 disposed under the water jacket. The water passing through the water jacket 20 may be discharged again into the radiator 60 through the pump driver 30 again. More particularly, the cooling water discharged from the radiator 60 through the discharge tube 66 may be introduced into the inlet 32 of the pump driver 30 and then be introduced into the inlet 22 of the water jacket 20 connected to the inlet of the pump driver. Also, the water passing through the water jacket 20 may be discharged to the pump driver 30 through the outlet 24 of the water jacket and then be discharged to the outlet 34 of the pump driver by an operation of the impeller to flow into the radiator 60 via the inflow tube 68.

A first water passage for introducing the cooling water introduced into the inlet from the radiator and a second water passage for transferring the water discharged from the water jacket to the outlet are formed inside the pump driver 30 to pass through the pump driver. Each of the water passages may be connected to the inlet 22 and the outlet 24 of the water jacket 20.

In the cooling unit 50 according to the present device, as shown in FIG. 2, a bottom surface of the pump driver 30 may be closely attached to a top surface of the water jacket 20 to reduce a whole height of the cooling unit. Also, the waterproof gasket may surround the connected portions between the water jacket and the pump driver to prevent water from leaking between the pump driver 30 and the water jacket 20. As described above, the silicon plate may be used as the waterproof gasket.

Also, unlike the FIG. 2a, a connection pipe 28 may connect each of the water passages of a pump driver 30 to the inlet 22 and the outlet 24 of the water jacket 20. FIG. 2b illustrates a state in which the connection pipe is exposed between the water jacket and the pump driver.

FIG. 2b is a view of a state in which a cooling unit according to another embodiment is mounted on the CPU according to the present device. FIG. 2b illustrates a state in which the connection pipe 28 between the pump driving part 30 and the water jacket 20 is exposed to the outside. In this case, a gap is formed by a height of the connection pipe between the water jacket and the pump driver.

As shown in FIG. 2b, in another embodiment of the cooling unit according to the present device, the connection pipe 28 for circulating water between the pump driver 30 and water jacket 20 is formed by a predetermined height to form a gap having a predetermined distance between the pump driver and the water jacket. In this case, when the cooling unit 50 is mounted on a CPU 10, an upper end of a coupling clip 55 may be coupled and attached to a top surface of the water jacket 20 to fix and mount the cooling unit to the CPU. That is, since the pump driver 30 is connected and fixed to the water jacket 20 through the connection pipe 28, and a waterproof gasket 40 and a driving motor 45 are also be fixed to the top surface of the pump driver, the water jacket may be fixed by using the coupling clip to fix the cooling unit to the CPU. In this case, a separate fixing unit may be provided between the pump driver 30 and the water jacket 20. Also, the waterproof gasket for waterproofing may be disposed on the connected portions where the pump driver and the water jacket are connected to the connection pipe.

FIG. 3 is an exploded perspective view of the cooling unit according to the present device. FIG. 4 is a view for explaining respective components of the cooling unit according to the present device.

FIG. 4a is a cross-sectional view of a water jacket 20, FIG. 4b is a cross-sectional view of a pump driver 30, FIG. 4c is a perspective view of an impeller when viewed from a lower side, and FIG. 4d is a perspective view of the driving motor according to the present device when viewed from the lower side. In particuiar, FIG. 4a illustrates a section in which a portion of the top surface and a side surface of the water jacket are cut so as to illustrate the inside of the water jacket in detail. Referring to FIGS. 3 and 4, each component of the cooling unit according to the present device will be described below.

The cooling unit 50 according to the present device includes the water jacket 20 through which cooling water passes therein to cool the CPU 10, the pump driver 30 introducing the cooling water into the water jacket to discharge the water passing through the water jacket, the waterproof gasket 40 covering and sealing the top surface of the pump driver, the driving motor 45 providing a driving force to the pump driver, and the coupling clip for mounting the cooling unit 50 to the CPU 10. The impeller 36 for discharging water of the water jacket 20 is mounted on the discharge part 35 of the pump driver 30.

The water jacket 20 according to the present device may be mounted on the top surface of the CPU 10 to receive cooling water cooled by and discharged from the radiator 60 via the pump driver 30, thereby cooling the CPU 10 while the cooling water passes therethrough. The water jacket also discharges again the water warmed by heat transmitted from the CPU while passing therethrough to the radiator 60 via the pump driver 30. The water jacket 20 includes the inlet 22 through which the cooling water is introduced through the pump driver and the outlet 24 through which the water is discharged to the pump driver. The inlet 22 of the water jacket is disposed in an extension line in a vertical direction of the inlet 32 of the pump driver to connect both inlets 32 and 22 to each other when the pump driver is connected to the water jacket. Also, the cooling water may be directly introduced from the radiator 60 into the water jacket 20. In this case, the discharge tube 66 of the radiator is directly connected to the inlet 22 of the water jacket. Also, the outlet 24 of the water jacket is exposed to a space 35a formed in a lower portion of the outlet 35 of the pump driver to discharge the water circulated within the water jacket to the outlet 35.

The water jacket 20 may be formed of an aluminium or copper material which has excellent thermal conductivity and heat exchange efficiency. Here, in consideration of manufacturing costs, it is preferable that the water jacket is formed of the aluminium material.

Also, a plurality of porous aluminium plates 26 may be laminated and then brazed to form multiple water passages within the water jacket 20. More particularly, honeycomb-shaped porous aluminium plates 26 may be piled to overlap each other, and then aluminium molecular powder may be scattered between the aluminium plates to bond the aluminium plates to each other. Thus, the bonded aluminium plate may be recognized as the same material. Therefore, the honeycomb-shaped multiple water passages may be formed within the water jacket 20. Therefore, the cooling water introduced into the water jacket may be dispersed to pass through the multiple water passages formed within the water jacket 20, thereby maximizing the heat exchange efficiency.

As described above, as the thermal conductivity and the heat exchange efficiency of the water jacket 20 are improved, heat of the cooling water passing through the water jacket may effectively take the heat from the CPU 10. As a result, the cooling water and the CPU may become in approximate thermal balance state. Therefore, a cooling effect of the CPU may be maximized.

The water increasing in temperature while passing through the water jacket 20 may be discharged to the outlet 35 of the pump driver 30 via the outlet 24 of the water jacket. Then, the water may be discharged to the outlet 34 of the pump driver by an operation of the impeller 36 to flow into the radiator 60 via the inflow tube 68.

The pump driver 30 according to the present device may be mounted on an upper portion of the water jacket 20 to introduce the cooling water discharged from the radiator 60 into the water jacket. Then, the water passing through the water jacket may be pumped and discharged to the radiator 60. The pump driver 30 includes the inlet 32 connected to the discharge tube 66 to introduce the cooling water discharged from the radiator 60, the outlet 34 through which the water passing through the water jacket 20 is discharged to the inflow tube 68, and the discharge part 35 in which the impeller 36 is mounted and having a groove shape so that the water discharged from the water jacket is pooled. The discharge part 35 may have a recessed groove shape so that a predetermined amount of water pumped from the water jacket by the operation of the impeller 36 is pooled. Also, the discharge part 35 may have the outlet 34 through which the pooled water is discharged by the operation of the impeller 36 in one surface thereof. Also, the space 35a may be formed in a lower portion of the discharge part to expose and open the outlet 24 of the water jacket 20. Thus, the water within the water jacket may be discharged to the discharge part through the space. Thus, the water passing through the water jacket 20 may be pumped to the discharge part 35 by the operation of the impeller 36, and then be discharged to the outlet 34 of the pump driving part 30 to flow into the radiator 60 through the inflow tube 68.

The inlet 32 and the outlet 34 of the pump driver 30 are respectively connected to the discharge tube 66 and the inflow tube 68 to circulate water together with the radiator 60. Here, a connecting bolt 39a and a connecting nut 39b may be used to prevent water from leaking through the connected portions between the respective tubes and the inlets and outlets. To respectively connect the discharge tube 66 and the inflow tube 68 to the inlet 32 and the outlet 34, one end of the connecting bolt 39a may be coupled and attached to the inlet 32 and the outlet 34. Then, one end of the respective tubes may be inserted into the connecting nut 39b to pass. Thereafter, the end of the tube may be fitted into the other end of the connecting bolt which is not coupled and attached yet. Then, the connecting nut 39b may be coupled and attached to the connecting bolt 39a in which the tube is fitted. Here, it is appreciated that the inlet 62 and the outlet 64 of the radiator 60 may be connected to the respective tubes according to the above described method.

It is preferable that the pump driver 30 is formed of plastic. Alternatively, the pump driver be formed of the same material as the water jacket 20, i.e., the aluminium or copper material.

The impeller 36 according to the present device may be mounted on the discharge part 35 of the pump driver 30. A plurality of rotation blades for pumping within the water jacket 20 to the discharge part 35 is disposed on a lower portion of the impeller. Also, the impeller 36 may include a plurality of metal shafts 36a to receive a driving force from the driving motor 45. Typically, the driving force of the motor is transmitted through the driving shaft. However, the present device provides a magnetic pump system which includes a plurality of magnet shafts 45a for transmitting the driving force to the driving motor 45 and a plurality of metal shafts 36a for receiving the driving force of the driving motor 45 through the magnet shafts. Here, it is appreciated that the metal shafts may be disposed on the driving motor instead of the magnets, and the magnet shaft may be disposed on the impeller. The plurality of magnet shafts 45a and the plurality of metal shafts 36a may be disposed on the driving motor 45 and the impeller 36 in a longitudinal direction and have the same mount position with respect to each other. Thus, the impeller 36 may be interlocked with the driving motor by a magnetic force without installing a separate driving shaft to the driving motor 45, thereby being rotated by driving force the driving motor. As described above, when the magnetic pump system is used, noises due to friction with the driving shaft may be removed.

The impeller 36 includes a circulation type rotation blade 37 or a magnetic field emission type rotation blade, preferably, includes the magnetic field emission type rotation blade. The circulation type rotation blade 37 may have a side surface having a rectangular shape. The magnetic field emission type rotation blade may have a side surface having a trapezoidal or triangular shape which is formed by being trimmed at a predetermined angle. Here, the trimming angle of the rotation blade may be set at any predetermined angle.

The circulation type rotation blade may operate normally only when the discharge part 35 is fully filled with water. If water is mixed with air in the discharge part, the circulation type rotation blade may abnormally operate and thus be stopped in operation. Thus, in the case where the circulation type rotation blade is used, if air is mixed into the water jacket 20, the impeller 36 may stop during the operating. On the other hand, in the case of the magnetic field emission type rotation blade, even though the discharge part 36 is filled with air, the magnetic field emission type rotation blade may operate normally to discharge the water. Thus, even if the water jacket 20 is filled with air, there is no problem to use.

When the impeller 36 is mounted on the discharge part 35 of the pump driver 30 to operate, water may leak through a gap of a peripheral portion of the impeller to damage internal devices of the computer. Thus, to solve this problem, the waterproof gasket 40 is mounted on the top surface of the pump driver and the impeller to seal the pump driver and the impeller. A silicon plate having an excellent waterproofing property may be used as the waterproof gasket. The water proof gasket may cover at least the peripheral portion of the impeller. Therefore, the upper portion of the pump driver 30 and the impeller 36 may be completely sealed to realize complete waterproof. Also, since the driving motor 45 does not contact the impeller by the waterproof gasket 40, the driving unit may be completely separated from the circulation unit. As described above, according to the present device, since the driving motor 45 and the impeller 36 may be interlocked with each other by the magnetic force, but do not physically contact each other, the driving unit may be separated from the circulation unit, and thus the noises may be decreased.

The driving motor 45 according to the present device may receive a power from the outside to generate a driving force, thereby operating the impeller 36. To transmit the driving force to the impeller, the plurality of magnet shafts 45a exposed to a bottom surface thereof. The magnet shafts 45a may be disposed on the same position as those of the metal shafts 36a mounted on the impeller 36. The magnet shafts may be interlocked with the metal shaft of the impeller to transmit the driving force generated from the driving motor to the impeller.

A brushless DC (BLDC) motor may be used as the driving motor 45. Also, a permanent magnet, especially, an AlNiCo magnet may be used as the magnet shaft 45a.

The AlNiCo magnet may be formed of aluminum, nickel, and cobalt as main materials. The AlNiCo magnet may be used for a speaker, a gauge, a microphone, a reed switch, an amplifier, and the likes. Since the AlNiCo magnet has a extremely small change in amount of magnetic flux according to the temperature, temperature-resistance stability (a maximum temperature of about 850℃) and hardness are very high. On the other hand, since the AlNiCo magnet has low coercivity, a magnetic force of the AlNiCo magnet may be easily decreased by an external magnetic field. Actually, although the AlNiCo magnet has a very strong attraction force, if the AlNiCo magnet is repeatedly attached and detached, the magnetic force of the ALNiCo may be weak to rarely generate the magnetic force. Therefore, since the driving motor 45 according to the present device is rarely separated after the installation thereof, it is preferable to use the AlNiCo magnet having the strong attraction force.

To smoothly pump water in the water jacket 20 to the radiator, the driving motor 45 should be maintained at a rotation rate of about 2000 rpm or more, and preferably, a rotation rate of about 2800 rpm. In the conventional air-cooling type cooler, since the cooling fan of should be rotated at a rotation rate of at least 5000 rpm or more, there is a problem with the serious noise. However, since the driving motor 45 according to the present device is rotated at a rotation rate corresponding only a half of that of the conventional cooling fan, noises due to the driving motor may be significantly reduced. Also, unlike the conventional cooling fan, since it is unnecessary to provide a blade on the driving motor, noises due to the blade may not occur.

FIG. 5 is a view of the radiator according to the present device, FIG. 5a is a perspective view of the radiator, and FIG. 5b is a cross-sectional view of the radiator. In particular, FIG. 5b illustrates a section in which a portion of the top surface and the side surface of the radiator are cut so as to illustrate the inside of the radiator 60 in detail. As shown in FIGS. 5a and 5b, the inlet 62 to which the inflow tube 68 for introducing water passing through the water jacket 20 is connected and the outlet 64 to which the discharge tube 66 for discharging cooling water is connected are disposed on a front surface of the radiator 60 according to the present device. A plurality of panels 65 in which the water passages 65a are formed in a zigzag shape are disposed in parallel to form the multiple water passages within the radiator 60. Also, the radiator may be increased in size to maximize the cooling efficiency.

Each of the panels 65 disposed inside the radiator 60 may be formed of an aluminium or copper material which has excellent thermal conductivity and heat exchange efficiency. In consideration of price, it is preferred that the panel may be formed of the aluminium material.

The inlet 62 and outlet 64 disposed on the front surface of the radiator 60 may communicate with each of the water passages 65a formed in each of the panels 65. Thus, water introduced into the inlet 62 may be dispersed into each of the water passages 65a to flow and pass through the water passages, thereby being mixed at the outlet 64 and discharged through the outlet. As described above, since the radiator 60 according to the present device may disperse and cool the introduced water, the cooling efficiency may be improved.

Also the cooling fan 70 for cooling the water passing through each of the water passages 65a within the radiator is mounted on the front or back surface of the radiator 60. When the cooling fan 70 is mounted on the front surface of the radiator, the cooling fan may circulate air within the computer body to cool the components mounted to the inside of the computer body.

The water cooler for computer CPU according to the present device may inject or exchange internal water through the radiator 60. That is, a separate injection hole may be formed in the radiator 60, or a separate hose may be connected to the inlet and outlet of the radiator to inject or exchange water. Thus, water may be injected even through air is mixed in the water jacket 20.

Effect Of The Device

As described above, the water cooler for the computer CPU according to the present device may provide the superior cooling efficiency when compared to that of the conventional air cooling-type cooler to allow the CPU to exert optimal performance as well as rarely generate the noise during the operating, thereby significantly improving user's working environment.

That is to say, the water cooler for the computer CPU having an impeller according to the present device may have effects as follows.

First, since the CPU is cooled by using water, the CPU may be improved in cooling efficiency.

Second, due to a feature of water, the CPU may be cooled to a temperature approaching room temperature to exert the optimal performance and reduce the possibility of CPU defects.

Third, since the water jacket is formed of the aluminium or copper material which has excellent thermal conductivity and heat exchange efficiency and has the inner structure having the porous honeycomb shape to disperse the cooling water and pass therethrough, the heat generated from the CPU may be effectively exchanged to maximize the cooling efficiency.

Fourth, since the magnetic pumping system is used to reduce the frictional sound due to the friction of the driving shaft, and the driving motor is rotated at a rotation rate corresponding to a half of that of the conventional air-cooling type cooler, the noises generated during the operating may be significantly reduced.

Lastly, the water cooler may be commonly applied to a CPU provided by Intel or AMD through only slight modification in standard without separately modifying in structure and shape.

The preferred embodiment of the present device is described with the specific terms, however, the detailed description may be amended or modified according to viewpoints and applications, not being out of the scope, technical idea and other objects of the present device.

What is claimed is:

1. A water cooler for a computer central processing unit (CPU) having an impeller, which introduces cooled water therein to circulate the cooled water therein, thereby cooling the CPU of the computer, the water cooler comprising:

a circulator comprising a first inlet through which the cooled water is introduced, the first inlet being mounted on a top surface of the CPU, a discharge part having a recessed groove shape so that the water circulating within the water cooler is discharged and pooled, and a first outlet disposed on a surface of the discharge part to discharge the water pooled in the discharge part, wherein the circulator introduce the cooled water to circulate the introduced water therein, thereby discharging the water;

an impeller mounted on the discharge part of the circulator, and the impeller comprising a plurality of rotation blades on a bottom surface thereof to discharge the water within the discharge part to the first outlet by a rotation force; and a driving motor mounted above the impeller, the driving motor receiving a power from the outside to transmit a driving force into the impeller, thereby driving the impeller.

2. The water cooler of claim 1, wherein the circulator comprises:
a pump driver comprising the first inlet, the discharge part, and the first outlet; and
a water jacket comprising a second inlet mounted on a top surface of the CPU and under the pump driver, the second inlet being disposed in an extension line of the first inlet to introduce the cooled water therein, a water passage formed in the water jacket so that the introduced cooled water is circulated, and a second outlet through which the circulated water is discharged, the second outlet being opened to a predetermined space formed in a lower portion of the discharge part.

3. The water cooler of claim 1, wherein the circulator comprises:
a water jacket comprising a second inlet mounted on a top surface of the CPU and under the pump driver, the second inlet being disposed in an extension line of the first inlet to introduce the cooled water therein, a water passage formed in the water jacket so that the introduced cooled water is circulated, and a second outlet through which the circulated water is discharged, the second outlet being opened to a predetermined space formed in a lower portion of the discharge part;
an inflow pipe connecting the first inlet to the second inlet, the inflow pipe being exposed between the water jacket and the pump driver; and
a discharge pipe connecting the discharge part to the second outlet, the discharge pipe being exposed between the water jacket and the pumper driver.

4. The water cooler of claim 2 or 3, wherein the water jacket is formed of an aluminum material, and
a plurality of porous aluminum plate having a plurality of honeycomb-shaped holes are laminated and bonded to each other through a brazing method to form multiple water passages within the water jacket.

5. The water cooler of claim 1, further comprising a waterproof gasket formed of a waterproofing material to cover at least a peripheral portion of the impeller on the circulator and a top surface of the impeller.

6. The water cooler of claim 1, wherein the driving motor comprises a plurality of magnet shafts exposed to a surface corresponding to the impeller,
the impeller comprises a plurality of metal shafts at the same position as each of the magnet shafts, and
each of the magnet shafts is interlocked with each of the metal shafts to transmit the driving force of the driving motor to the impeller.

7. The water cooler of claim 1, wherein each of the rotation blades of the impeller is a magnetic field emission type rotation blade of which a lower end is trimmed at a predetermined angle.

8. The water cooler of claim 1, further comprising:
a radiator in which the water passing through the circulator is introduced to circulate the introduced water therein and cool the water, thereby discharging the cooled water, the radiator comprising a plurality of water passages formed by laminating and coupling a plurality of panels in which water passages having a zigzag shape are formed therein to each other, wherein the radiator comprises a third inlet which introduces the water discharged through the first outlet to disperse and introduce the water into each of the water passages and a third outlet discharging the water passing through each of the water passages;
an inflow tube having one end connected to the first outlet and one end connected to the third inlet to introduce the water discharged through the first outlet into the third inlet; and
a discharge tube having one end connected to the third outlet and one end connected to the first inlet to introduce the cooled water discharged through the third outlet into the first inlet.

FIG. 1

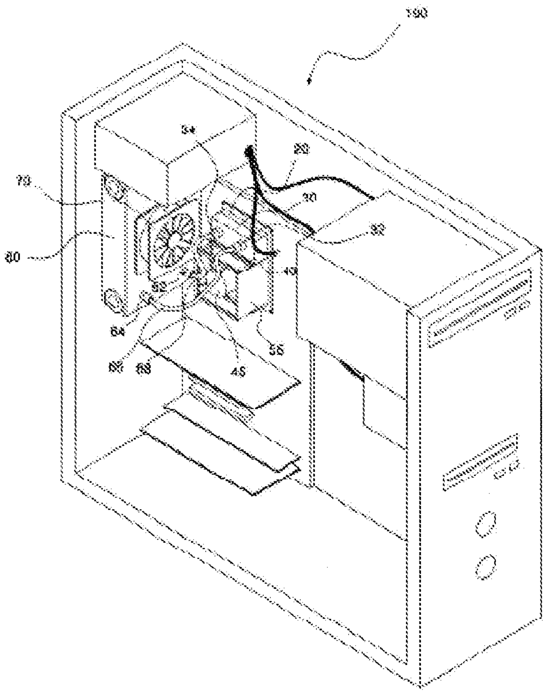
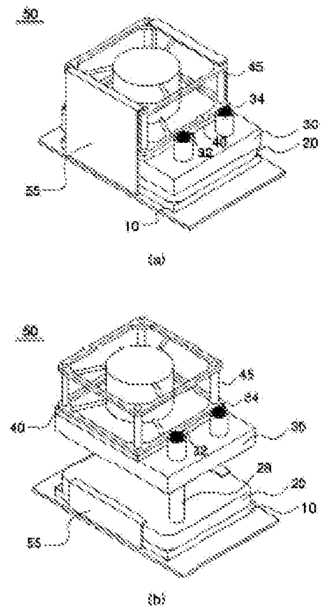


FIG. 2



(a)

(b)

FIG. 3

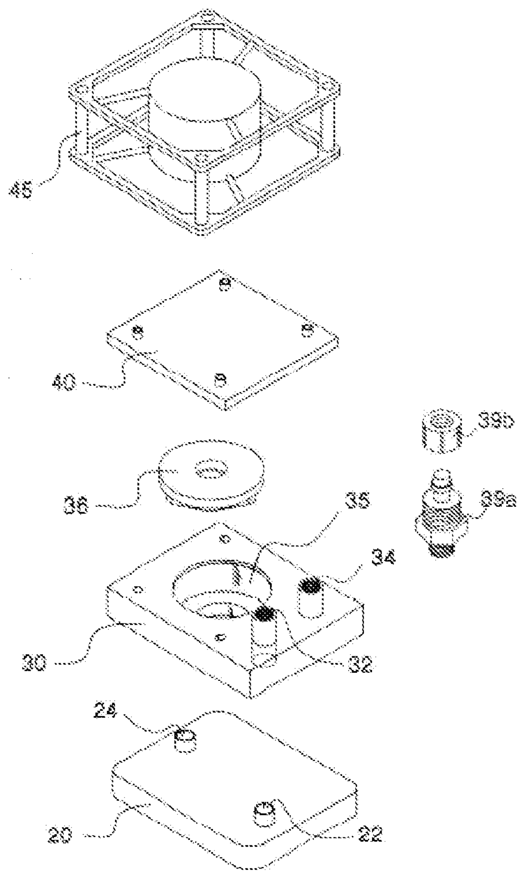


FIG. 4

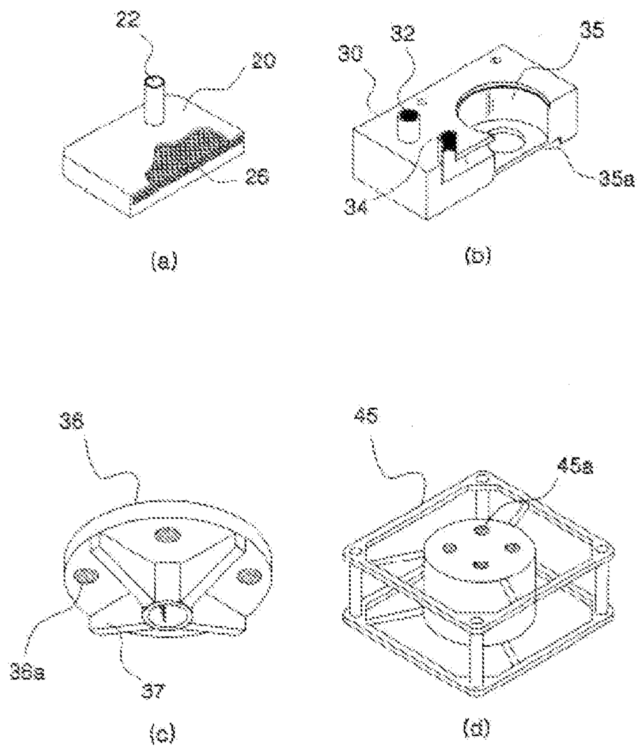
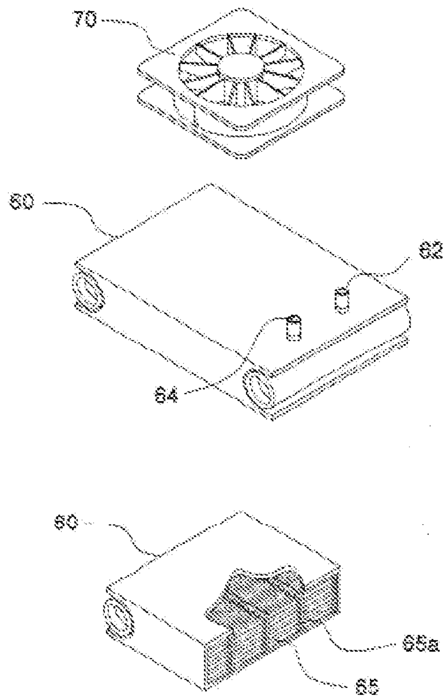


FIG. 5



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TRANSLATOR CERTIFICATION

County of New York
State of New York

Date: July 12, 2013

To whom it may concern:

This is to certify that the attached translation from Korean into English is an accurate representation of the documents received by this office.

The documents are designated as:

- KIPO - Application Number 20-2003-0006043

Anna Lee, Project Manager in this company, certifies that Steve Yang, who translated these documents, is fluent in Korean and standard North American English and qualified to translate. Anna Lee attests to the following:

"To the best of my knowledge, the aforementioned documents are a true, full and accurate translation of the specified documents."

Anna Lee

Signature of Anna Lee

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[21] Appln. No.: 092216860 [22]Appln. Date: Sept. 19, 2003
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The water cooler device for interface card of computer

Claims

1. A water cooler device for interface card of computer, wherein the water cooler device is arrange on chips of interface card of computer, and includes a water cooler, a circulating pump and a radiator; water cooled by the radiator circulates so as to arrive at an inlet of the water cooler on chips of interface card of computer, passes through a closed circulating water channel inside the water cooler so as to cool down heat produced by the chips, and gushes via a discharging part of the water cooler; water at the discharging part is delivered to a water outlet of the water cooler by cornering force of the circulating pump, and circulates so as to arrive at the radiator for heat exchange; blade of the circulating pump has a disc shape, and can correspondingly cover the discharging part; on the inner wall of the blade is arranged with a ring of magnet; the blade is positioned on the discharging part of the water cooler by means of a pressing board, so that the position of the blade is limited by the pressing board and the blade can freely rotate in the discharging part; windings having at least two polarities are arranged on the pressing board; the windings are sealed and combined on the pressing board while its circuit board is connected to a power supply; when the power supply is powered up, the circuit board switches the two windings to produce polarity change, and repels the magnet to bring the blade to rotate, so that water at the discharging part is delivered to a water outlet of the water cooler by cornering

Espacenet

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The water cooler device for interface card of computer

No documents available for this priority number.

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申請案號：92216860	

(以上各欄由本局填註)

新型專利說明書

一、新型名稱	中文	應用於電腦介面卡之水冷式散熱裝置
	英文	The water cooler device for interface card of computer
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	國籍(中英文)	1. 韓國 KR
	住居所(營業所)(中文)	1. 韓國漢城市龍山區新溪洞1-171號東進大樓2F (本地址與前向貴局申請者相同)
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	代表人(英文)	1. RYU JEONG MOO

008791

一、本案已向

國家(地區)申請專利	申請日期	案號	主張專利法第一百零五條準用第二十四條第一項優先權

二、☐主張專利法第一百零五條準用第二十五條之一第一項優先權:

申請案號:

日期:

三、主張本案係符合專利法第九十八條第一項☐第一款但書或☐第二款但書規定之期間

日期:

五、創作說明 (1)

(一)、新型所屬之技術領域：

本創作一種應用於電腦介面卡之水冷式散熱裝置，主要係大幅降低散熱裝置之高度，以克服介面卡安裝空間的限制，以及利用磁力驅動循環泵浦產生迴轉力量，使經散熱器冷卻的水能進入冷卻器吸收晶片產生的熱氣，且由循環泵浦排送散熱器，進而冷卻介面卡上之晶片者。

(二)、先前技術：

現行有關晶片(cpu)之散熱技術中，除了傳統式採氣冷式散熱方式外，較先進的技術乃有利用水冷的方式來提供晶片更優異的散熱效果，其中如第一圖所示，該水冷器1是設在介面卡11之晶片上方，散熱器12係為一箱體且包含風扇13、複數個金屬散熱片14和泵浦15，經散熱器12冷卻的水送至水冷器1並提供晶片散熱，且由泵浦15循環至散熱器12進行熱交換，該種型式除構件眾多、體積龐大，同時水冷器1和散熱器12及其泵浦15係採分離式，除電腦機箱內無足夠空間外，其裝設也相當繁瑣；另在同一申請人前所提呈之第92208939號專利案(如第二、三圖)中，係揭露散熱器2冷卻的水循環到電腦晶片上之水冷器21進而冷卻晶片，以及利用馬達22通電後，讓磁鐵軸221激磁推斥葉輪23之金屬軸231驅轉，藉此令葉輪23將水冷器21的水排出且循環到散熱器2，以完成熱交換，其主要的特色就是利用磁力驅動葉輪23之非物理性接觸的方式，達到循環水流散熱的效能，但就該案中係較習用者減少許多零組件，而且把葉輪23和水冷器21整合成一單體，同時

五、創作說明 (2)

該馬達22採磁力驅動葉輪23除了更能防止水份滲漏，也提昇了其使用壽命，但由於其機構仍需佔據一定高度，所以其可以應用於主機板之晶片散熱，但對於一般的VGA顯示卡或介面卡，因為其分設於插槽中且相鄰的間距相當接近，所以並無充裕的空間足以供給其安裝，因此為滿足前述之使用要求，乃需進一步的改善。

（三）、新型內容：

本創作之主要目的，係提供一種應用於電腦介面卡之水冷式散熱裝置，利用散熱器冷卻的水循環到水冷器，進而對晶片提供散熱，因此具較佳的散熱效能。

本創作之次要目的，係提供一種應用於電腦介面卡之水冷式散熱裝置，其中水冷器和循環泵浦組合後，係為一單體式之結構，大幅降低其高度，所以可以安裝在介面卡之晶片上，而冷卻晶片之熱氣。

本創作之再一目的，係提供一種應用於電腦介面卡之水冷式散熱裝置，其中該循環泵浦係採用非物理接觸之磁激式驅動葉輪轉動，故結構上得以更精簡耐用，具較佳的可信賴度。

（四）、實施方式：

首請參閱第四~八圖所示，本創作一種應用於電腦介面卡之水冷式散熱裝置，其中該散熱裝置3係設於電腦介面卡4之晶片（圖未示）上方，包括由一鋁材成型之水冷器31、一循環幫浦32和鋁材質的散熱器33所組成，經散熱器33冷卻的水，循環到介面卡4晶片上的水冷器31之入口

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五、創作說明 (3)

311，經水冷器31內部密閉之循環水道，以冷卻晶片所產生的熱氣，且由水冷器31之排出部312湧出，利用循環泵浦32以迴轉力量將排出部31的水排至水冷器31之排水口313，並循環至散熱器33進行熱交換；該循環泵浦32，其葉輪321略呈一盤形體，並恰可與排出部312對應蓋合，葉輪321內壁環設一磁塊322，以及藉一壓板323將葉輪321定位於水冷器31之排出部312上方，使葉輪321被壓板323限位，且於排出部312中呈自由狀轉動，又壓板323上方設置至少有二極之繞組R1、R2，其電路板324接引電源同時將繞組R1、R2封合於壓板323上方，當啟動電源電路板324切換該二繞組R1、R2產生極性變化，並推斥磁塊322帶動葉輪321驅轉，令排出部312的水被葉輪321之迴轉力量排出至排水口313而循環至散熱器33進行熱交換。

又，請參閱第四、八圖所示，在實際製造時，該水冷器31之入水口311係設於稍低準位，排水口313係設於相對較高準位，經散熱器33冷卻的水自入水口311進入沿水冷器31內部之密閉水道吸收晶片41之熱氣，並循環至排出部313湧出，以及藉循環泵浦32排至排水口313，這樣子的作法，是能讓水冷器31內冷卻的水能充份有效的吸收晶片41之熱氣使其散熱。

續請參閱第九圖，係本本創作散熱器之另一安裝實施例參考圖，基於空間和安裝便利性的考量，該散熱器33係安裝在另一個空卡5上，以及該空卡5係設置在與介面卡4相鄰的插槽（slot）上，藉此可利用閒置的插槽提供散熱

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器 33安裝，使散熱器 33能達到最佳的散熱功效。

圖式簡單說明

第一圖、係習用水冷式散熱器之裝置示意圖。

第二圖、係第92208939號專利案裝置於電腦機箱內之示意圖。

第三圖、係第92208939號專利案之馬達和葉輪從下面看的立體圖。

第四圖、係本創作之立體外觀圖。

第五圖、係本創作安裝在電腦介面卡上方之裝置示意圖。

第六圖、係本創作水冷器和循環泵浦之立體分解圖。

第七圖、係本創作水冷器和循環泵浦之組合立體體圖。

第八圖、係本創作水冷器和循環泵浦之組合剖視圖。

第九圖、係本創作散熱器之另一安裝實施例參考圖。

圖號說明

3、散熱裝置	31、水冷器	311、入水口
312、排出部	313、排水口	32、循環泵浦
321、葉輪	322、磁塊	323、壓板
324、電路板	33、散熱器	4、介面卡
5、空卡	R1、R2、繞組	

四、中文創作摘要 （創作名稱：應用於電腦介面卡之水冷式散熱裝置）

本創作係有關一種應用於電腦介面卡之水冷式散熱裝置，其包括由一水冷器、一循環幫浦和散熱器所組成，經散熱器冷卻的水循環到水冷器，以冷卻晶片所產生的熱氣且由水冷器之排出部湧出，利用循環泵浦將排出部的水排出，並循環至散熱器進行熱交換；該循環泵浦，其葉輪內壁環設一磁塊，以及藉一壓板將葉輪定位於水冷器之排出部上方，又壓板上方設置至少有二極之繞組，當啟動電源，電路板切換該二繞組產生極性變化，並推斥磁塊帶動葉輪驅轉，令排出部的水被葉輪之迴轉力量排出至排水口而循環至散熱器，藉此得降低其高度，以提供介面卡上之晶片有效散熱者。

英文創作摘要 （創作名稱：The water cooler device for interface card of computer）

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四、中文創作摘要　（創作名稱：應用於電腦介面卡之水冷式散熱裝置）

本案之代表圖為：第四圖。

元件符號說明：

3、散熱裝置　31、水冷器　311、入水口
313、排水口　323、壓板　324、電路板
33、散熱器　4、介面卡

英文創作摘要　（創作名稱：The water cooler device for interface card of computer）

六、申請專利範圍

1、一種應用於電腦介面卡之水冷式散熱裝置，其中該散熱裝置係設於電腦介面卡之晶片上方，包括由一水冷器、一循環幫浦和散熱器所組成，經散熱器冷卻的水，循環到介面卡晶片上的水冷器之入口，經水冷器內部密閉之循環水道，以冷卻晶片所產生的熱氣，且由水冷器之排出部湧出，利用循環泵浦以迴轉力量將排出部的水排至水冷器之排水口，並循環至散熱器進行熱交換；該循環泵浦，其葉輪略呈一盤形體，並恰可與排出部對應蓋合，葉輪內壁環設一磁塊，以及藉一壓板將葉輪定位於水冷器之排出部上方，使葉輪被壓板限位，且於排出部中呈自由狀轉動，又壓板上方設置至少有二極之繞組，其電路板接引電源同時將繞組封合於壓板上方，當啟動電源電路板切換該二繞組產生極性變化，並推斥磁塊帶動葉輪驅轉，令排出部的水被葉輪之迴轉力量排出至排水口而循環至散熱器。

2、如申請專利範圍第1項所述之應用於電腦介面卡之水冷式散熱裝置，其中該水冷器係採用鋁材為最佳。

3、如申請專利範圍第1項或第2項所述之應用於電腦介面卡之水冷式散熱裝置，其中該水冷器之入水口係設於稍低準位，排水口係設於相對較高準位，經散熱器冷卻的水自入水口進入沿冷水器內部之密閉水道吸收晶片之熱氣，並循環至排出部湧出，以及藉循環泵浦排至排水口。

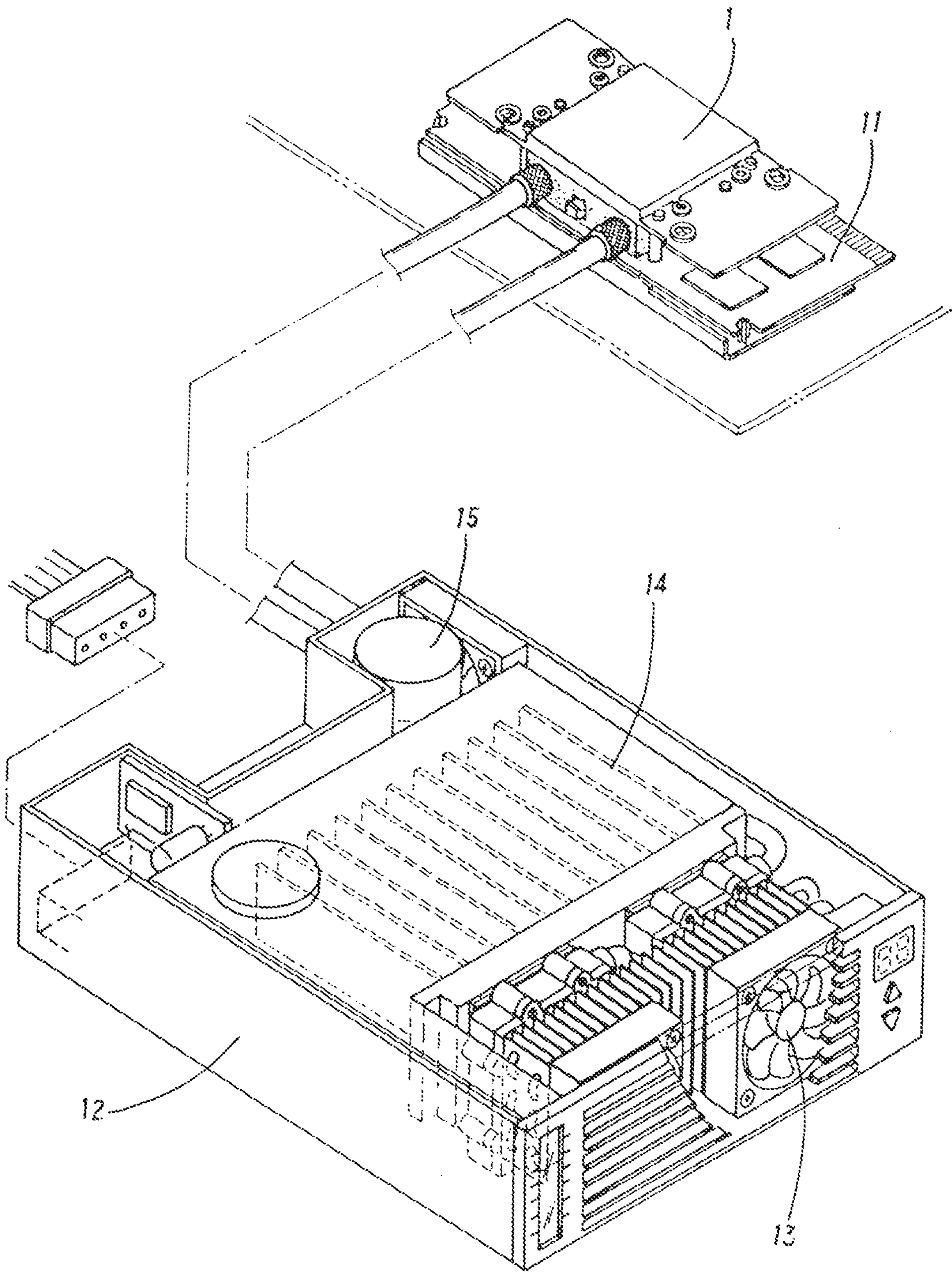
4、如申請專利範圍第1項所述之應用於電腦介面卡之水冷式散熱裝置，其中該散熱器係採用鋁材質者。

5、如申請專利範圍第1項或第4項所述之應用於電腦介面卡之水冷式散熱裝置

六、申請專利範圍

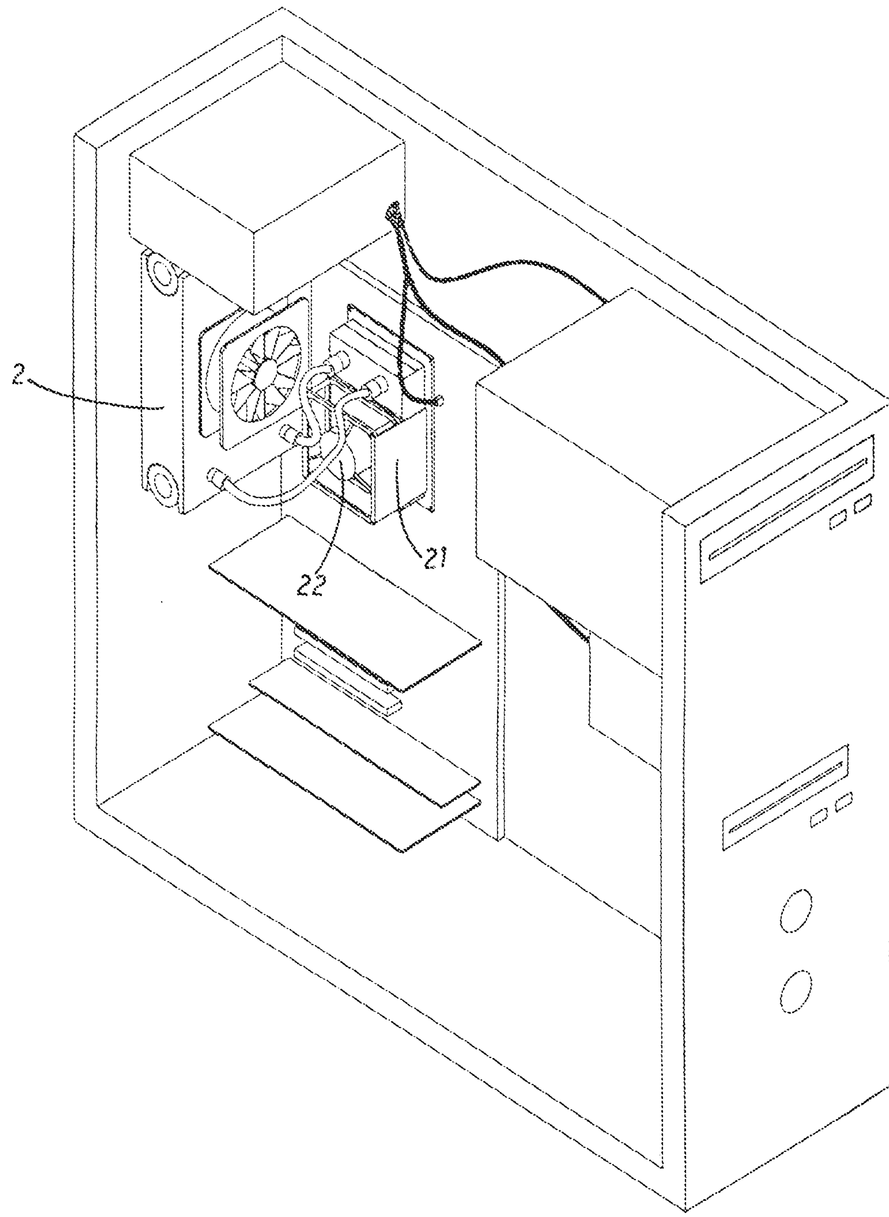
卡之水冷式散熱裝置，其中該散熱器係安裝在介面卡上者。

6、如申請專利範圍第1項或第4項所述之應用於電腦介面卡之水冷式散熱裝置，其中該散熱器係安裝在另一個空卡上，以及該空卡係設置在與介面卡相鄰的插槽（slot）上。



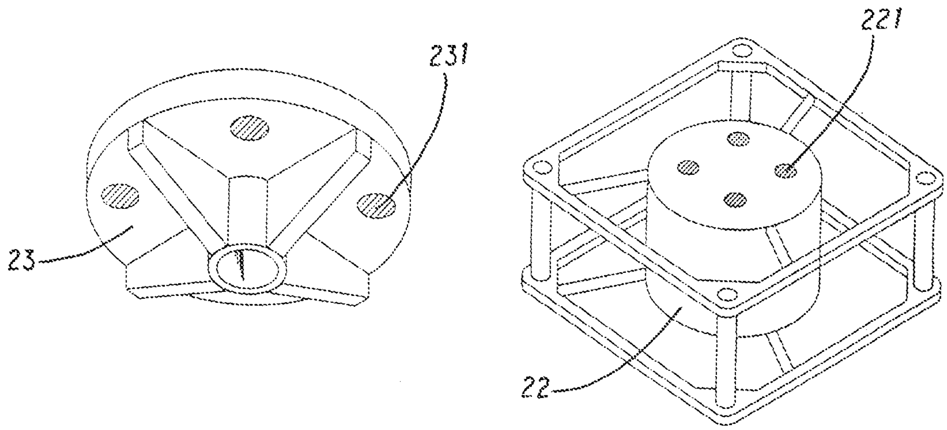
第一圖

068802



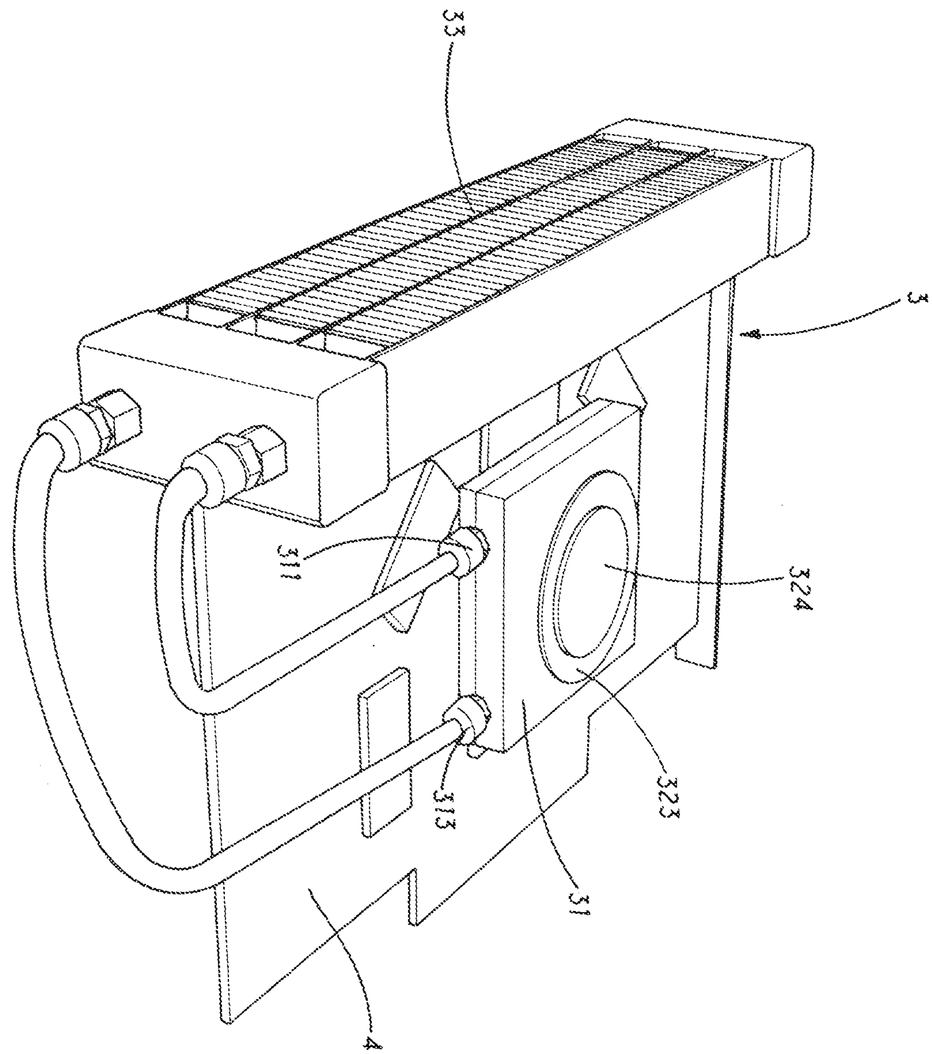
第二圖

008803

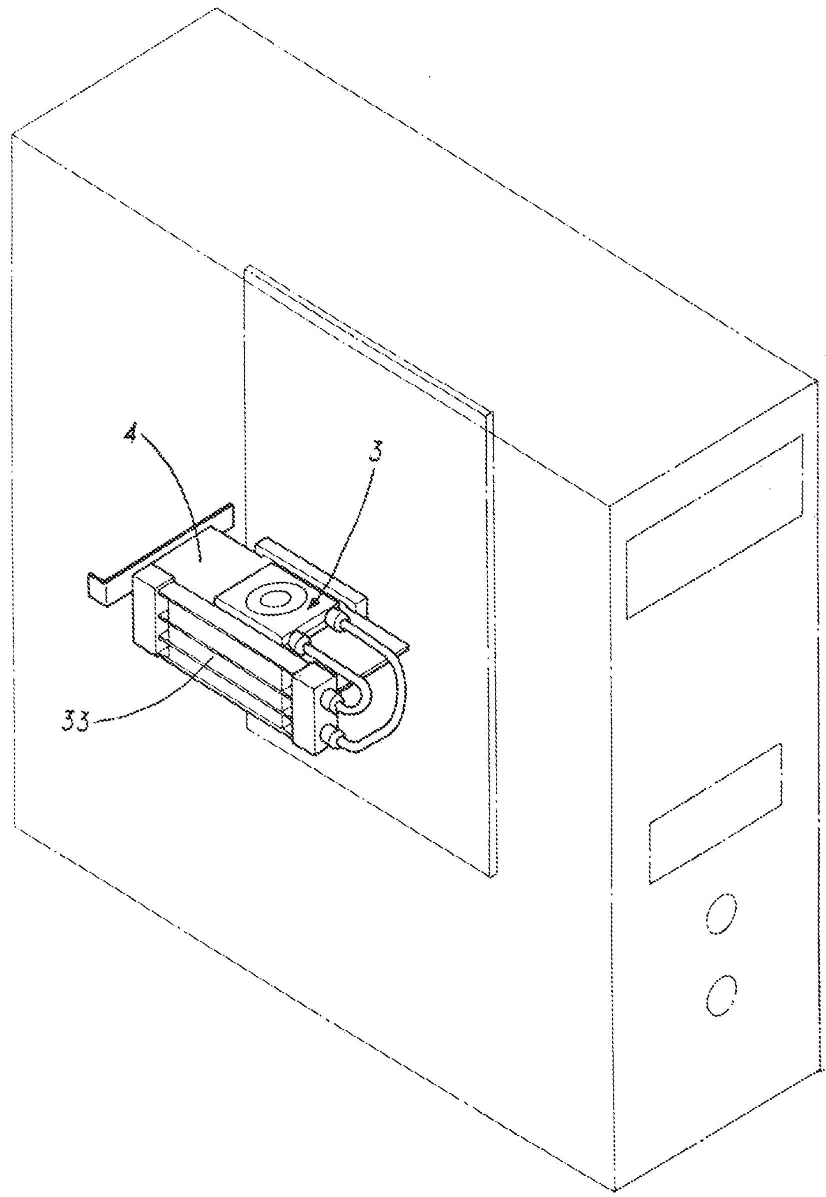


第 三 圖

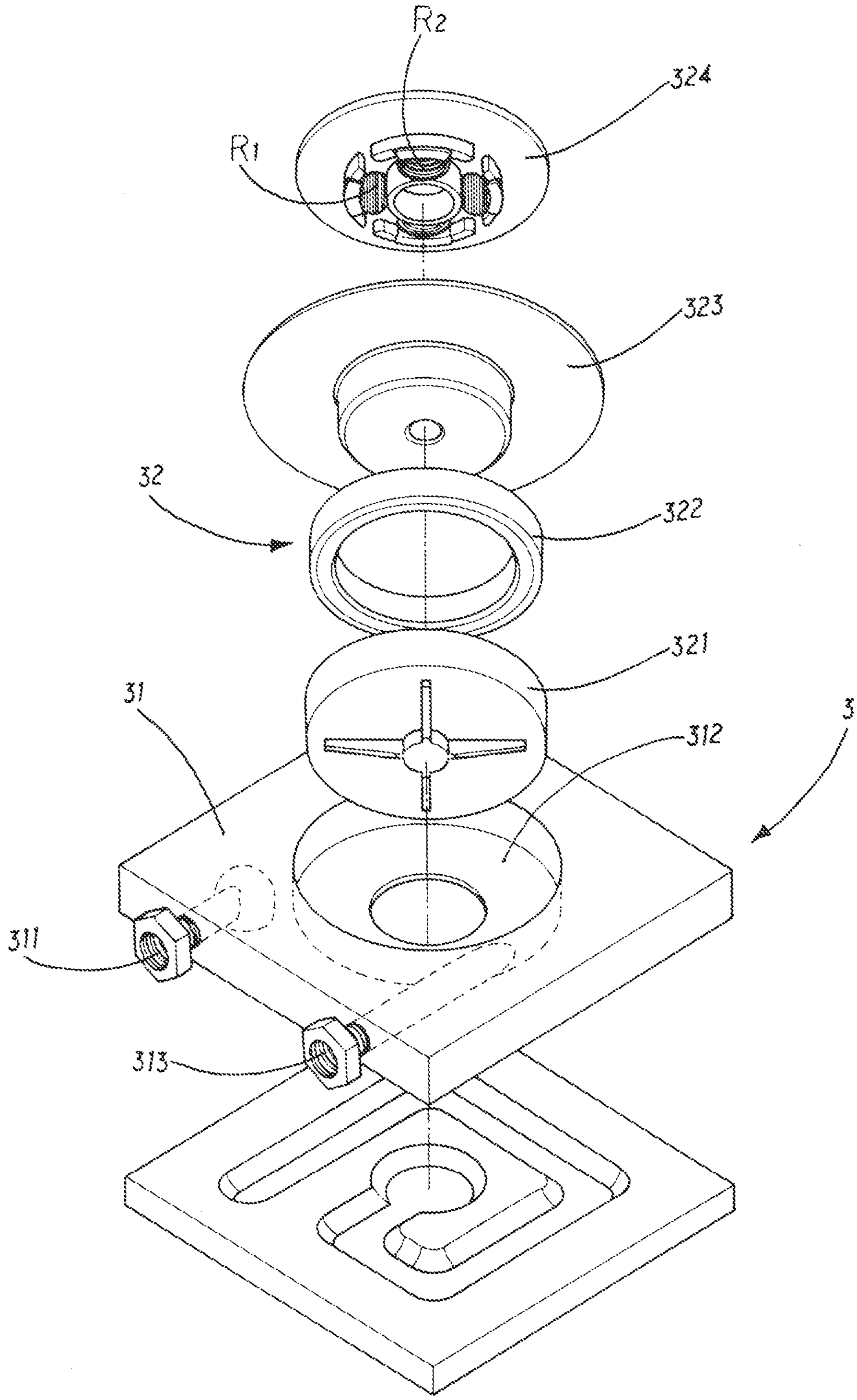
008804



第四圖

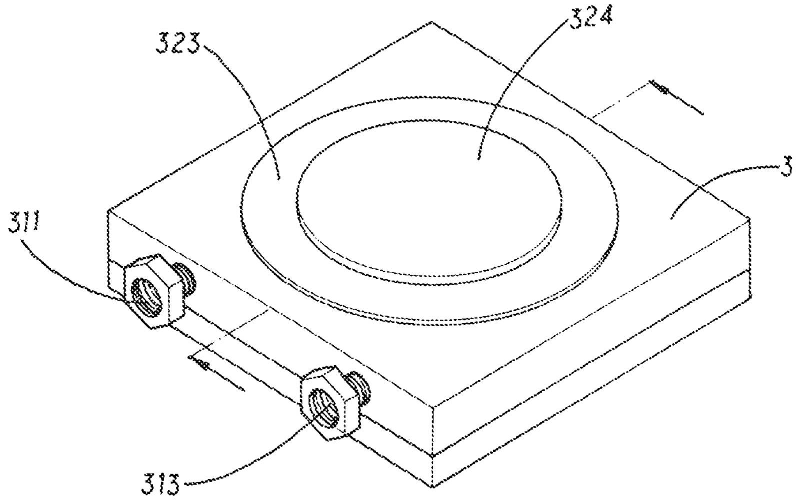


第五圖

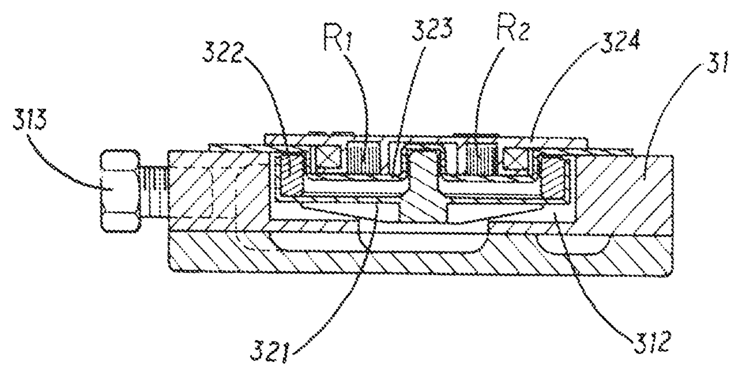


第六圖

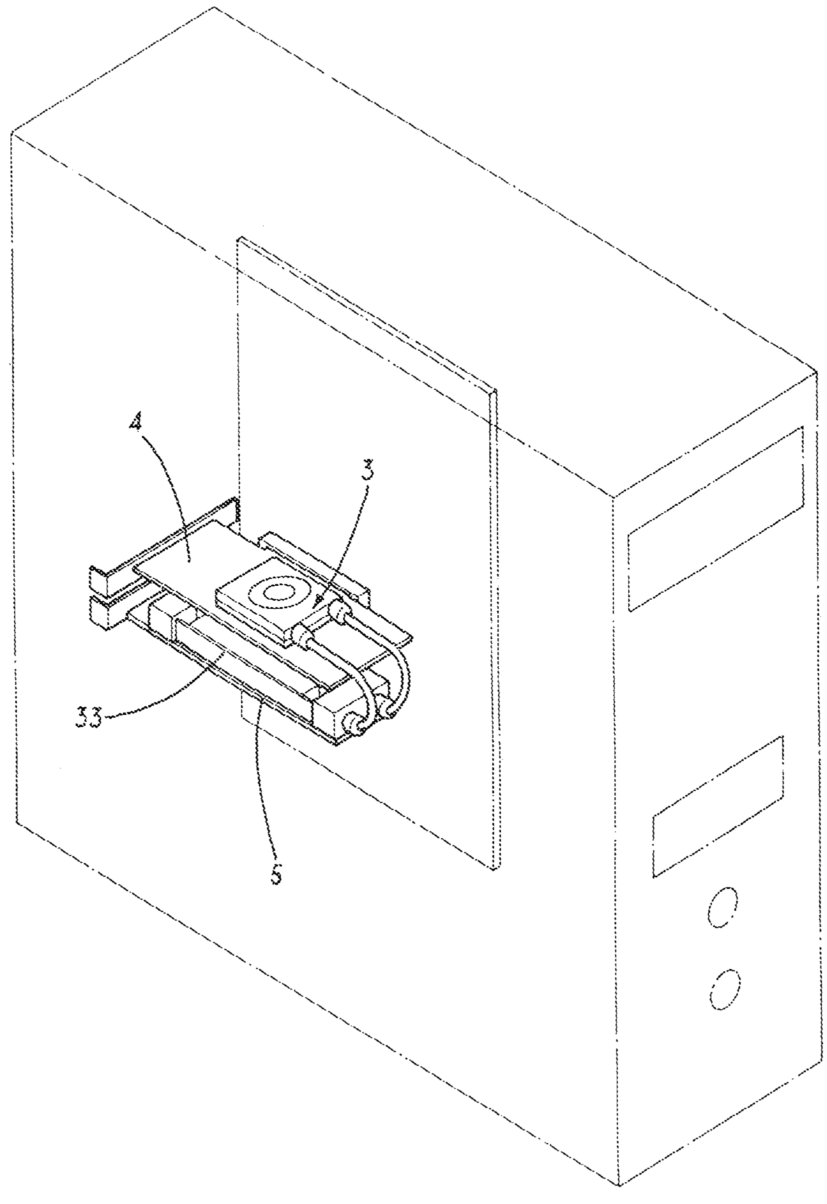
008807



第七圖



第八圖



第九圖

[19] Republic of China
[11] Certificate No.: M244513
[45] Date of Publication: September 21, 2004
[51] Int. Cl.[7]: G06F1/20
H05K7/20

[12] Patent Gazette (U)

Utility Model 5 page in total

[54] Description: A water-cooling radiating device

[21] Application No.: 092216907
[22] Filing Date: September 19, 2003

[72]
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Lai, Chen Tien
Zhou, Shi-Wen
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[74] Agent

1

[57] Claims

1. A water-cooling radiating device, which comprises:
A tank, that takes the form of a hollow case and has a chamber, which connects with the outside via a water inlet;
A cooling cylinder, that takes the form of a cylinder both ends of which are open and contains a hollow space: the said cooling cylinder is placed above the said tank horizontally; there's a chamber inside the cylinder wall that is connected with the said tank; there's a water outlet on the said cooling cylinder, enabling the chamber inside the cylinder wall to connect with the outside; and

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A pump, that is connected with the said water inlet on the tank and the said water outlet on the cooling cylinder via two water pipes; thus, the said pump, tank, cooling cylinder and water pipes form a closed loop; when water is filled into this loop, the said pump, as the power source, will drive water to circulate in the loop.
2. The water-cooling radiating device described in Claim 1 is characterized by the fact that the said pump is mounted in the hollow space of the said cooling cylinder.
3. The water-cooling radiating device described in Claim 1…

…is characterized by the fact that in the said hollow space of the cooling cylinder, plural radiating fins are extended from the inside of the cylinder wall.

4. The water-cooling radiating device described in Claim 1 is characterized by the fact that plural heat conducting fins are extended from the inside wall of the said chamber of the tank.
5. The water-cooling radiating device described in Claim 1 is characterized by the fact that the said cooling cylinder comprises a radiator, a cover and an end cap.
6. The water-cooling radiating device described in Claim 5 is characterized by the fact that the said radiator is mounted above the tank and the said chamber of the cooling barred is formed on the said radiator.
7. The water-cooling radiating device described in Claim 6 is characterized by the fact that the said cover covers the said radiator and the said end cap connects the said cover with one end of the said radiator to close the chamber.
8. The water-cooling radiating device described in Claim 7 is characterized by the fact that there's a certain space between the said cover and the said radiator as well as the surface of the said tank.
9. The water-cooling radiating device described in Claim 1 is characterized by the fact that plural heat transfer fins are extended from the inside of the chamber of the said cooling cylinder.
10. The water-cooling radiating device described in Claim 9 is characterized by the fact that one side of two neighboring heat transfer fins leans against the two openings of the said cooling cylinder respectively; while there's a relatively big space between the other side and the two openings of the said cooling cylinder respectively.
11. The water-cooling radiating device described in Claim 1 is characterized by the fact that a fan is mounted on one end of the said cooling cylinder to help radiate heat.

Brief explanation of the drawings:

Figure 1 is a stereograph of a common water-cooling radiating device.

Figure 2 is a stereograph of the water-cooling radiating device provided in this invention.

Figure 3 is an exploded diagram of the water-cooling radiating device provided in this creation.

Figure 4 is a diagram of water circulation in the water-cooling radiating device provided in this creation.

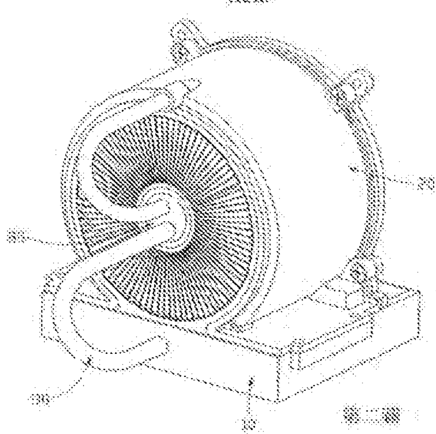

Figure 2

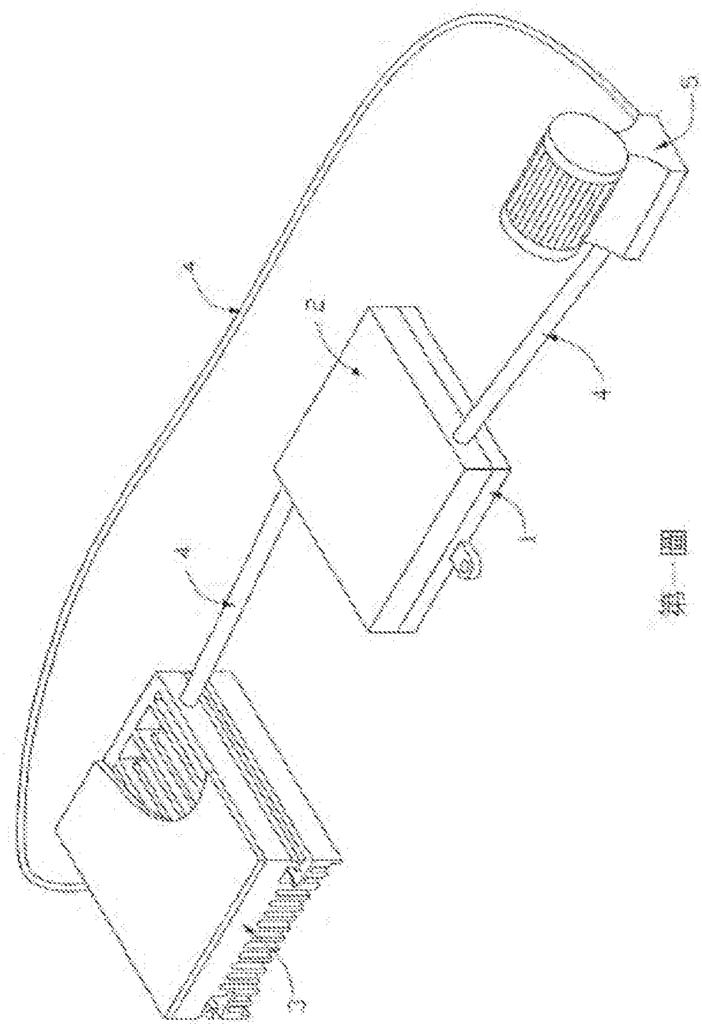

Figure 1
7059

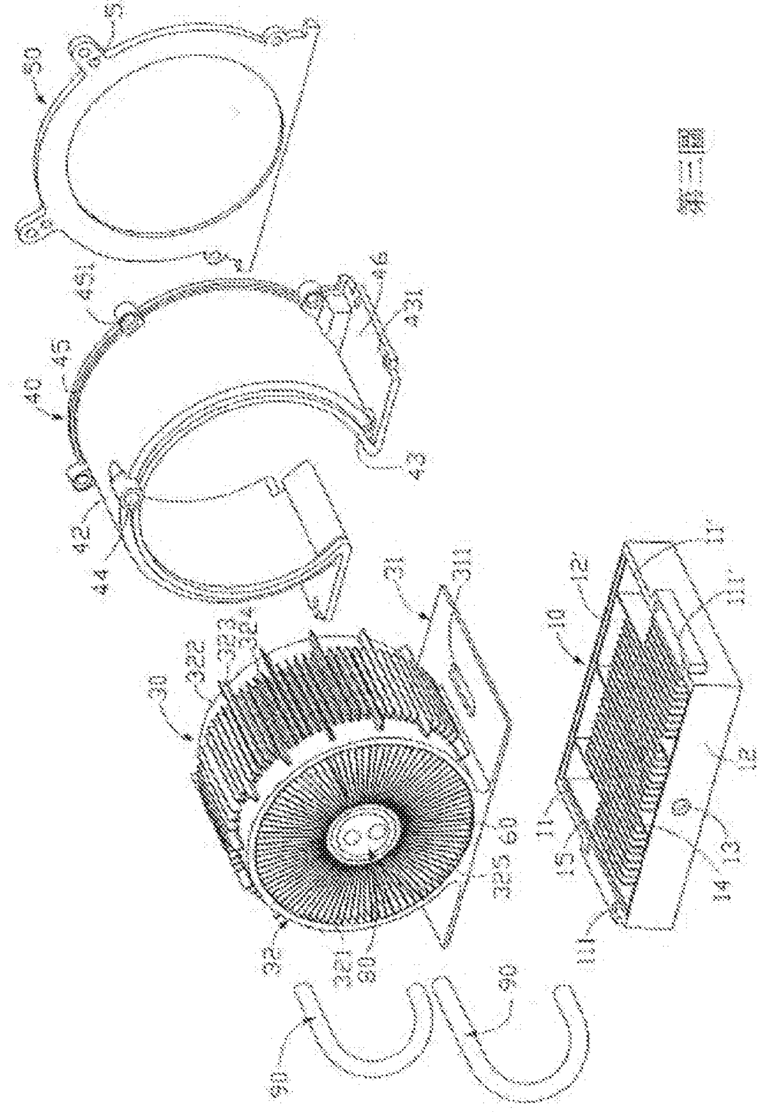

Figure 3
7060

(5)

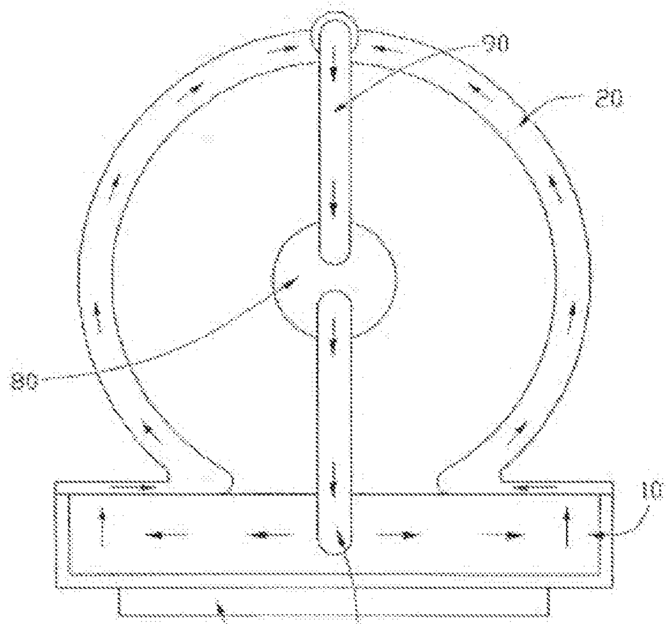

Figure 4
7061

7082

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TRANSLATOR CERTIFICATION

County of New York
State of New York

Date: July 25, 2013

To whom it may concern:

This is to certify that the attached translations from Chinese (Traditional) into English is an accurate representation of the document received by this office.

The documents are designated as:

- Taiwanese Patent Application No. 092216907
- Taiwanese Patent Grant for Utility Model No. 92216907

Clarence Rivette, Project Manager in this company, certifies that Zheng Zhao, who translated these documents from Chinese (Traditional) into English, is fluent in traditional Chinese and standard North American English and qualified to translate. Clarence Rivette attests to the following:

"To the best of my knowledge, the aforementioned documents are a true, full and accurate translation of the specified documents."

Signature of Clarence Rivette

【19】中華民國　　【12】專利公報　（U）

【11】證書號數：M244513
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【54】名　稱：水冷式散熱裝置
LIQUID COOLING HEAT DISSIPATING DEVICE

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[57]申請專利範圍：

1.一種水冷式散熱裝置，包括：
一水槽，其為中空盒狀體，內部具有一腔室，該腔室通過一入水口與外部相通；
一冷卻水筒，呈兩端開放之圓筒狀而形成一中空部，該冷卻水筒橫置於水槽上方，其筒壁內部具有與水槽相連通之腔室，該冷卻水筒上設有一出水口，使筒壁內部腔室與外部相通；及
一泵，藉由二水管與上述水槽之入水口及冷卻水筒之出水口連接，從而由泵、水槽及冷卻水筒及水管連成一封閉迴路，該迴路中充入水，以泵為動力源使水在該迴路中循環流動。

2.如申請專利範圍第1項所述之水冷式散熱裝置，其中該泵係裝設於冷卻水筒之中空部。

3.如申請專利範圍第1項所述之水冷式

散熱裝置，其中該冷卻水筒之中空部內，於筒壁內側伸設有複數散熱鰭片。

4.如申請專利範圍第1項所述之水冷式散熱裝置，其中該水槽之腔室內壁延伸有複數導熱片。

5.如申請專利範圍第1項所述之水冷式散熱裝置，其中該冷卻水筒由散熱體、一罩體及一端蓋組成。

6.如申請專利範圍第5項所述之水冷式散熱裝置，其中該散熱體係固設於水槽上方，上述冷卻水筒之腔室即形成於該散熱體上。

7.如申請專利範圍第6項所述之水冷式散熱裝置，其中該罩體係罩設於散熱體上，該端蓋係連接罩體與散熱體之一端，以密封腔室。

8.如申請專利範圍第7項所述之水冷式散熱裝置，其中該罩體與散熱體及水槽上表面間具有一定間距。

9.如申請專利範圍第1項所述之水冷式散熱裝置，其中該冷卻水筒之腔室內延伸出複數傳熱片。

10.如申請專利範圍第9項所述之水冷式散熱裝置，其中兩相鄰傳熱片之一側邊分別朝向冷卻水筒之兩開口端，而另一側邊則與冷卻水筒之二開口端分別具有一較大間距。

11.如申請專利範圍第1項所述之水冷式散熱裝置，其中該冷卻水筒之一端裝設一風扇，以協助散熱。

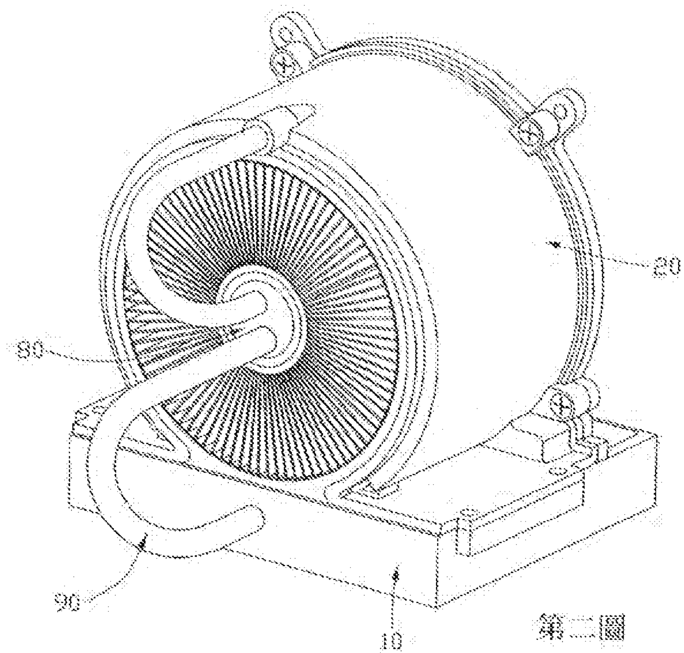
圖式簡單說明：

第一圖係一習知水冷式散熱裝置之立體圖。

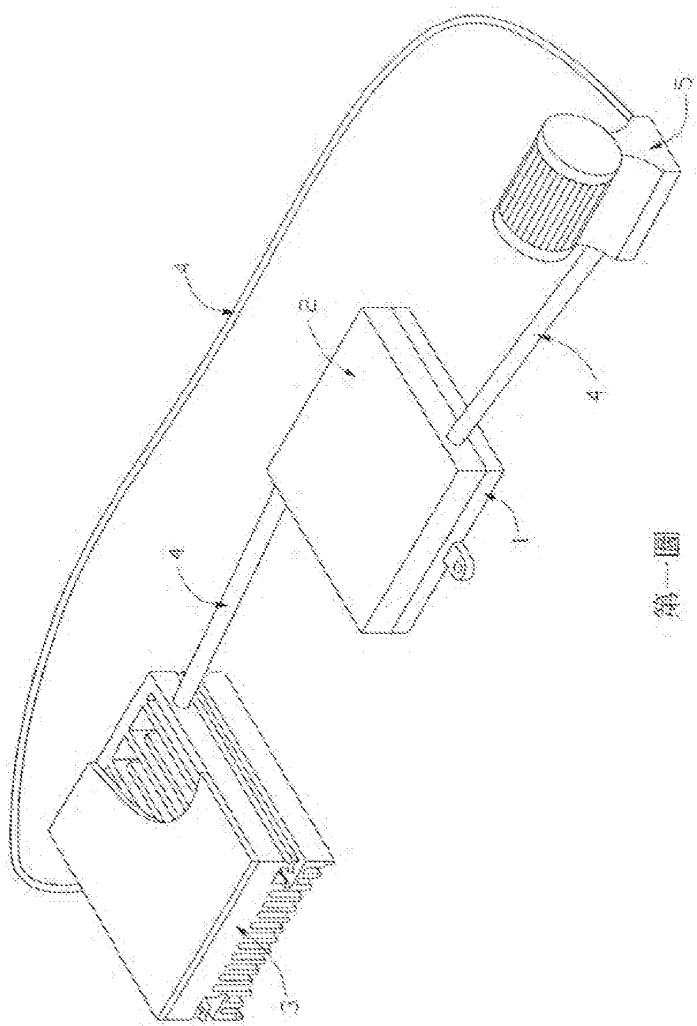
第二圖係本創作水冷式散熱裝置之立體圖。

第三圖係本創作水冷式散熱裝置之立體分解圖。

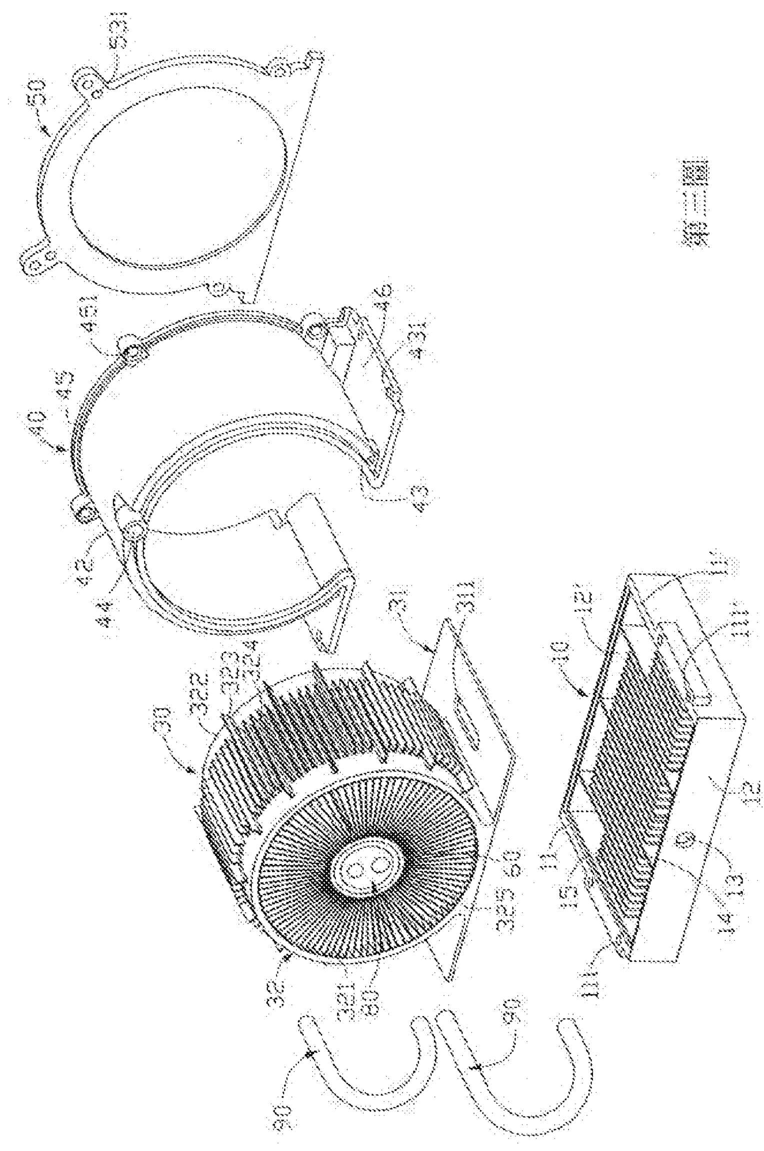
第四圖係本創作水冷式散熱裝置之水循環示意圖。



第二圖



第一圖



第三圖

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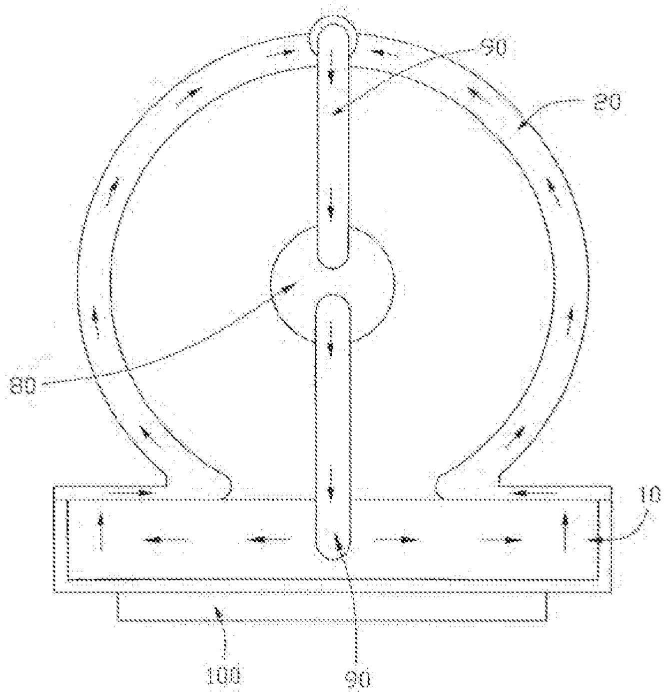

第四圖

[stamp:] Publication
Filing Date: September 19, 2003
Application No.: 92216907

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The above columns shall be filled out by our Office Granted Patent for Utility Model		
1. Description of utility model	Chinese	Water-cooling radiating device
	English	Water-cooling radiating device
2. Inventor (3 inventors in total)	Chinese name	1. Lee, Hsieh Kun 2. Lai, Chen Tie
	English name	1. Lee, Hsieh Kun 2. Lai, Chen Tie
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	Domicile (Chinese)	1. No. 2 Ziyou Street, Tucheng City, Taipei County, Taiwan 2. No. 2 Ziyou Street, Tucheng City, Taipei County, Taiwan
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3. Applicant (1 applicant in total)	Chinese name	Hon Hai Precision Industry Co., Ltd.
	English name	Hon Hai Precision Industry Co., Ltd.
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	Representative (Chinese)	1. Kuo, Tai-Ming
	Representative (English)	1. Kuo, Tai-Ming

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The above columns shall be filled out by our Office Granted Patent for Utility Model		
1. Description of utility model	Chinese	
	English	
2. Inventor (3 inventors in total)	Chinese name	3. Zhou, Shi-Wen
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3. Applicant (1 applicant in total)	Chinese name	
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	Nationality (Chinese & English)	
	Domicile (place of business) (Chinese)English	
	Domicile (place of business) (English)	
	Representative (Chinese)	
	Representative (English)	

1. Patent applications for this invention have been filed in the following countries (regions)	Filing date	Application number	Claim the right of priority under Paragraph 1 of Article 24-1 as permitted under Article 105 of the Patent Law
None			

2. □ Claim the right of priority under Paragraph 1 of Article 24-1 as permitted in Article 105 of the Patent Law:

Application No.:
Date:
None

3. Claim that this invention meets the period specified in the exclusions under □ Subparagraph 1 or □ Subparagraph 2 of Paragraph 1 of Article 98 of the Patent Law:

Date:

4. Abstract in Chinese (description of invention: Water-cooling radiating device)

A water-cooling radiating device, which comprises a tank, a cooling cylinder and a pump; the said tank takes the form of a hollow case and has a chamber, which connects with the outside via a water inlet; plural heat conducting fins are extended from the inside wall of the said chamber; the said cooling cylinder takes the form of a cylinder both ends of which are open and contains a hollow space, and is placed above the said tank horizontally; plural radiating fins are extended from the inside of the cylinder wall in the said hollow space; there's a chamber inside the cylinder wall that is connected with the said tank; plural heat transfer fins are extended from the inside of the said chamber; there's a water outlet on the said cooling cylinder, enabling the chamber inside the cylinder wall to connect with the outside; the said pump is mounted in the hollow space of the said cooling cylinder and is connected with the said water inlet on the tank and the said water outlet on the cooling cylinder via two water pipelines; thus, the said pump, tank, cooling cylinder and water pipelines form a closed loop; when water is filled into this loop, the said pump, as the power source, will drive water to circulate in the loop.

[Designated representative drawing and explanation]

Abstract in English (description of invention: Water-cooling radiating device)

A water-cooling radiating device, which comprises a tank, a cooling cylinder and a pump; the said tank takes the form of a hollow case and has a chamber, which connects with the outside via a water inlet; plural heat conducting fins are extended from the inside wall of the said chamber; the said cooling cylinder takes the form of a cylinder both ends of which are open and contains a hollow space, and is placed above the said tank horizontally; plural radiating fins are extended from the inside of the cylinder wall in the said hollow space; there's a chamber inside the cylinder wall that is connected with the said tank; plural heat transfer fins are extended from the inside of the said chamber; there's a water outlet on the said cooling cylinder, enabling the chamber inside the cylinder wall to connect with the outside; the said pump is mounted in the hollow space of the said cooling cylinder and is connected with the said water inlet on the tank and the said water outlet on the cooling cylinder via two water pipelines; thus, the said pump, tank, cooling cylinder and water pipelines form a closed loop; when water is filled into this loop, the said pump, as the power source, will drive water to circulate in the loop.

4. Abstract in Chinese (description of invention: Water-cooling radiating device)

1) The designated representative drawing for this invention is: Figure 2.
2) A brief explanation to the code numbers of components on the representative drawing:

Tank: 10
Cooling cylinder: 20
Pump: 80
Water pipeline: 90

Abstract in English (description of invention: Water-cooling radiating device)

5. Description of invention (1)

[Field of Technology]
This invention relates to a water-cooling radiating device, in particular, a water-cooling radiating device that has a compact structure, high degree of integration, high reliability and high efficiency of heat radiation and can be easily disassembled.

[Prior Art]
Central processing unit (CPU) is a core component in computer, the performance of which has a direct impact on the operating performance of the whole machine. The ever-increasing requirements for the performance of computers call for on-going improvement of the performance of CPU. In response to this demand, new high frequency and high-speed CPUs have been rolled out continuously. However, the faster CPU operates, the more heat is produced in unit time. On the other hand, since computers tend to be small sized and portable, the size of mainframe becomes smaller and smaller. The smaller space restricts heat radiation, and the sharp rise of heat and the reduction of available space for heat radiation worsen the accumulation of heat, resulting in continuous increase of the temperature of CPU. This will seriously affect its stability and other performance. Today, heat radiation has become a major hindrance to the development of high-frequency and high-speed CPUs. It is a regular practice in the industry to mount a radiator on the surface of CPU to help radiate heat and get rid of heat produced by CPU in order to maintain its temperature within a range in which CPU can operate normally. The increase in the operating speed inevitably demands that CPU can radiate more efficiently. On the other hand, the space occupied by a radiator needs to be reduced in response to the development tendency of mainframe towards smaller space. In other words, radiators are required to give play to their heat radiation effect within a limited space.

Originally, radiators were all aluminum extrusions and produced by extrusion molding of metal materials. Such radiator comprises a base and plural radiating fins mounted on the base. The base absorbs heat and conducts heat to the radiating fins, and then the radiating fins radiate heat to the outside.

5. Description of invention (2)

Along with the development of the technology, the industry insiders have been improving this kind of radiator. They have been optimizing the specific structure and shape of the radiating fins and base, or producing the base and radiating fins separately and then fitting them together. However, no matter how this radiator is improved, the effect of its heat radiation realized by conduction is unable to be improved significantly. When new high-speed CPUs are put out on an on-going basis, this radiator is unable to meet the needs. Later, some industry insiders designed a device using liquid circulation to radiate heat, which is called water-cooling radiating system. It sets up a water circulating path between the heat source in the mainframe and the radiating zone, and through the circulation of liquid in the path, transmits heat from the heat source zone to the radiating zone and then radiates heat to the outside. As shown in Figure 1, a radiating base 2 with a hollow chamber inside is set up above CPU 1, and a radiator 3 is mounted at another place which is relatively spacious, convenient for installation and ventilated well; the radiator 3 also has a chamber, which is closed by a plural pipeline 4; the plural pipelines 4 connect the chamber of the radiator 3 with the chamber of the radiating base 2; thus, the said two chambers and two pipelines 4 form a closed circulation loop; water and other circulating liquid are filled into the said loop; to enable water to circulate in the said circulation loop, a pump 5 needs to be mounted at an appropriate place in the said pipeline, which is used for providing driving force to drive water to circulate in the said loop, thus radiating heat to the outside. Please refer to the technologies disclosed in Chinese Patents No. 98248834.3 and No. 99210734.2 for its typical embodiments.

It can be easily seen from Figure 1 and the said patents that a common water-cooling radiating system is formed by a number of components that are loosely deployed, which has the following shortcomings: first, it makes assembly and disassembly very inconvenient; second, it occupies a relatively big space, which is not suited to the development tendency of computer towards smaller size; third, due to complicated connections among chambers, holes and ducts and loose deployment of functional components, the vibration produced in disassembly and operation of the mainframe easily lead to damage to pipeline joints and further lead to leakage of pipelines, the consequence of which is immeasurable.

5. Description of invention (3)

In addition, only a small part of the pipeline system is connected with the radiator, resulting in low quantity of heat conducted from the pipelines to the radiator in unit time, accumulation of heat in the pipelines and slow heat conduction from the base connected with electronic components to the pipeline. Therefore, though this water-cooling radiating system gives play to the advantage of water-cooling radiation, it has not made best of this principle and its cost performance is unsatisfactory.

Therefore, even if we have a good principle, we still need a good and specific structural design that can give full play to the advantage of water-cooling radiation, avoid the problems caused by loose deployment of components and maintain a high radiation performance.

[Contents]
The purpose of this invention is to provide a water-cooling radiating device, in particular, a water-cooling radiating device that has a compact structure, high degree of integration, high reliability and high efficiency of heat radiation and can be easily disassembled.

The water-cooling radiating device provided in this invention comprises a tank, a cooling cylinder and a pump; the said tank takes the form of a hollow case and has a chamber, which connects with the outside via a water inlet; plural heat conducting fins are extended from the inside wall of the said chamber; the said cooling cylinder takes the form of a cylinder both ends of which are open and contains a hollow space, and is placed above the said tank horizontally; plural radiating fins are extended from the inside of the cylinder wall in the said hollow space; there's a chamber inside the cylinder wall that is connected with the said tank; plural heat transfer fins are extended from the inside of the said chamber; there's a water outlet on the said cooling cylinder, enabling the chamber inside the cylinder wall to connect with the outside; the said pump is mounted in the hollow space of the said cooling cylinder and is connected with the said water inlet on the tank and the said water outlet on the cooling cylinder via two water pipelines; thus, the said pump, tank, cooling cylinder and water pipelines form a closed loop; when water is filled into this loop, the said pump, as the power source, will drove water to circulate in the loop.

5. Description of invention (4)

The water-cooling radiating device provided in this invention integrates the water circulation loop on the cooling cylinder, and a pump is mounted inside the cooling cylinder, thus realizing the integration of the water-cooling radiation system to the maximum extent as well as compact structure and convenient assembly and disassembly of the water-cooling radiation system, giving full play to the advantage of water-cooling radiation while minimizing the space it occupies. In addition, the pipeline is fully connected with the heat conducting fins, so that the whole pipeline radiates heat basically. Compared with the original water-cooling radiating system, the utilization of pipeline system in the water-cooling radiating device provided in this invention is significantly improved, so that it has a high radiation performance.

[Embodiment]
Below is a specific and detailed explanation of the water-cooling radiating device provided in this invention in light of the attached drawings.

Please refer to Figures 2 and 3. The water-cooling radiating device provided in this invention comprises a tank 10, a cooling cylinder 20, a pump 80 and at least two water pipes 90.

The said tank 10 takes the form of a hollow case with an open top. It has a bottom (not marked) and four side walls 11, 11' and 12, 12', two of which are opposite to each other respectively. There's a water inlet 13 on the lower part of the middle (between the right and left sides) of the side wall 12 that connects the inside of the tank 10 with the outside. There are plural partitions 14 between the side walls 12 and 12' that are extended from the tank bottom towards the upper part and perpendicular to the side walls 12 and 12'. Such partitions 14 are of equal height as the side walls 12 and 12'. One side of two neighboring partitions 14 is connected with the side walls 12 and 12' respectively; while there's a relatively big space between the other side and the side walls 12 and 12'. There are plural heat conducting fins 15 between two neighboring partitions 14 and between the side walls 11 and 11' and the neighboring partitions 14 that protrude from the upper surface of the said tank bottom and are paralleled to the partitions 14. There's a certain space between the two edges of the said heat conducting fins 15 and the side walls 12 and 12' of the tank 10. Such space is equal to the space between one edge of the partition 14 and the side walls 12 and 12'. A riveted edge each is horizontally extended from the upper exterior edges of the side walls 11 and 11'. There are connecting holes 111 and 111' in the said riveted edges.

5. Description of invention (5)

The said cooling cylinder 20 comprises a radiator 30, a cover 40 and an end cap 50.

The said radiator 30 comprises a horizontal cover plate 31 and a hollow cylinder 32 above the cover plate 31. The cover plate 31 tightly covers the upper opening of the tank 10 by soldering, so that the tank 10 takes the form of a closed case. There is a through hole 311 on each side of the cover plate 31.

The said cylinder 32 takes the form of a cylinder. Both ends of the cylinder 32 are open, which are openings 321 and 322. There are plural heat transfer fins extended from the exterior wall of the cylinder 32 and parallel to the axis of the cylinder 32. The width of each heat transfer fin is shorter than the axial length of the cylinder 32. One side of two neighboring heat transfer fins 323 leans against the two openings 321 and 322 of the cylinder 32 respectively, while there's a relatively big space between the other side and the two openings 321 and 322 of the cylinder 32 respectively. In addition, there are plural heat transfer fins 324 on the overlapping part of both neighboring heat transfer fins 323, which are used for increasing the area of exterior surface of the cylinder 32.

A hollow cylinder-shaped shell 60 is placed on the axis of the said cylinder 32. There are plural radiating fins 325 radially deployed between the said shell 60 and the interior wall of the cylinder 32. All the said radiating fins 325 come into close contact with the interior wall of the cylinder 32. The said radiating fins 325 can be made by fitting several pieces of fins together or continuously bending a metal piece. Or they can be extended from the interior wall of the cylinder 32 as an integral whole.

The shape of the said cover 40 is nearly the same as that of the radiator 30. It comprises a cylindrical part 42 corresponding to the cylinder 32 and two horizontal parts 46 connected with the cylindrical part 42 and corresponding to the cover plate 31. The said cover 40 covers the radiator 30. There's a certain space between the cylindrical part 42 and the exterior wall of the cylinder 32 and between the horizontal part 46 and the upper surface of the cover plate 31.

5. Description of invention (6)

There's a sealing edge 43 on the side edge of the cover 40 corresponding to the opening 321 of the cylinder 32 that protrudes towards the cylinder 32 and the cover plate 31. When the cover 40 covers the radiator 30, the sealing edge 43 is appressed to the periphery of the opening 321 of the cylinder 32 and the edge of upper surface of the cover plate 31, and comes into contact with one side edge of the heat transfer fins 323; the side edge of the cover 40 corresponding to the opening 321 of the cylinder 32 is turned outward and bent into a joint edge 45. The joint edge 45 has plural lugs (not marked) on it, in which there are connecting holes 451. Another choice is not to set up the lugs, but to directly set up connecting holes in the joint edge 45. There is a connecting hole 432 in the sealing edge in each side of the horizontal part 46 of the cover 40 that correspond to the connecting holes 111 and 111` in the riveted edges of two side walls 11 and 11` of the tank 10. Therefore, the cover 40 can be fixedly connected with the tank 10 by passing rivet joints through the connecting holes 431 and 111 and through the connecting holes 431 and 111` in the cover 40 and the tank 10 respectively, and cover the radiator 30.

The end cap 50 is connected with the joint edge 45 of the cover 40. There are lugs and connecting holes 531 on the end cap 50 that correspond to the lugs and connecting holes 451 on the cover 40. By passing rivet joints through the connecting holes 451 and 531 in the cover 40 and the end cap 50 respectively, the end cap 50 is connected with the cover 40, and comes into close contact with the periphery of the opening 322 of the cylinder 32 and the side edge of the cover plate 31, and contact with one side edge of the heat transfer fins 323. There are sealing washers (not marked) between the cover 40 and the tank 10, between the cover 40 and the periphery of the opening 321 of the cylinder 32, between the end cap 50 and the cover 40, between the end cap 50 and the periphery of the opening 322 of the cylinder 32. Thus, the radiator 30, the cover 40 and the end cap 50 jointly form a cooling cylinder 20. The cooling cylinder 20 has a chamber inside its walls, in which water can flow. There's a water outlet 44 on the top of the cover 40, which enables the loop inside the chamber of the cooling cylinder 20 to connect with the outside.

5. Description of invention (7)

The said pump 80 is mounted inside the said shell 60. The pump 80 shall have an excellent vibration-absorption capacity, a long service life, a long duration of continuous operation and a low noise. The pump 80 is connected with the water inlet 13 on the tank 10 and the water outlet 44 on the cover 40. Thus, the tank 10, cooling cylinder 20, pump 80 and water pipes 90 jointly form a closed circulation loop, in which there's water.

Please refer to Figure 4. In this water-cooling radiating device, the lower surface of the bottom of the tank 10 can come into contact with heat-generating electronic components 100, absorb the heat generated therefrom and conduct the heat to the heat conducting fins 15 protruding from the tank bottom. The said heat conducting fins 15 and the tank bottom will conduct the heat to water in the tank 10, resulting in the rise of water temperature. The pump 80, as the power source, will drive the heated water in the tank 10 to flow into the chamber of the cooling cylinder 20 via the through holes at both sides of the cover plate 31 and then flow upward through the loop inside the chamber. The heat is then transmitted to the heat transfer fins 323 and 324 inside the chamber and protruding from the exterior wall of the cylinder 32, and radiated to the environment by the radiating fins 325 contact with the interior wall of the cylinder 32. When the said two routes of water flow are on the top of the cylinder 20, its temperature is the lowest. The said cooled water converges and then flows out through the water outlet 44 on the cover 40, and then flows into the tank 10 via the water pipes 90. The water circulates in the said way continuously, so that the heat absorbed from the heat-generating electronic components 100 is transmitted by the tank 10 to the whole cooling cylinder 20, and then radiates to the environment through the radiating fins 325.

The water-cooling radiating device provided in this invention uses the pump 80 as the power source and water as the medium to rapidly conduct the heat generated by the electronic components 100 to the whole cooling cylinder 20 via the circulation loop, and then to the radiating fins 325, from where the heat is finally radiated to the environment. The circulation of water can rapidly transmit the heat to the whole cooling cylinder 20. Compared with traditional radiators, the water-cooling radiating device provided in this invention significantly strengthens the transmission of heat from heat-absorption components to radiating components.

5. Description of invention (8)

In addition, if a fan is mounted on one end of the cylinder 20, the temperature distribution of the radiating fins 325 in the hollow part of the cylinder 32 will match with the blowing rate and wind speed of the fan (i.e., the temperature at the outer part of the radial radiating fins 325 in the hollow part of the cylinder 32 along the radial direction of the cylinder 32 is higher, and is lower at the inner part; while the wind speed of the fan at the periphery along the radial direction is higher, and the blowing rate is reducing towards the center). Where the temperature of the radiating fins 325 is high, the blowing rate is high; where the temperature is low, the blowing rate also is low. Thus, the auxiliary radiation function of the fan is made full use of. This invention makes full and efficient use of the principle of water-cooling radiation and is characterized by a high degree of integration and excellent radiation performance.

To sum up, this invention meets the elements of a utility model. So, we hereby apply for a patent for this invention. However, what are described above are just relatively good embodiments of this invention. Any modification or changes of the same effect that may be made by any person knowing the art of this invention in the spirit of this invention shall be covered by the claims specified hereafter.

Brief explanation of the drawings:

[Brief explanation of the drawings]
Figure 1 is a stereograph of a common water-cooling radiating device.
Figure 2 is a stereograph of the water-cooling radiating device provided in this invention.
Figure 3 is an exploded diagram of the water-cooling radiating device provided in this creation.
Figure 4 is a diagram of water circulation in the water-cooling radiating device provided in this creation.

[Explanation of the code numbers of the components]

Tank	10	Side wall	11, 11', 12, 12'
Connecting hole	111, 111', 431, 451, 531		
Water inlet	13	Partition	14
Heat conducting fin	15	Cooling cylinder	20
Radiator	30	Cover plate	31
Cylinder	32	Opening	321, 322
Heat transfer fin	323, 324	Radiating fin	325
Cover	40	Cylindrical part	42
Horizontal part	46	Sealing edge	43
Water outlet	44	Joint edge	45
End cap	50	Shell	60
Pump	80	Water pipe	90

6. Claims

1) A water-cooling radiating device, which comprises:
A tank, that takes the form of a hollow case and has a chamber, which connects with the outside via a water inlet;
A cooling cylinder, that takes the form of a cylinder both ends of which are open and contains a hollow space; the said cooling cylinder is placed above the said tank horizontally; there's a chamber inside the cylinder wall that is connected with the said tank; there's a water outlet on the said cooling cylinder, enabling the chamber inside the cylinder wall to connect with the outside; and
A pump, that is connected with the said water inlet on the tank and the said water outlet on the cooling cylinder via two water pipes; thus, the said pump, tank, cooling cylinder and water pipes form a closed loop; when water is filled into this loop, the said pump, as the power source, will drive water to circulate in the loop.
2) The water-cooling radiating device described in Claim 1 is characterized by the fact that the said pump is mounted in the hollow space of the said cooling cylinder.
3) The water-cooling radiating device described in Claim 1 is characterized by the fact that in the said hollow space of the cooling cylinder, plural radiating fins are extended from the inside of the cylinder wall.
4) The water-cooling radiating device described in Claim 1 is characterized by the fact that plural heat conducting fins are extended from the inside wall of the said chamber of the tank.
5) The water-cooling radiating device described in Claim 1 is characterized by the fact that the said cooling cylinder comprises a radiator, a cover and an end cap.
6) The water-cooling radiating device described in Claim 5 is characterized by the fact that the said radiator is mounted above the tank and the said chamber of the cooling barred is formed on the said radiator.
7) The water-cooling radiating device described in Claim 6 is characterized by the fact that the said cover covers the said radiator and the said end cap connects the said cover with one end of the said radiator to close the chamber.

6. Claims

8) The water-cooling radiating device described in Claim 7 is characterized by the fact that there's a certain space between the said cover and the said radiator as well as the surface of the said tank.
9) The water-cooling radiating device described in Claim 1 is characterized by the fact that plural heat transfer fins are extended from the inside of the chamber of the said cooling cylinder.
10) The water-cooling radiating device described in Claim 9 is characterized by the fact that one side of two neighboring heat transfer fins leans against the two openings of the said cooling cylinder respectively; while there's a relatively big space between the other side and the two openings of the said cooling cylinder respectively.
11) The water-cooling radiating device described in Claim 1 is characterized by the fact that a fan is mounted on one end of the said cooling cylinder to help radiate heat.

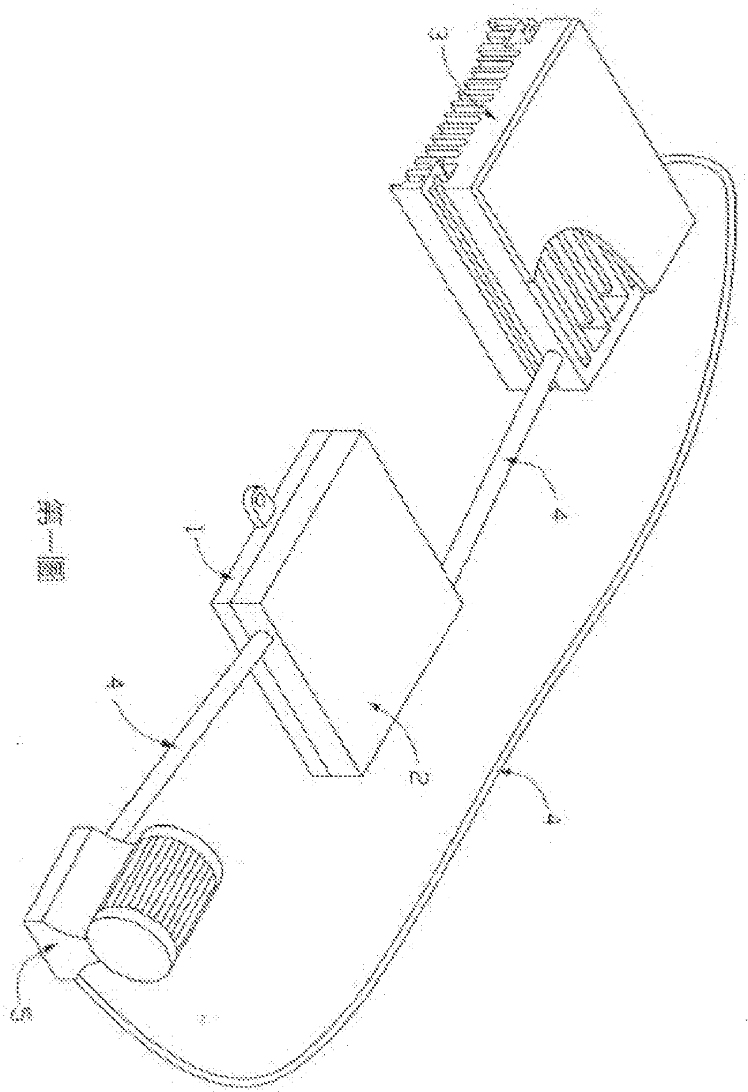


Figure 1

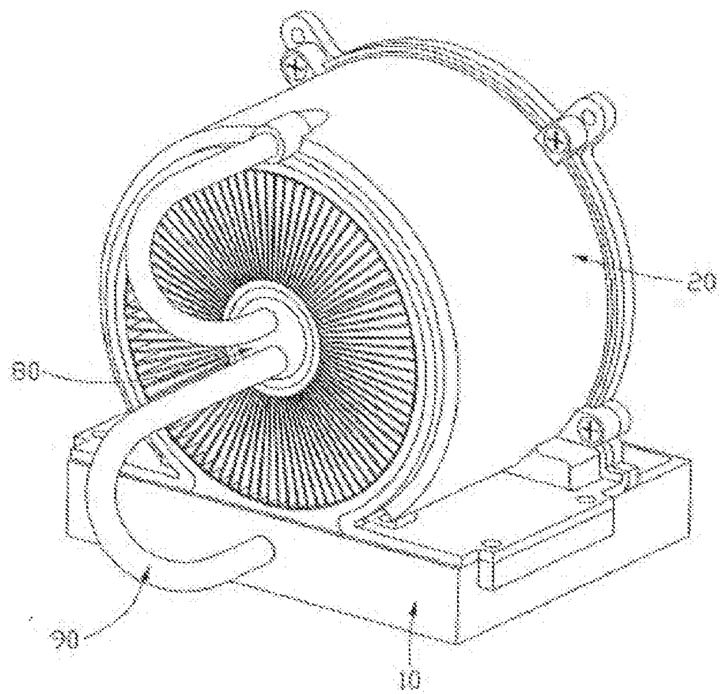
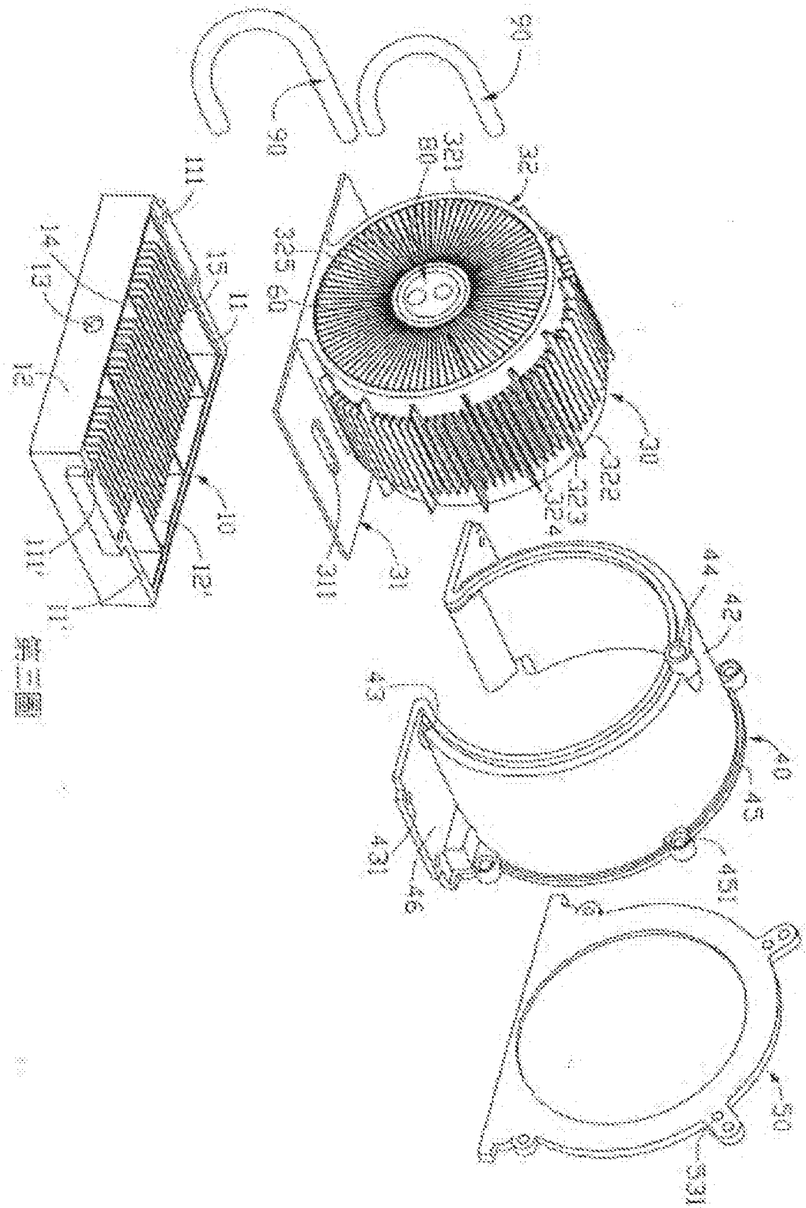


Figure 2


90
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第三圖

Figure 3

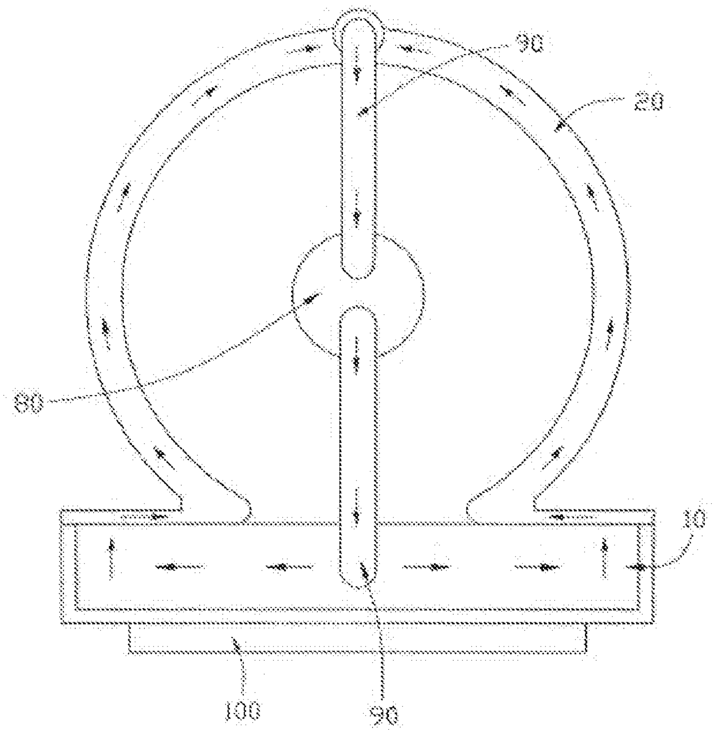


Figure 4

公告本

申請日期：92.9.19	IPC分類
申請案號：92216907	G06F 1/20 // H05K 7/20　　M244513

(以上各欄由本局填註)

新型專利說明書

一、新型名稱	中文	水冷式散熱裝置
	英文	LIQUID COOLING HEAT DISSIPATING DEVICE
二、創作人(共3人)	姓名(中文)	1. 李學坤 2. 賴振田
	姓名(英文)	1. LEE, HSIEH-KUN 2. LAI, CHEN-TIEN
	國籍(中英文)	1. 中華民國 ROC 2. 中華民國 ROC
	住居所(中文)	1. 台北縣土城市自由街2號 2. 台北縣土城市自由街2號
	住居所(英文)	1. 2, Tzu Yu Street, Tu-Cheng City, Taipei Hsien, Taiwan, ROC 2. 2, Tzu Yu Street, Tu-Cheng City, Taipei Hsien, Taiwan, ROC
三、申請人(共1人)	名稱或姓名(中文)	1. 鴻海精密工業股份有限公司
	名稱或姓名(英文)	1. HON HAI PRECISION INDUSTRY CO., LTD
	國籍(中英文)	1. 中華民國 ROC
	住居所(營業所)(中文)	1. 台北縣土城市自由街2號　(本地址與前向貴局申請者相同)
	住居所(營業所)(英文)	1. 2, Tzu Yu Street, Tu-Cheng City, Taipei Hsien, Taiwan, ROC
	代表人(中文)	1. 郭台銘
	代表人(英文)	1. GOU, TAI-MING

申請日期：92.9.19	IPC分類
申請案號：92216907	

（以上各欄由本局填註）

新型專利說明書

一、新型名稱	中文	
	英文	
二、創作人（共3人）	姓名（中文）	3.周世文
	姓名（英文）	3.ZHOU, SHI-WEN
	國籍（中英文）	3.中國 PRC
	住居所（中文）	3.深圳市寶安區龍華鎮油松第十工業區東環二路2號
	住居所（英文）	3.2, Dong Huan 2nd Road, You-Song Tenth Industrial Park, Long-Hua Town, Bao-An District, Shenzhen City, PRC
三、申請人（共1人）	名稱或姓名（中文）	
	名稱或姓名（英文）	
	國籍（中英文）	
	住居所（營業所）（中文）	
	住居所（營業所）（英文）	
	代表人（中文）	
	代表人（英文）	

一、本案已向

國家(地區)申請專利	申請日期	案號	主張專利法第一百零五條準用第二十四條第一項優先權

無

二、□主張專利法第一百零五條準用第二十五條之一第一項優先權：

申請案號：

無

日期：

三、主張本案係符合專利法第九十八條第一項□第一款但書或□第二款但書規定之期間

日期：

四、中文創作摘要 （創作名稱：水冷式散熱裝置）

一種水冷式散熱裝置，包括一水槽、一冷卻水筒及一泵。該水槽為中空盒狀體，內部具有一腔室，該腔室通過一入水口與外部相通，且腔室內壁延伸有複數導熱片；該冷卻水筒呈兩端開放之圓筒狀而形成一中空部，其橫置於水槽上方，該中空部內由筒壁伸設有複數散熱鰭片，筒壁內部具有與水槽相連通之腔室，於腔室內延伸出複數傳熱片，冷卻水筒上設有一出水口，使筒壁內部腔室與外部相通；該泵裝設於冷卻水筒之中空部，藉由二水管與上述水槽之入水口及冷卻水筒之出水口連接，從而由泵、水槽及冷卻水筒及水管連成一封閉迴路，該迴路中充入水，以泵為動力源使水在該迴路中循環流動。

【指定代表圖及說明】

英文創作摘要 （創作名稱：LIQUID COOLING HEAT DISSIPATING DEVICE）

A liquid cooling heat dissipating device includes a tank having a room therein in communication with outside via a orifice, a column-shaped cooling barrel defining a cavity surronded by a wall, and a pump. The cooling barrel is mounted on the tank and a chamber is formed in the wall. The chamber is connected to the room of the tank and in communication with outside via a orifice. The pump is connected to the two orifice by two pipes and a circular loop is formed in which liquid flows by the pump, the

四、中文創作摘要 （創作名稱：水冷式散熱裝置）

（一）、本案指定代表圖為：第二圖

（二）、本代表圖之元件代表符號簡單說明：

水槽	10	冷卻水筒	20
泵	80	水管	90

英文創作摘要 （創作名稱：LIQUID COOLING HEAT DISSIPATING DEVICE)

barrel and the tank.

五、創作說明 (1)

【新型所屬之技術領域】

本創作係關於一種水冷式散熱裝置，特別係關於一種結構緊湊、集成度高，拆裝便利、可靠性好且散熱效率高之水冷式散熱裝置。

【先前技術】

中央處理器係電腦中的核心部件，其性能之優劣直接影響整機運行之性能，隨著對電腦性能需求的不斷提高，必然要求中央處理器之性能亦不斷提高，因此，高頻高速中央處理器不斷推出，而中央處理器運行速度愈快，則單位時間產生之熱量愈多；另一方面，如今電腦正朝小型化便攜式方向發展，主機的尺寸愈來愈小，而空間越小越影響熱量的散發，伴隨發熱量之劇增及可利用之散熱空間減小，使得熱量的累積更加嚴重，從而引起中央處理器溫度不斷升高，其運行之穩定性及其它性能受到很大影響，如今散熱問題也成為高頻高速中央處理器推出之一大障礙。業界通常在中央處理器表面加裝一散熱器輔助散熱，以及時排除中央處理器產生之熱量，使其溫度維持在可正常運行之範圍內，隨著中央處理器運行速度之提高，必然要求散熱器具有更加高效之散熱性能，同時為適應空間日漸減小之發展趨勢，亦需要散熱器占用空間小，使其在有限空間內發揮最大散熱效能。

最初，散熱器均係鋁擠型，其採用金屬材料一體擠出成型，該散熱器具有一基座及設於該基座上之複數散熱鰭片，由基座吸收熱量傳至散熱鰭片再散發到周圍環境中，

隨著技術的發展，業者也不斷對此種散熱器作改進，如對散熱鰭片及基座具體結構及形狀上作優化設計，或分開製造基座及散熱鰭片再組裝等等，但無論怎樣改進之，此種單純利用傳導方式之散熱效果均無法獲得突破性提高，隨高速中央處理器之不斷推出，該種散熱器日漸不勝應用。隨後，即有業界人士便設計了利用液體循環進行散熱的裝置，即水冷散熱系統。其在電腦主機內熱源與散熱區間設置一水路循環通道，藉由液體在通道內循環將熱量由熱源帶至散熱區並散發出去。如第一圖所示，其在中央處理器1上方設一內具空腔之散熱座2，在其它較為寬敞而便於安裝且通風良好位置安裝一散熱器3，該散熱器3亦具有一腔室，藉由複數管路4密封連接散熱器3之腔室與散熱座2之腔室，因此由上述二腔室及二管路4形成一封閉之循環迴路，該迴路內充有水等循環液體，為使水在該迴路內循環，另需在管路適當位置安裝一泵體5，用以提供動力，使水在上述循環迴路中循環流動，將熱量散發出去。其典型的具體應用另請參見大陸專利第98248834.3號、第99210734.2號揭露之技術內容。

參照第一圖及上述專利不難看出習知水冷散熱系統均由一系列分散佈設之元件連接而成，一則安裝拆卸極為不便，二則占用空間較大，較不適應如今電腦朝小型化發展之趨勢，三則，由於各腔室孔道間連接較多，且各功能部件均分散佈置，拆裝時及主機工作時產生的振動易造成管路接口的損壞，從而引起泄漏，其後果係難以估計的。而

且，管路系統中僅有一小部分長度經由散熱器，因此，單位時間管路到散熱器的傳熱量較少，引起管路內熱量累積，也使與電子元件接觸之基座到管路之傳熱速度減慢，因此，其雖然利用水冷散熱的優點，卻未使該原理得到很好的發揮，加之成本考量而言，性價比不令人滿意。

因此，即使有好的創作原理，仍然需要有較佳的具體之結構設計使其既能充分利用水冷散熱的優勢，又可避免傳統元件分散安裝而導致的問題，同時保持高效之散熱性能。

【內容】

本創作之目的在於提供一種水冷式散熱裝置，特別係指一種結構緊湊、集成度高，拆裝便利、可靠性好且散熱效率高之水冷式散熱裝置。

本創作水冷式散熱裝置，包括一水槽、一冷卻水筒及一泵。該水槽為中空盒狀體，內部具有一腔室，該腔室通過一入水口與外部相通，且腔室內壁延伸有複數導熱片；該冷卻水筒呈兩端開放之圓筒狀而形成一中空部，其橫置於水槽上方，該中空部內由筒壁伸設有複數散熱鰭片，筒壁內部具有與水槽相連通之腔室，於腔室內延伸出複數傳熱片，冷卻水筒上設有一出水口，使筒壁內部腔室與外部相通；該泵裝設於冷卻水筒之中空部，藉由二水管與上述水槽之入水口及冷卻水筒之出水口連接，從而由泵、水槽及冷卻水筒及水管連成一封閉迴路，該迴路中充入水，以泵為動力源使水在該迴路中循環流動。

五、創作說明 (4)

本創作水冷式散熱裝置將水循環管路集成於冷卻水筒之實體上，且泵安裝於冷卻水筒內，實現水冷式循環系統最大限度之集成，結構緊湊，拆裝便利，在充分利用水冷散熱優勢之同時，使占用空間降到最小；另外，管路全長均與傳熱片接觸，基本上整個管路均在散熱，相較前案，管路系統之利用率大大提高。因此，本創作水冷式散熱裝置具有高散熱性能。

【實施方式】

下面結合附圖，對本創作水冷式散熱裝置作具體而詳細之說明。

請參閱第二至三圖，本創作水冷式散熱裝置包括一水槽10、一冷卻水筒20、一泵80及至少二水管90。

該水槽10為上部開口之中空方盒狀體，其具有一槽底(未標示)及兩兩相對之四側壁11、11'及12、12'，其中側壁12左右居中而偏下之位置設有一連通水槽10內部與外部之入水口13。兩側壁12、12'之間設有複數由槽底向上延伸且與側壁12、12'垂直之隔板14，該等隔板14係與側壁12、12'等高，兩相鄰兩隔板14之一側邊係分別與側壁12、12'相連，而另一側邊則與側壁12、12'間具有一定間距。在兩相鄰隔板14之間及側壁11、11'與相鄰隔板14間，從上述槽底上表面向上凸設有複數平行於隔板14之導熱片15，該等導熱片15兩側邊緣與水槽10側壁12、12'間均具有一定間距，該間距與隔板14之一側邊與側壁12、12'之間距相等。上述側壁11、11'外部上邊緣各水平延伸有一

鉚合邊，其上設有連接孔111、111'。

上述冷卻水筒20由一散熱體30、一罩體40及一端蓋50組成。

該散熱體30係由一水平蓋板31及一設於蓋板31上之中空筒體32。該蓋板31藉由錫焊方式固定蓋設於水槽10上部開口，使水槽10呈一封閉盒狀，該蓋板31靠向兩側分別開設有上下貫穿之通孔311。

該筒體32呈圓筒狀，兩端開放而各具有一開口端321、322，筒體32外壁面延伸有複數與筒體32軸線平行之傳熱片323，每一傳熱片323之寬度均小於筒體32軸向長度，兩相鄰傳熱片323之一側邊分別靠向筒體32之二開口端321、322，而另一側邊則與筒體32二開口端321、322分別具有較大間距。另外，在上述任意二相鄰傳熱片323間之重疊部分還設有複數傳熱片324，以增加筒體32之外表面積。

該筒體32之軸心線位置設有一中空圓筒形殼體60，在該殼體60與筒體32內壁間設有複數呈放射狀排佈之散熱鰭片325，該等散熱鰭片325均與筒體32內壁緊密接觸，其可由多數個鰭片單體組接而成或由一金屬片體連續彎折而成，亦可由筒體32內壁一體延伸而出。

罩體40具有大致同於上述散熱體30之形狀，其具有一與筒體32對應之筒形部42及連接該筒形部42而與蓋板31對應之二水平部46，該罩體40罩設在散熱體30上，筒形部42與筒體32外壁面間，水平部46與蓋板31上表面間均具有一

定距離。該罩體40對應筒體32開口端321之側邊具有向筒體32及蓋板31凸伸之密封邊43，該密封邊43在罩體40罩設散熱體30時緊貼筒體32之開口端321周緣及蓋板31之上表面邊緣，並與傳熱片323一側邊接觸；而罩體40對應筒體32開口端322之側邊則向外翻折出接合邊45，該接合邊45上設有複數凸耳（未標號），凸耳上設有連接孔451，當然，不設凸耳直接在接合邊45上設連接孔亦可。上述罩體40水平部46兩側之密封邊43各設有與水槽10二側壁11、11'鉚合邊上之連接孔111、111'相對應之連接孔431，因此，該罩體40可藉由鉚合元件穿過罩體40與水槽10上對應之連接孔431與111、431與111'而與水槽10固定連接，並罩設散熱體30上。

該端蓋50與上述罩體40之接合邊45連接，其對應罩體40之凸耳及連接孔451亦設有凸耳及連接孔531，可藉由鉚接元件穿過罩體40與端蓋50上相對應之連接孔451、531使端蓋50與罩體40連接，同時與筒體32之開口端322周緣及蓋板31側邊緊密接觸，並與傳熱片323一側邊接觸。在上述罩體40與水槽10、罩體40與筒體32開口端321周緣、端蓋50與罩體40、端蓋50與筒體32開口端322周緣之接觸面間均夾設有密封墊圈（圖未示出），從而，由散熱體30、罩體40、端蓋50共同形成一冷卻水筒20，該冷卻水筒20之筒壁內部具有腔室，可供水在其內部流動。在上述罩體40之最高位置具有一出水口44，使冷卻水筒20腔室內之迴路與外部相通。

泵80安裝於上述殼體60內，該泵80要求具有優良的減振特性、壽命長、可持續運轉時間長且噪音低。該泵80藉由二水管90分別與水槽10之入水口13及罩體40上之出水口44連接。因此，由水槽10、冷卻水筒20、泵80及水管90共同形成一封閉之循環迴路，該迴路中具有水。

請結合參閱第四圖，該水冷散熱裝置中，水槽10之槽底下表面可與發熱電子元件100接觸，吸收其產生之熱量，並傳導至由槽底向上凸伸出之導熱片15，該等導熱片15及槽底將熱量傳至水槽10中的水，引起水溫升高。而以泵80為動力源使水槽10內被加熱的水通過蓋板31兩側之通孔311分兩路流入冷卻水筒20之腔室內，並經過腔室內之迴路向上流動，將熱量傳遞給腔室內由筒體32外壁凸伸出之傳熱片323、324，並藉由與筒體32內壁相接觸之散熱鰭片325將熱量散發出去，當兩路水流至冷卻水筒20最高位置時，其溫度降到最低，匯流後由罩體40之出水口44流出，藉由水管90將該冷卻的水導入水槽10中，周而復始，不斷循環，使水槽10從發熱電子元件100吸收之熱量傳遞至整個冷卻水筒20，再進一步藉由散熱鰭片325散發出去。

本創作水冷散熱裝置以泵80為動力源，以水為媒介經由循環迴路將電子元件100產生之熱量迅速傳導至整個冷卻水筒20，進而傳導至散熱鰭片325，再將熱量散發出去。水之循環流動可將熱量迅速帶至整個冷卻水筒20。相較傳統散熱器而言，大大增強了吸熱元件到散熱元件間熱量之傳遞。同時，若在冷卻水筒20之一端面安裝風扇，則筒

體32中空部內散熱鰭片325之溫度分佈與風扇之風量及流速分佈吻合（上述筒體32中空部之放射狀散熱鰭片325沿筒體32徑向靠外溫度高，靠內溫度低，而風扇沿徑向外圍風速高，向中心風量減小），散熱鰭片325溫度高處風量大，溫度低處風量小，可充分利用風扇之輔助散熱功能。本創作使水冷散熱的原理得到充分有效利用，具有集成度高、散熱性能佳之特點。

綜上所述，本創作符合新型專利要件，爰依法提出專利申請。惟，以上所述者僅為本創作之較佳實施例，舉凡熟悉本案技藝之人士，在爰依本創作精神所作之等效修飾或變化，皆應涵蓋於以下之申請專利範圍內。

圖式簡單說明

【圖式簡單說明】

第一圖係一習知水冷式散熱裝置之立體圖。

第二圖係本創作水冷式散熱裝置之立體圖。

第三圖係本創作水冷式散熱裝置之立體分解圖。

第四圖係本創作水冷式散熱裝置之水循環示意圖。

【元件符號說明】

水槽	10	側壁	11、11'、12、12'
連接孔			111、111'、431、451、531
入水口	13	隔板	14
導熱片	15	冷卻水筒	20
散熱體	30	蓋板	31
筒體	32	開口端	321、322
傳熱片	323、324	散熱鰭片	325
罩體	40	筒形部	42
水平部	46	密封邊	43
出水口	44	接合邊	45
端蓋	50	殼體	60
泵	80	水管	90

六、申請專利範圍

1. 一種水冷式散熱裝置，包括：

一水槽，其為中空盒狀體，內部具有一腔室，該腔室通過一入水口與外部相通；

一冷卻水筒，呈兩端開放之圓筒狀而形成一中空部，該冷卻水筒橫置於水槽上方，其筒壁內部具有與水槽相連通之腔室，該冷卻水筒上設有一出水口，使筒壁內部腔室與外部相通；及

一泵，藉由二水管與上述水槽之入水口及冷卻水筒之出水口連接，從而由泵、水槽及冷卻水筒及水管連成一封閉迴路，該迴路中充入水，以泵為動力源使水在該迴路中循環流動。

2. 如申請專利範圍第1項所述之水冷式散熱裝置，其中該泵係裝設於冷卻水筒之中空部。

3. 如申請專利範圍第1項所述之水冷式散熱裝置，其中該冷卻水筒之中空部內，於筒壁內側伸設有複數散熱鰭片。

4. 如申請專利範圍第1項所述之水冷式散熱裝置，其中該水槽之腔室內壁延伸有複數導熱片。

5. 如申請專利範圍第1項所述之水冷式散熱裝置，其中該冷卻水筒由散熱體、一罩體及一端蓋組成。

6. 如申請專利範圍第5項所述之水冷式散熱裝置，其中該散熱體係固設於水槽上方，上述冷卻水筒之腔室即形成於該散熱體上。

7. 如申請專利範圍第6項所述之水冷式散熱裝置，其中

六、申請專利範圍

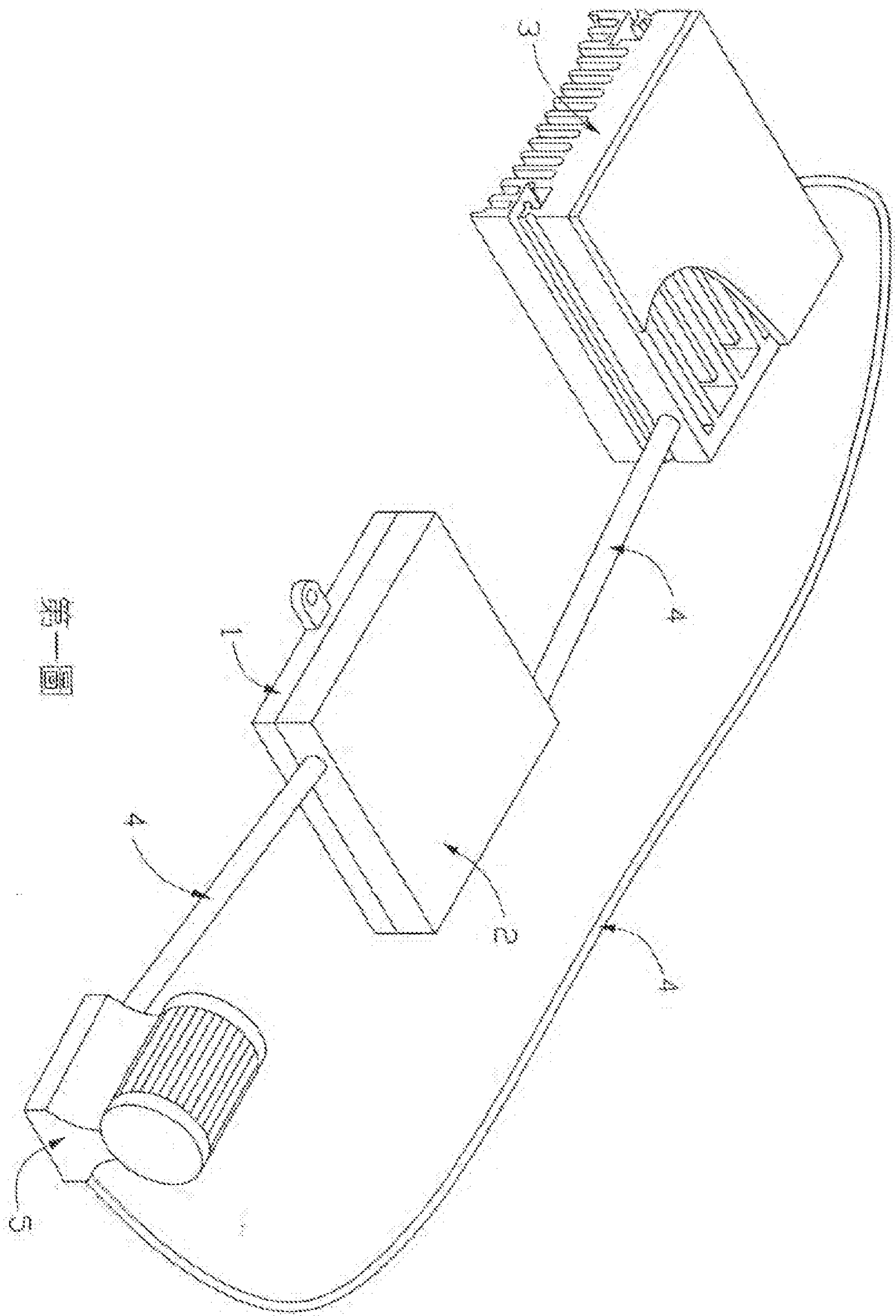
該罩體係罩設於散熱體上，該端蓋係連接罩體與散熱體之一端，以密封腔室。

8. 如申請專利範圍第7項所述之水冷式散熱裝置，其中該罩體與散熱體及水槽上表面間具有一定間距。

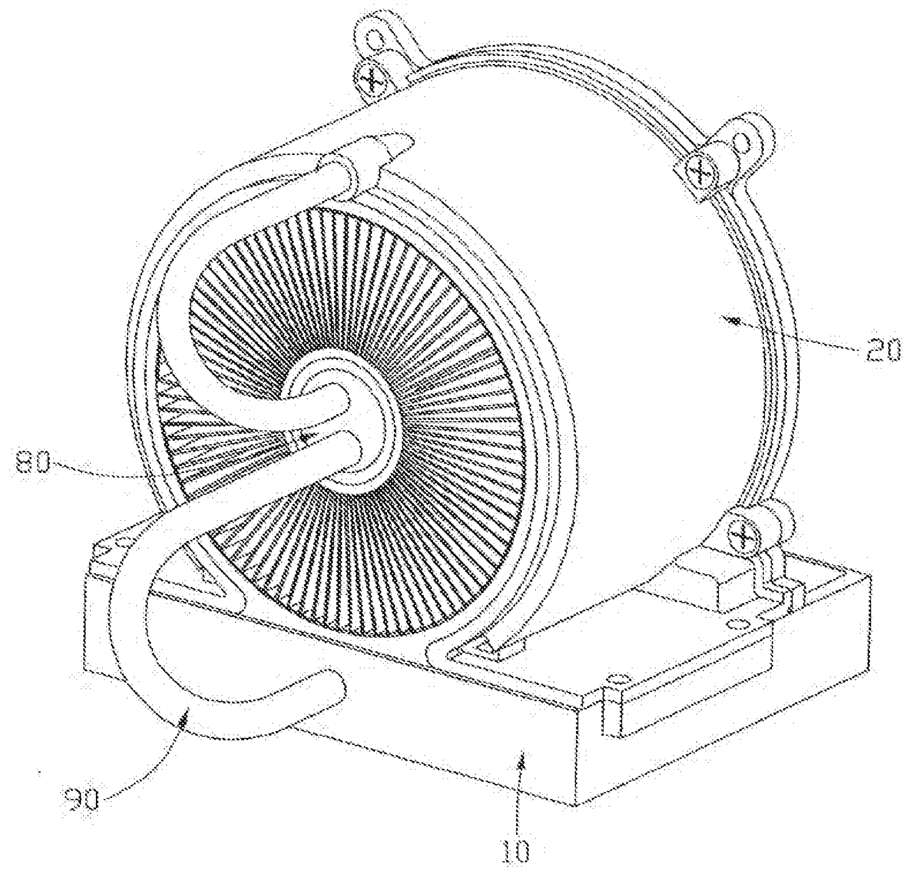
9. 如申請專利範圍第1項所述之水冷式散熱裝置，其中該冷卻水筒之腔室內延伸出複數傳熱片。

10. 如申請專利範圍第9項所述之水冷式散熱裝置，其中兩相鄰傳熱片之一側邊分別靠向冷卻水筒之兩開口端，而另一側邊則與冷卻水筒之二開口端分別具有一較大間距。

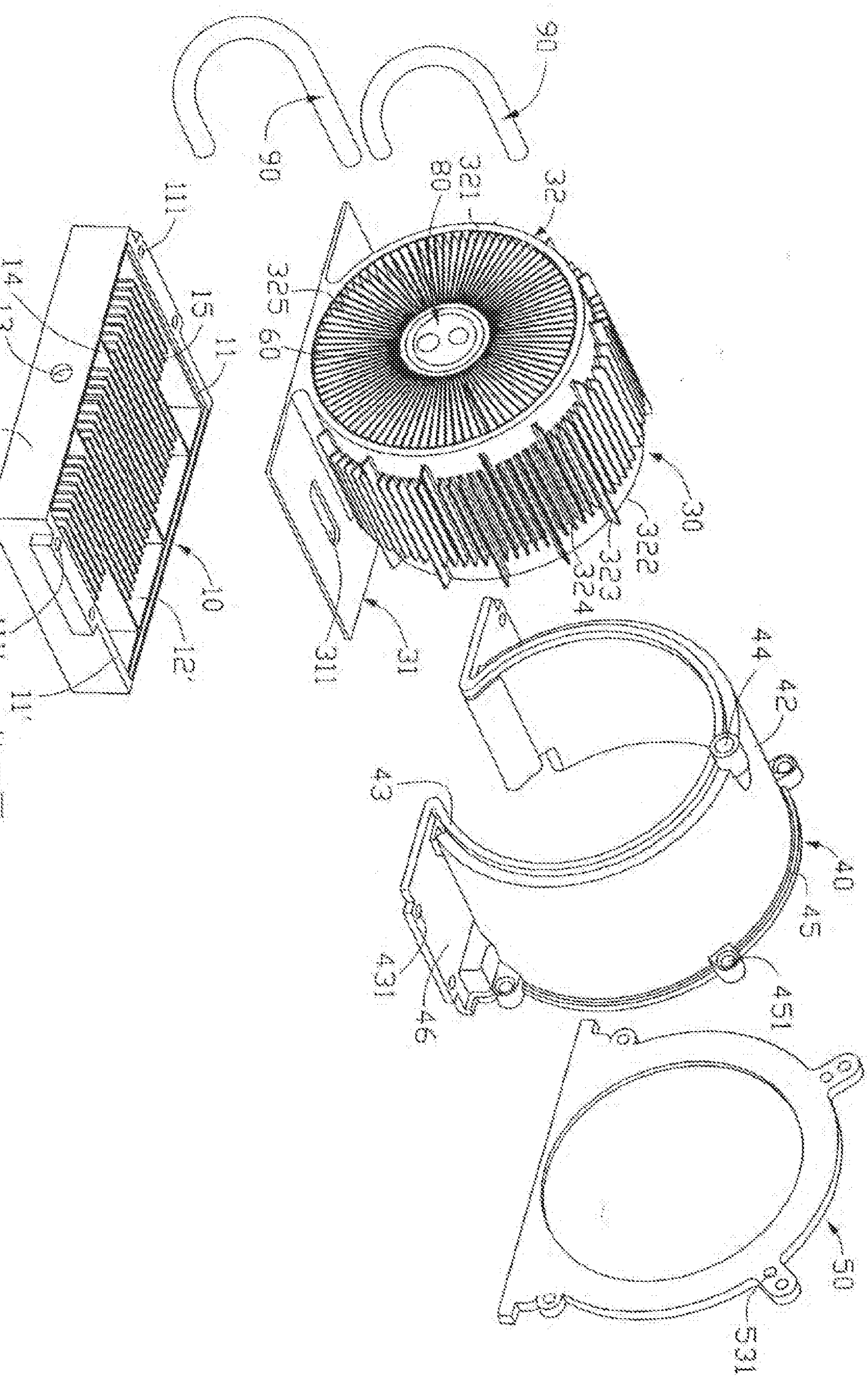
11. 如申請專利範圍第1項所述之水冷式散熱裝置，其中該冷卻水筒之一端裝設一風扇，以協助散熱。



第一圖



第二圖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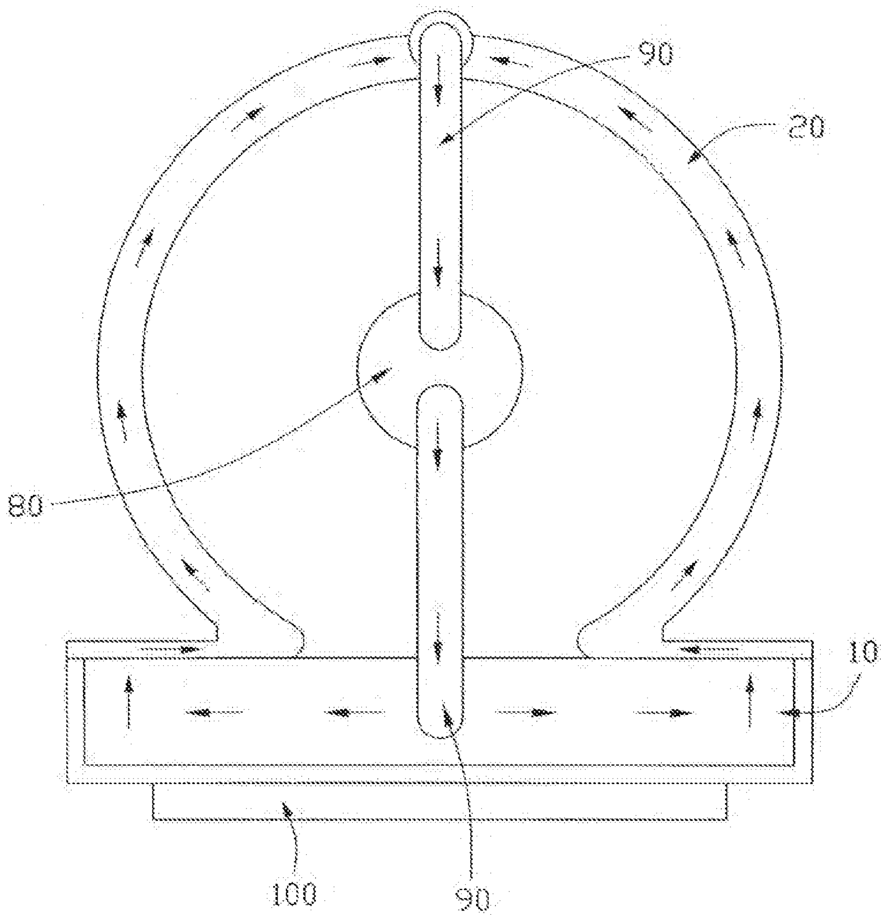
第三圖



第四圖

[19] Republic Of China [12] Patent Gazette (U)
[11] Patent No.: M251442
[45] Publication Date: Republic Of China Nov. 21, 2004
[51] Int. Cl.[7]: H05K7/20

Utility Model Total 6 pages

[54] Title: Liquid cooling apparatus

[21] Appln. No.: 092219772 [22]Appln. Date: Nov. 7, 2003

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Liquid cooling apparatus

Claims

1. A liquid cooling apparatus, comprising:

a cooling body, a first chamber and a second chamber which are conducted to each other are formed in the cooling body, the cooling body is provided with a liquid inlet conducted to the first chamber and a liquid outlet conducted to the second chamber;

a pump fixed on the cooling body, the pump is provided with a liquid in port and a liquid out port, the liquid out port is conducted to the first chamber and the liquid in port is conducted to the second chamber, so that the first chamber, the second chamber and the pump forms a loop for cooling liquid to circulate; and

heat dissipating mold assembly, arrange on the loop between the second chamber and the pump.

2. A liquid cooling apparatus according to claim 1, wherein the cooling body includes a main body, a bottom board hermetically mounted on one side of the main body for absorbing heat of heating electronic elements, and an upper cover hermetically mounted on another opposite side of the main body.

[19] Republic Of China [12] Patent Gazette (U)
[11] Patent No.: M256682
[45] Publication Date: Republic Of China Feb. 1, 2005
[51] Int. Cl.[7]: H05K7/20
G06F1/20
Utility Model Total 8 pages

[54] Title: Electronic element cooling device

[21] Appln. No.: 093206300 [22]Appln. Date: April 23, 2004

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Electronic element cooling device

Claims

1. An electronic element cooling device, comprising:

a main body provided with a first accommodating chamber and a second accommodating chamber, and a water storing space is formed in the second accommodating chamber;

a heat exchanging device arranged in the first accommodating chamber of the main body, and the heat exchanging device is provide with two fluid guiding holes;

a pump arranged in the second accommodating chamber of the main body, and the pump is provide with two water holes; and

two running path, a first running path connecting a fluid guiding hole of the heat exchanging device with the water hole of the pump, and a second running path connecting another fluid guiding hole of the heat exchanging device with the water storing space of the second accommodating chamber.

2. An electronic element cooling device according to claim 1, wherein the second accommodating chamber of the main body is provided with an opening; the opening is covered with a cover; the cover is provided with a connecting hole; the connecting hole is conducted to the fluid guiding hole of the heat exchanging device.

3. An electronic element cooling

Espacenet

Bibliographic data: TWM273072 (U) — 2005-08-11

Key-fixing structure

No documents available for this priority number.

Inventor(s): LIN LIANG-JIUN [TW]; HSU HSIN-AN [TW] ± (LIN, LIANG-JIUN, ; HSU, HSIN-AN)

Applicant(s): FIRST INT COMPUTER INC [TW] ± (FIRST INTERNATIONAL COMPUTER, INC)

Classification: **- international:** ***H01H13/52;*** (IPC1-7): H01H13/52
- cooperative:

Application number: TW20050201757U 20050131

Priority number (s): TW20050201757U 20050131

Abstract not available for TWM273072 (U)

Last updated: 23.09.2013 Worldwide Database 5.8.11.4; 92p

M273032

公告本

申請日期：94-07-08	IPC分類
申請案號：94202298	G06F 1/20, H05K 7/20

(以上各欄由本局填註)

新型專利說明書

一、新型名稱	中文	集成式液冷散熱機構
	英文	
二、創作人（共2人）	姓名（中文）	1.段強飛 2.江太陽
	姓名（英文）	1.Duan Qiang-fei 2.
	國籍（中英文）	1.中國大陸 CN 2.中國大陸 CN
三、申請人（共1人）	名稱或姓名（中文）	1.訊凱國際股份有限公司
	名稱或姓名（英文）	1.
	國籍（中英文）	1.中華民國 TW
	住居所（營業所）（中文）	1.台北縣中和市中正路786號9樓 （本地址與前向貴局申請者相同）
	住居所（營業所）（英文）	1.
	代表人（中文）	1.林仁政
	代表人（英文）	1.

一、本案已向

國家(地區)申請專利	申請日期	案號	主張專利法第一百零八條準用第二十七條第一項國際優先權

無

二、☐主張專利法第一百零八條準用第二十九條第一項國內優先權:

申請案號:

無

日期:

三、主張本案係符合專利法第九十四條第二項☐第一款或☐第二款規定之事實,其事實發生日期為:

四、中文創作摘要　（創作名稱：集成式液冷散熱機構）

一種集成式液冷散熱機構，其具有一水冷排模組，水冷排模組的上、下側處各成型有一上蓋體及一下蓋體，在上蓋體處組設一水流驅動模組，而在下蓋體處安裝有一冷板模組，俾於該水流驅動模組、水冷排模組及冷板模組之間連通有一水流通道，利用該水流通道使冷卻液體於各模組間產生循環式的流動。藉以將該水流驅動模組、水冷排模組及冷板模組集成化，且直接利用一連通的水流通道使冷卻液體在其間流動，而能加速循環速度，以提昇散熱速率者。

五、英文創作摘要　（創作名稱：）

六、指定代表圖

（一）、本案代表圖為：第七圖

（二）、本案代表圖之元件符號簡單說明：

集成式液冷散熱機構10

中央處理器	20	固定座	201
冷板模組	1	冷板	11
吸熱面	12	散熱片	13
密封墊片	14、37	水冷排模組	2
箱體	21	上蓋體	22
下蓋體	23	散熱片	24
流道	25	水流驅動模組	3
本體	31	上容置空間	311
下容置空間	312	線圈座	33
上蓋	34	導引座	35
扇葉座	36	固定架	4
開口	41	鎖固片	42
螺栓元件	15		

四、創作說明 (1)

【新型所屬之技術領域】

本創作係有關於一種集成式液冷散熱機構，尤指一種應用在發熱電子元件（中央處理器）上之集成式液冷散熱機構。

【先前技術】

按，現今電腦的運算功能愈來愈強大，且其運算速度也迅速提高，而其整體造形、構造及與主機板連接方式更是突破傳統之巢窠，可謂是電腦業界之重大改革，更由於新一代中央處理器挾帶超速的運算功能，也使得中央處理器在處理運算指令時所產生的溫度更高，故如何利用良好的導熱及散熱系統來使中央處理器在其所允許的溫度下正常工作，已被業界視為極重要之課題。

是以，即有業者設計出一種水冷式散熱系統，請參照第一圖所示，該水冷式散熱系統100a包括有一安裝在中央處理器200a上之散熱座10a，於散熱座10a之兩端分別設有出水口101a及進水口102a，進水口102a上連結有管路103a至一水幫浦20a的出水口201a處，而散熱座10a的出水口101a則再連結管路104a至一冷卻座30a 的進水口301a，冷卻座30a係可由複數個散熱鰭片303a所構成，該冷卻座30a之出水口302a再連接管路304a至一水箱40a 的進水口401a，水箱40a的出水口則再連結管路402a至水幫浦20a的進水口202a處，以形成一水冷式循環散熱系統100a。使用時，由水幫浦20a將冷水輸送至散熱座10a內進行熱交換後流出熱水，熱水再經由管路104a流入於冷卻座30a 內進行熱交

四、創作說明 (2)

換後形成冷水，再由管路304a流回至水箱40a 內，以持續進行循環式的熱交換散熱處理。

惟，此種水冷式散熱系統100a係分別由獨立的散熱座10a、水幫浦20a、冷卻座30a及水箱40a所組成，再加上各裝置間所串接的管路103a、104a、304a、402a，造成整個水冷式散熱系統100a之體積龐大，而佔用非常多的安裝空間，這對於朝向輕薄化的電腦主機而言，無疑是另一欲解決的課題。

有鑑於上述習知所產生之各問題，本案創作人遂以從事該行業多年之經驗，並本著精益求精之精神，積極研究改良，遂有本創作『集成式液冷散熱機構』之產生。

【新型內容】

本創作之目的在於提供一種集成式液冷散熱機構，其係令該集成式液冷散熱機構係由水流驅動模組、水冷排模組及冷板模組集成化，且直接利用一連通的水流通道使冷卻液體在其間流動，而能加速循環速度，以提昇散熱速率者。

本創作之一特徵在於集成式液冷散熱機構係包括有一水冷排模組，其由複數道散熱片所構成，水冷排模組的上、下側處各成型有一上蓋體及一下蓋體，在上蓋體處組設一水流驅動模組，利用該水流驅動模組使冷卻液體產生流動，另，在下蓋體處安裝有一冷板模組，冷板模組底面為一吸熱面，可與電子元件作接觸，以及，在該水流驅動模組、水冷排模組及冷板模組之間連通有一水流通道，利用

四、創作說明 (3)

該水流通道使冷卻液體於各模組間產生循環式的流動。

本創作之另一特徵在於該水冷排模組具有一固定架，固定架上、下兩側處係分別形成有一上蓋體及下蓋體，而在固定架中間處則設有複數道散熱片，該複數道散熱片之間設有流道，流道的兩端分別與上蓋體及下蓋體相連通，令下蓋體內的熱水利用水流驅動模組之抽送力量經由流道流至上蓋體內時，該熱水再經過該複數道散熱片時會進行熱交換而形成冷卻液體，再流至上蓋體內。

本創作之又一特徵在於該水流驅動模組係包括有一本體，本體內隔成有上容置空間及下容置空間，本體上設有一與下容置空間相連通的注水口，於上容置空間內設有線圈座及上蓋，而在下容置空間處則設有一導引座，導引座之底面並凹設有流道，另，於導引座底部處則樞設有一扇葉座，當水流驅動模組安裝在水冷排模組的上蓋體內時，該扇葉座係位於固定架的上蓋體內，當水不足時，即從注水口處注入水至下容置空間內，再分別經由導引座之流道及扇葉座流至上蓋體內。

【實施方式】

有關本創作之詳細說明及技術內容，配合圖式說明如下，然而所附圖式僅提供參考與說明用，並非用來對本創作加以限制者。

本創作係一種「集成式液冷散熱機構」，請參照第二圖所示，本實施例中，該集成式液冷散熱機構10係作為中央處理器20（如第七圖所示）散熱之用，其由下而上依序

四、創作說明 (4)

組裝有冷板模組 1、水冷排模組2及水流驅動模組3，以及在該等模組之間連通有一水流通道。

本創作，該水冷排模組2 具有一箱體21，箱體21上、下兩側處係分別形成有一上蓋體22及下蓋體23，而在箱體21中間處則設有複數道散熱片24，於該複數道散熱片24之間設有流道25，流道25的兩端分別與上蓋體22及下蓋體23相連通，本實施例中，上蓋體22內之冷卻液體係利用位於中間處的兩流道25輸送至下蓋體23，而位於下蓋體23的熱水則利用位於兩側處的兩流道25輸送至上蓋體22內（如第七圖所示）。

請續參照第二、三、四圖所示，該水流驅動模組3 係包括有一本體31，本體31內隔成有上容置空間311 及下容置空間312，本體31上設有一與下容置空間312相連通的注水口32，於上容置空間311 內設有線圈座33及上蓋34，而在下容置空間312 處則設有一導引座35，導引座35之底面並凹設有流道351 ，另，於導引座35底部處則樞設有一扇葉座36，當水流驅動模組3安裝在水冷排模組2上時，該扇葉座36係位於固定架21的上蓋體22內，當水不足時，即從注水口32處注入水至下容置空間312 內，再分別經由導引座35之流道351及扇葉座36流至上蓋體22內。

請再參照第二圖所示，該冷板模組 1係安裝在水冷排模組2 的下蓋體23內，包括有一冷板11，冷板11之底面中間處為一吸熱面12（如第七圖所示），吸熱面12係貼附在中央處理器20上，並在冷板11之頂面設有複數道併列排設

四、創作說明 (5)

的散熱片13。

本創作組裝時，即在該箱體21底部與冷板11之間置設有密封墊片14，使水冷排模組2置設在冷板模組1之冷板11上，令冷板11上的散熱片13位於下蓋體23內，並利用螺栓元件15使冷板11鎖固在下蓋體23之底部處，而冷板模組1組裝在下蓋體23內後所形成的空間，可使該冷卻液體直接沖擊冷板11上的散熱片13。嗣，亦在箱體21頂部與水流驅動模組3之間置設有密封墊片37，使水流驅動模組3置設在水冷排模組2的上蓋體22處，令水流驅動模組3上的扇葉座36位於上蓋體22內，再利用螺栓元件38使水流驅動模組3鎖固在箱體21之頂部處，而使水流驅動模組3、水冷排模組2及冷板模組1集成一體。

本創作中，當將該水流驅動模組3、水冷排模組2及冷板模組1集成一體後，該水流驅動模組3之流道351、水冷排模組2之流道25以及冷板模組1之複數道散熱片13間的流道即連通形成一水流通道（如第七圖之箭頭流經的區域所示），利用該水流通道使冷卻液體於各模組間能產生循環式的流動。

請參照第五、六圖所示，本創作中，在該冷板模組1之底部處係鎖固有一固定架4，固定架4中間處形成一開口41，使冷板11底面之吸熱面12從開口41處凸伸出於外，茲可與中央處理器20相貼附接觸，而在固定架4的兩相對應側邊處則分別向外延伸設有鎖固片42，鎖固片42係鎖固在中央處理器固定座201上（如第七圖所示）。

四、創作說明 (6)

另，在該水冷排模組2 的側邊處係可利用螺栓元件26鎖設有一散熱風扇5及風扇濾網51，以利用該散熱風扇5之作動，以提昇整個水冷排模組2的熱交換效率。

本創作組立時，即令集成式液冷散熱機構10置設在中央處理器20上方，並利用螺栓元件43使固定架4 的鎖固片42固設在中央處理器固定座201 上，而使整個集成式液冷散熱機構10安裝在中央處理器20上方處。

請參照第七圖所示，本創作使用時，即令冷卻液體從上蓋體22處的中間兩流道25往下輸送至下蓋體23，而直接沖激位於下蓋體23處的散熱片13，以對散熱片13進行熱交換散熱，而熱交換後的熱水利用水流驅動模組3 之抽送力量再經由兩側之流道25流經該複數道散熱片24進行熱交換而形成冷卻液體，再流至上蓋體22內，而持續循環的進行散熱。

本創作中，由於該集成式液冷散熱機構10係由水流驅動模組3、水冷排模組2及冷板模組 1集成化，且直接利用一連通的水流通道使冷卻液體在其間流動，而能加速循環速度，以提昇散熱速率者。

綜上所述，本創作之「集成式液冷散熱機構」，的確能藉由上述所揭露之構造，達到所述之功效。且本創作申請前未見於刊物亦未公開使用，誠已符合新型專利之新穎、進步等要件。

惟，上述所揭之圖式及說明，僅為本創作之實施例而已，非為限定本創作之實施例；大凡熟悉該項技藝之人士

四、創作說明 (7)

，其所依本創作之特徵範疇，所作之其它等效變化或修飾，皆應涵蓋在以下本案之申請專利範圍內。

圖式簡單說明

【圖式簡單說明】

第一圖係習知水冷式散熱系統之外觀圖。

第二圖係本創作集成式液冷散熱機構之立體分解圖。

第三圖係本創作水幫浦之立體分解圖。

第四圖係本創作水幫浦另一角度之立體分解圖。

第五圖係本創作集成式液冷散熱機構欲與固定架及散熱風扇組裝之立體外觀圖。

第六圖係集成式液冷散熱機構與固定架及散熱風扇組裝後之立體外觀圖。

第七圖係集成式液冷散熱機構之剖面作動圖。

〔元件代表符號〕

＜習知＞

水冷式散熱系統100a

中央處理器	200a	散熱座	10a
水幫浦	20a	冷卻座	30a
散熱鰭片	303a	水箱	40a
出水口	101a、201a、302a		
進水口	102a、202a、301a、401a		
管路	103a、104a、304a、402a		

＜本創作＞

集成式液冷散熱機構10

中央處理器	20	固定座	201

圖式簡單說明

冷板模組	1	冷板	11
吸熱面	12	散熱片	13
密封墊片	14、37	水冷排模組	2
箱體	21	上蓋體	22
下蓋體	23	散熱片	24
流道	25、351	水流驅動模組	3
本體	31	上容置空間	311
下容置空間	312	注水口	32
線圈座	33	上蓋	34
導引座	35	扇葉座	36
固定架	4	開口	41
鎖固片	42	散熱風扇	5
風扇濾網	51	螺栓元件	15、26

五、申請專利範圍

1、一種集成式液冷散熱機構，用以將一電子元件所發出的熱能，經由一冷卻液體的循環，而快速的將熱能發散；包括：

一水冷排模組，由複數道散熱片所構成，該水冷排模組的上、下各成型有一上蓋體及一下蓋體；

一水流驅動模組，作動時係使該冷卻液體產生流動，該水流驅動模組係與該水冷排模組的上蓋體組設；

一冷板模組，其底面為一吸熱面，用以與該電子元件作接觸，該冷板模組的上緣係與該水冷排模組的下蓋體組設；以及

一水流通道，連通於該水流驅動模組、該水冷排模組及該冷板模組之間，使該水流驅動模組作動時，該冷卻液體於該各模組間，產生循環式的流動。

2、如申請專利範圍第1項所述之集成式液冷散熱機構，其中該水流驅動模組具有一注水口。

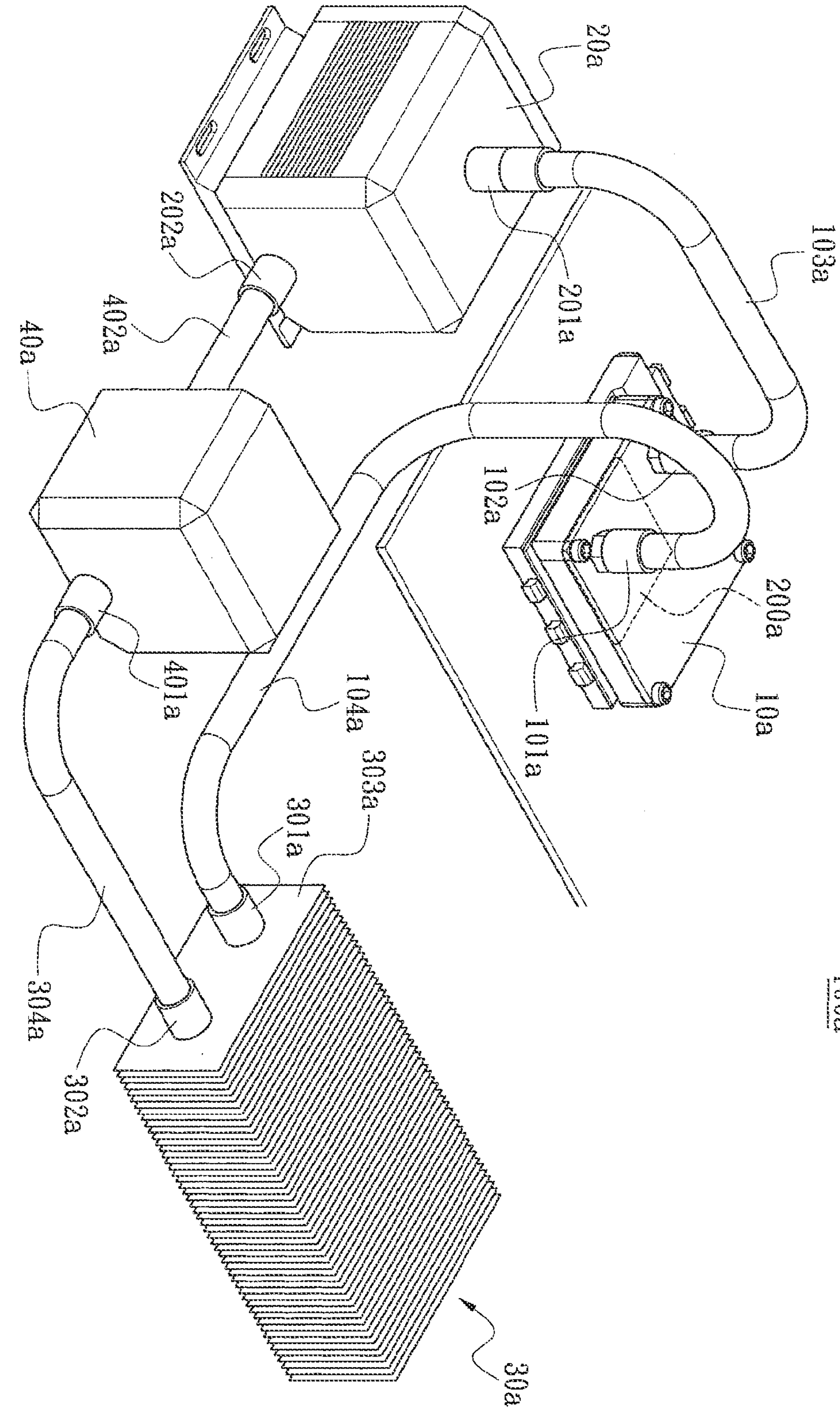
3、如申請專利範圍第1項所述之集成式液冷散熱機構，其中該冷板模組另組設有一固定架。

4、如申請專利範圍第1項所述之集成式液冷散熱機構，其中該水冷排模組係組設有一散熱風扇。

5、如申請專利範圍第1項所述之集成式液冷散熱機構，其中該冷板模組的一上平面成型有複數道散熱片。

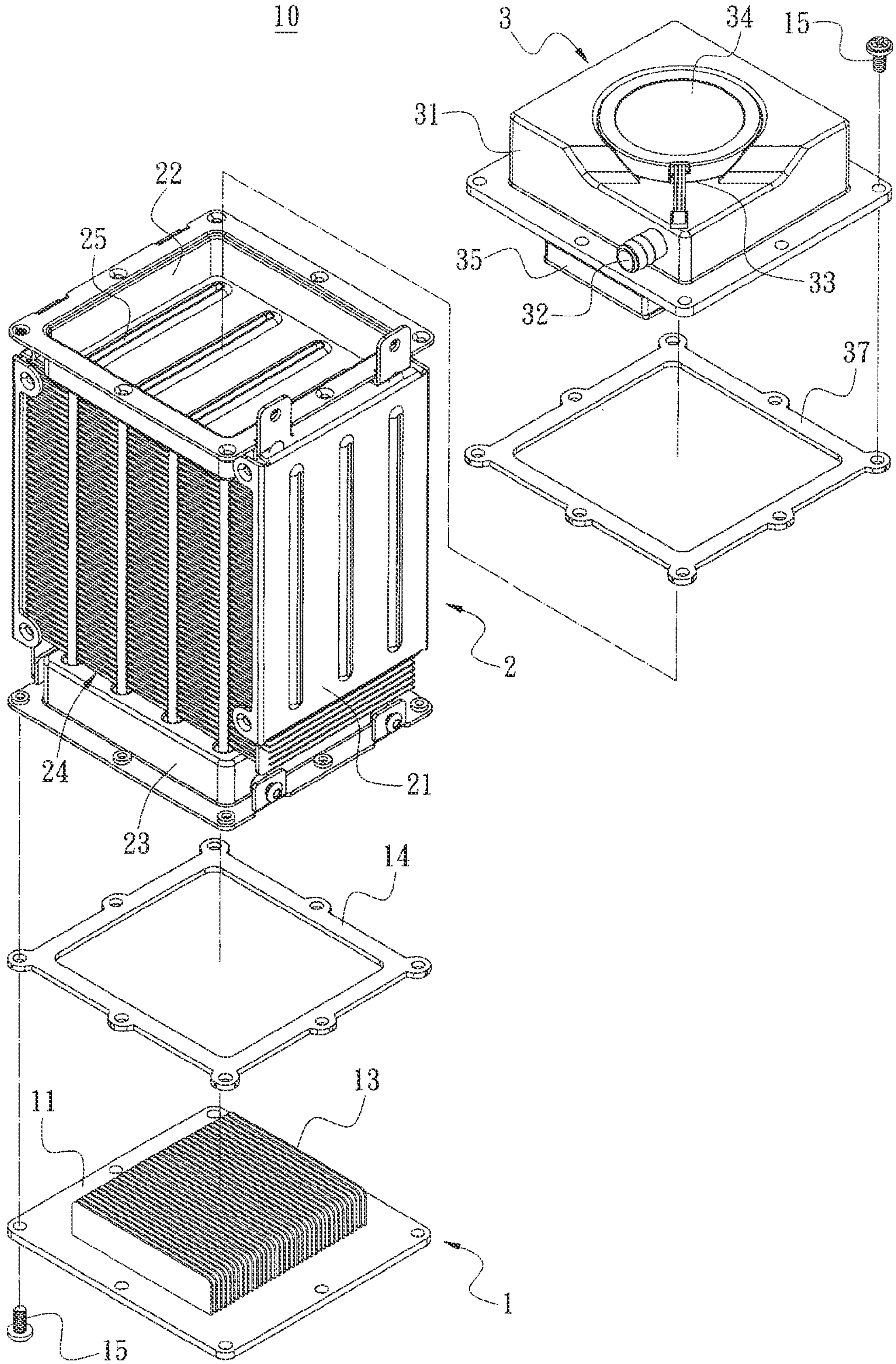
6、如申請專利範圍第5項所述之集成式液冷散熱機構，其中該等散熱片係位於該下蓋體與該冷板模組組設後所形成的空間內。

圖式


20a
201a
202a
402a
40a
103a
102a
200a
10a
101a
104a
401a
303a
301a
304a
302a
30a
100a

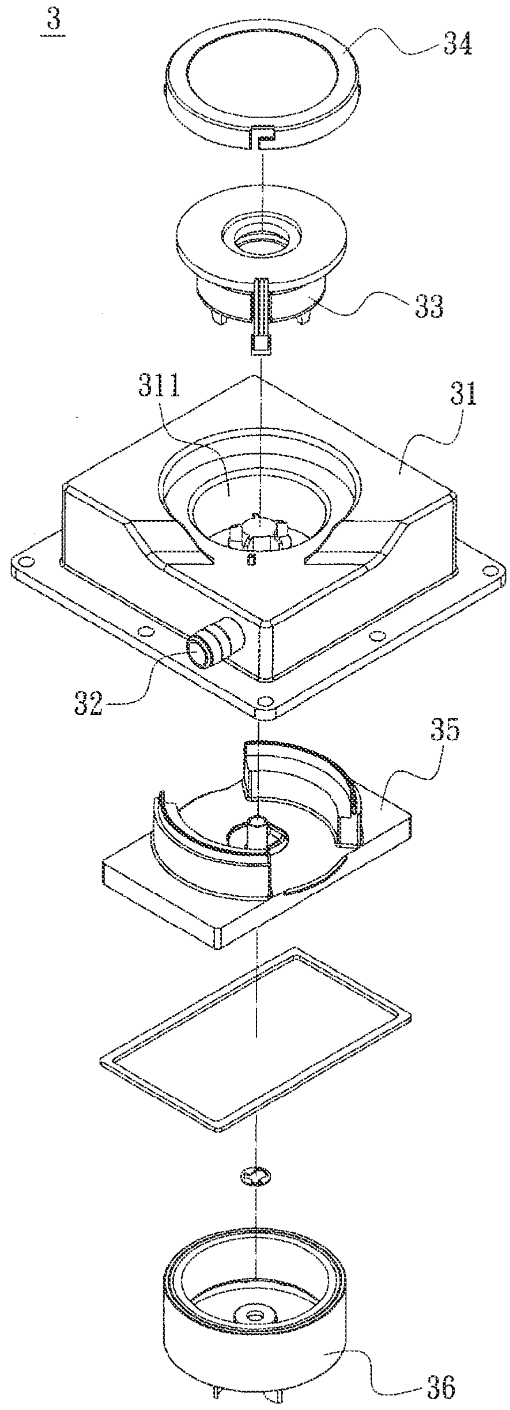
第一圖

圖式



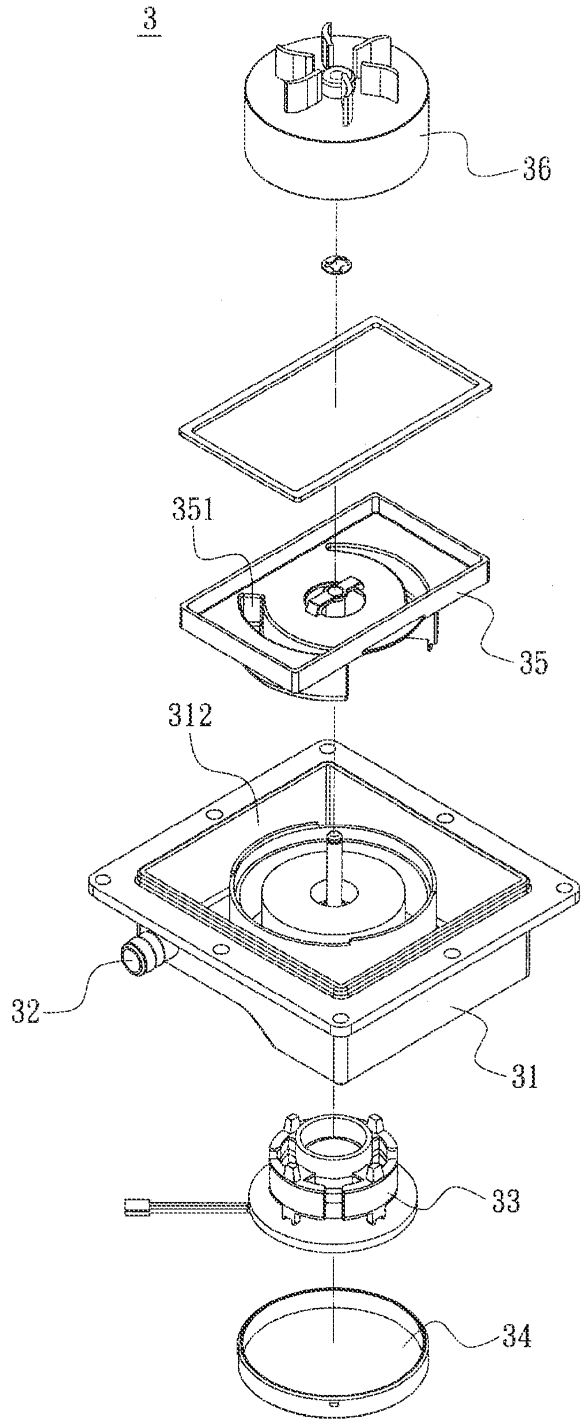
第二圖

圖式



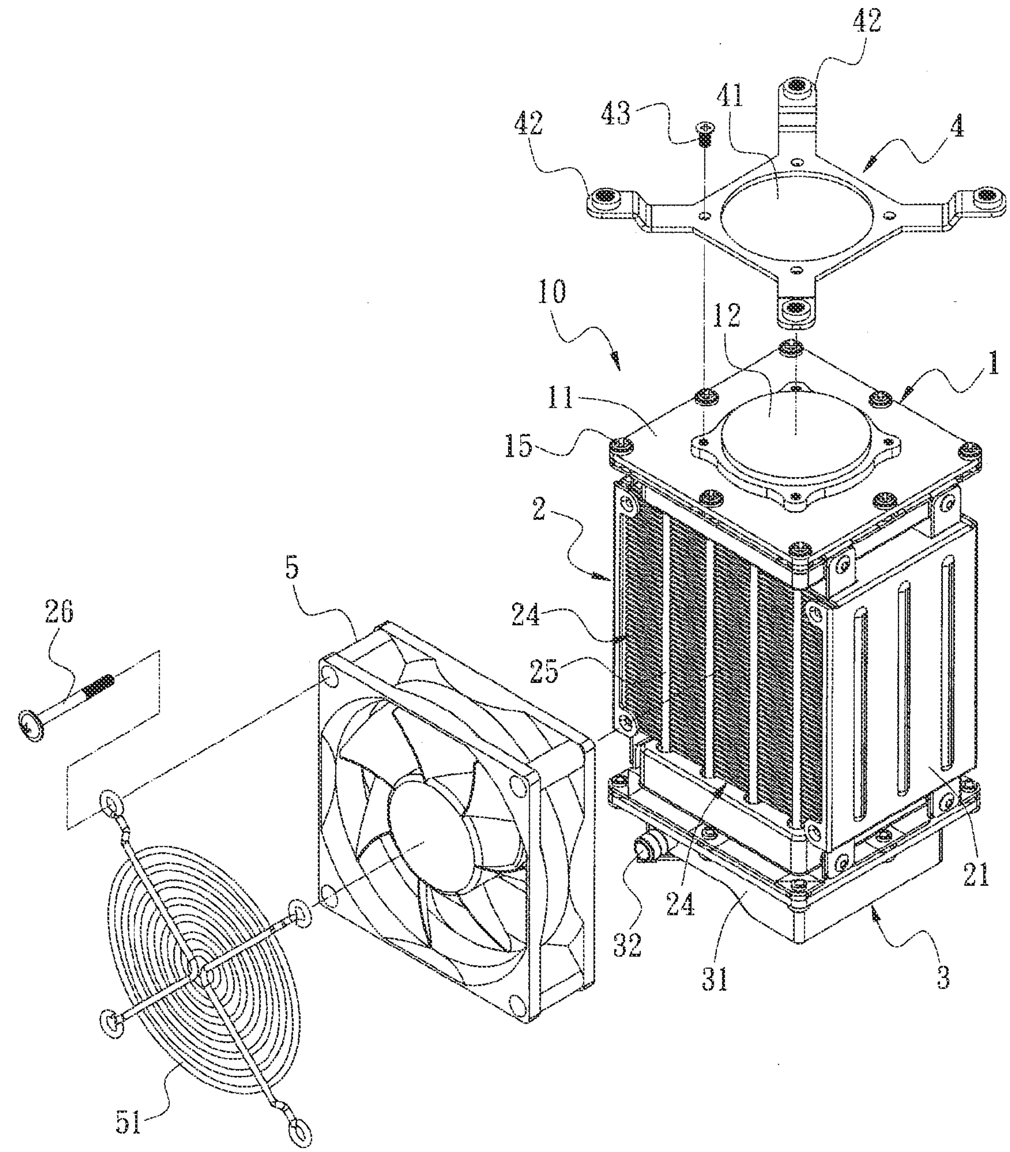
第三圖

圖式



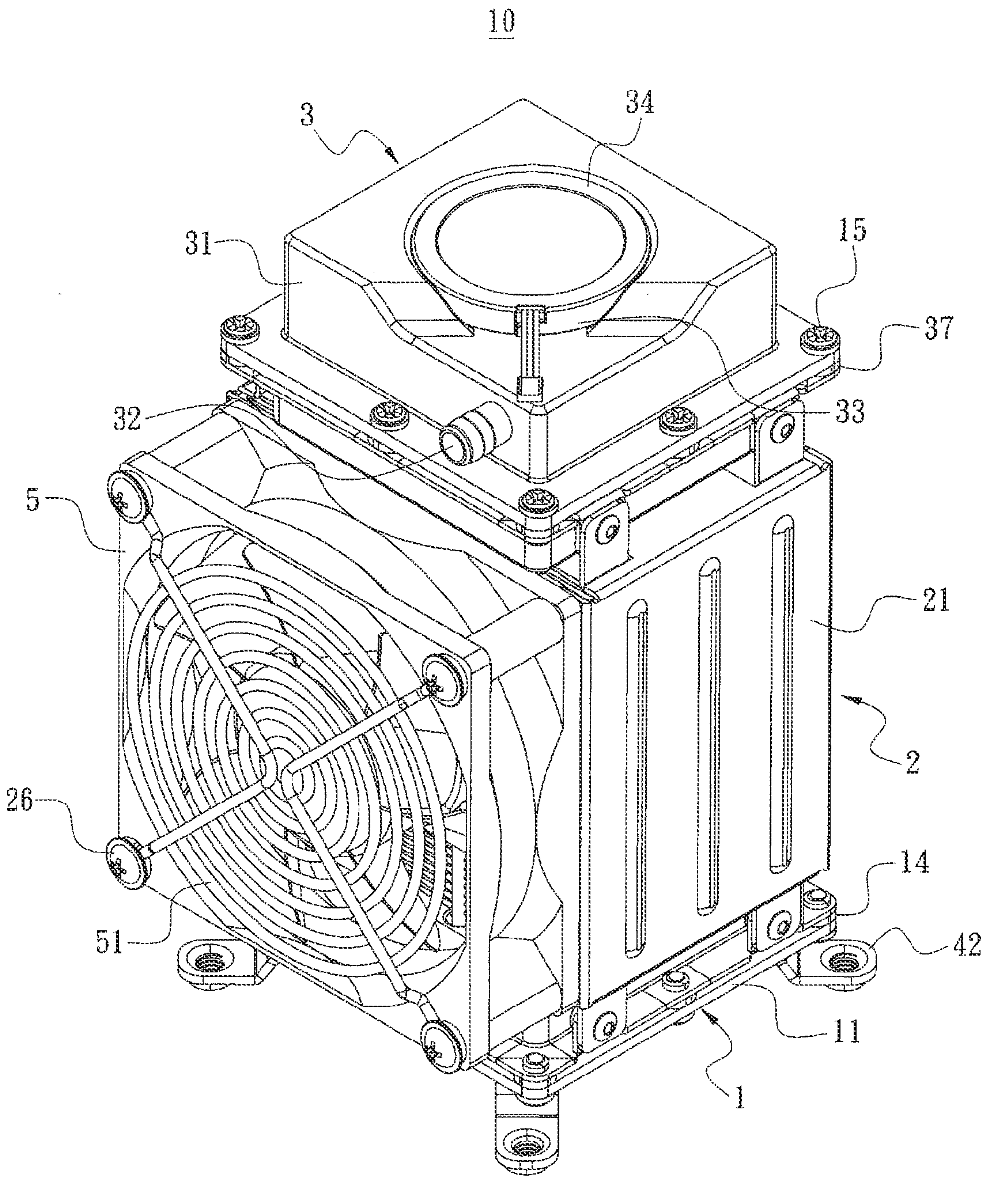
第四圖

圖式



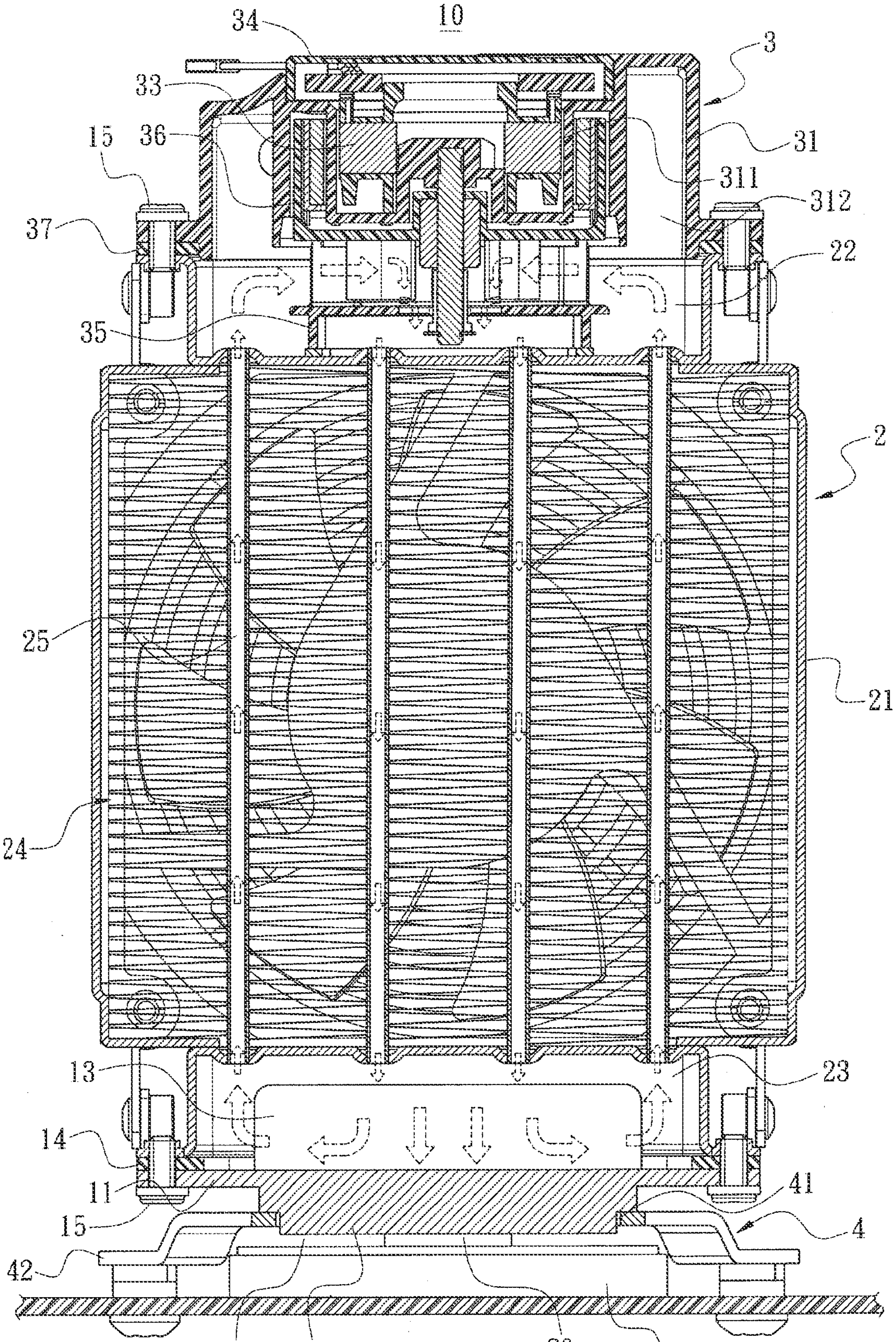
第五圖

圖式



第六圖

圖式


10
34
3
33
36
31
15
311
312
37
22
35
2
25
21
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13
23
14
41
11
15
4
42
1
12
20
201

第七圖

[19] Republic Of China [12] Patent Gazette (U)
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[51] Int. Cl.[7]: H05K7/20

Utility Model Total 10 pages

[54] Title: The water cooler device for computer

[21] Appln. No.: 094200892 [22]Appln. Date: Jan. 18, 2005

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RYU JEONG MOO
[71] Applicant:
3R SYSTEM CO., LTD
[74] Agent: MR. XUE MINGHONG

The water cooler device for computer

Claims

1. A water cooler device for computer, comprising a water cooler, a radiator and a circulating pump; wherein the inner space of the water cooler is a closed circulating water channel; water cooled by the radiator circulates so as to arrive at a water inlet of the water cooler, passes through the circulating water channel inside the water cooler, and gushes via a discharging part of the water cooler; water at the discharging part is delivered to a water outlet of the water cooler by cornering force of the circulating pump, and circulates so as to arrive at the radiator for heat exchange; it is characterized in that:

the circulating pump, blade of which has a disc shape, and can correspondingly cover the discharging part; on the inner wall of the blade is arranged with a ring of magnet, center of which is mounted with a bearing;

a base, bottom face of which is arranged with a recessed part and a mandrel corresponding to the blade ring wall and the bearing, so that the blade is accommodated on the bottom face of the base, and at the top face of the base is formed with a low-lying area, peripheral end of which is formed with axle holes; and a winding and a circuit board are integratedly accommodated in the low-lying area;

a sealing cover, which is covered on the top of the base, and screw elements are locked with screw holes pre-arranged on the water cooler by passing through via holes at the side face of the sealing cover and the axle

公告本

M275684

申請日期：	94.1.18	IPC分類
申請案號：	94200892	H05K 7/20

(以上各欄由本局填註)

新型專利說明書

一、新型名稱	中文	應用於電腦之水冷式散熱裝置
	英文	The water cooler device for computer
二、創作人(共1人)	姓名(中文)	1.柳廷武
	姓名(英文)	1.RYU JEONG MOO
	國籍(中英文)	1.韓國 KR
三、申請人(共1人)	名稱或姓名(中文)	1.韓商3R系統股份有限公司
	名稱或姓名(英文)	1.3R SYSTEM CO., LTD.
	國籍(中英文)	1.韓國 KR
	住居所(營業所)(中文)	1.韓國漢城市龍山區新溪洞1-171號東進大樓2F (本地址與前向貴局申請者相同)
	住居所(營業所)(英文)	1.2F, Dongjin B/D #1-171, Shinkye-Dong, Yongsan-Ku, Seoul, Korea
	代表人(中文)	1.柳廷武
	代表人(英文)	1.RYU JEONG MOO

一、本案已向

國家(地區)申請專利	申請日期	案號	主張專利法第一百零八條準用第二十七條第一項國際優先權

無

二、□主張專利法第一百零八條準用第二十九條第一項國內優先權:

申請案號:

無

日期:

三、主張本案係符合專利法第九十四條第二項□第一款或□第二款規定之事實，其事實發生日期為:

四、創作說明 (1)

【新型所屬之技術領域】

本創作一種應用於電腦之水冷式散熱裝置，主要係有效簡化該散熱裝置之構件和組裝，並提昇循環幫浦的動力輸出和多元性使用目的，以及利用磁力驅動循環幫浦產生迴轉力量，使經散熱器冷卻的水能有效將熱源散熱，達到最佳的散熱效果。

【先前技術】

在同一申請人前所提呈之第92216860號專利案（如第八、九圖），其中該散熱裝置3係設於電腦介面卡4之晶片（圖未示）上方，包括由一鋁材成型之水冷器31、一循環幫浦32和鋁材質的散熱器33所組成，經散熱器33冷卻的水，循環到介面卡4晶片上的水冷器31之入水口311，經水冷器31內部密閉之循環水道，以冷卻晶片所產生的熱氣，且由水冷器31之排出部312湧出，利用循環泵浦32以迴轉力量將排出部31的水排至水冷器31之排水口313，並循環至散熱器33進行熱交換；該循環泵浦32，其葉輪321略呈一盤形體，並恰可與排出部312對應蓋合，葉輪321內壁環設一磁塊322，以及藉一壓板323將葉輪321定位於水冷器31之排出部312上方，使葉輪321被壓板323限位，且於排出部312中呈自由狀轉動，又壓板323上方設置至少有二極之繞組R1、R2，其電路板324接引電源同時將繞組R1、R2封合於壓板323上方，當啟動電源電路板324切換該二繞組R1、R2產生極性變化，並推斥磁塊322帶動葉輪321驅轉，令排出部312的水被葉輪321之迴轉力量排出至排水口313

而循環至散熱器33進行熱交換。

惟，就前述結構而言，雖稱實用，但其結構和組裝程序較複雜，再者該排出部31和壓板323所能提供對應裝置磁塊322和繞組R1、R2的空間不足，致循環幫浦32的功率不足而影響水冷器31內之水流速率，使得散熱效果不佳，是以鑑於前揭不足，乃有必要加以改進。

【新型內容】

本創作之主要目的，係提任一種應用於電腦之水冷式散熱裝置，其中葉輪內壁設有一磁塊，中央套裝有一軸承，且恰可容設機座底面，機座底面具有心軸，頂面成型有窪部，繞組和電路板組合後，容置於窪部中，藉此乃提供葉輪和繞組充裕的裝置空間，而可得到良好的功率輸出，以驅動葉輪高速運轉，進而提昇水流速率和較佳散熱效果。

本創作之次要目的，係提任一種應用於電腦之水冷式散熱裝置，其中該循環幫浦的各部件，係可在成型後依序螺合組成，大幅簡化其裝配工時，同時該循環幫浦可依需求於其底面採金屬材成型，直接定著於熱源上方，或採用具有箱體之水冷器，以達到相對遠離於發熱源外接散熱，而可依需求達到多元性的使用目的。

【實施方式】

首請參閱第一~四圖所示，本創作一種應用於電腦之水冷式散熱裝置，包括由一水冷器1、一散熱器10和循環幫浦2所組成，其中水冷器1的內部係為密閉的循環水道，

四、創作說明 (3)

其底面係以金屬材成型，並恰可定著於熱源上方，經散熱器10冷卻的水，循環到水冷器1的入水口11，經水冷器1內部的循環水道，且由水冷器1之排出部12湧出，利用循環幫浦2以迴轉力量將排出部12的水排至水冷器1之排水口13，並循環至散熱器10進行熱交換，其改良在於：該循環幫浦2，其葉輪21略呈一盤形體，並恰可與排出部12對應蓋合，葉輪21內壁環設一磁塊22(請參閱第三圖)，其中央套裝有一軸承23；該機座24，其底面對應葉輪21環壁及軸承23，設有凹部25和心軸26，使葉輪21容設於機座24底面，機座24和水冷器1間設有墊圈S，且於機座24頂面成型有窪部27，其周端具有軸孔240；以及繞組28和電路板281組合一體容置於機座24頂面窪部27中；該封蓋29，係蓋合於機座24上方，藉螺固元件291穿越封蓋29端側之通孔292和機座24的軸孔240，而和水冷器1預設之螺孔15鎖結一體，藉由上述特徵，令經散熱器10冷卻的水，經水冷器1和循環幫浦2推送得冷卻熱源H1，並循環至散熱器10進行熱交換，以提供熱源H1有效散熱。

次請參閱第五~七圖所示，係為本創作水冷器的另一實施例之立體分解、組合立體圖和使用示意圖，其中循環幫浦2的主要構件及組成係與前述實施例相同，包含葉輪21、磁塊22、機座24、繞阻28，電路板281、封蓋29(請參考第一、一A及第三圖)所組成，本實施例之水冷器5的內部為密閉的循環水道，以及水冷器5連通有一水箱51、入水口52和排水口53設於其一側，排水口53外接至熱源上

四、創作說明 (4)

方的冷卻室54的入水端，冷卻室54內部為循環水道，並設有一入水端和排水端，散熱器10冷卻的水，由入水口52進入水冷器5經循環幫浦2推送，由水冷器5的排水口53送出並循環到冷卻室54的入水端，且將熱源散熱，並由冷卻室54排水端排出至散熱器10進行熱交換，復由入水口52進入水冷器5，藉此以達到相對遠離於熱源外接散熱者。

圖式簡單說明

【圖式簡單說明】

第一圖、係本創作實施例之立體分解圖。

第一A圖、係本創作循環幫浦之立體分解圖。

第二圖、係本創作實施例之組合立體圖。

第三圖、係本創作實施例之組合剖視圖。

第四圖、係本創作實施例之使用示意圖。

第五圖、係本創作另一實施例之立體分解圖。

第六圖、係本創作另一實施例之組合立體圖。

第六A圖、係本創作另一實施例之循環幫浦和散熱器之組裝參考圖。

第七圖、係本創作另一實施例之使用示意圖。

第八圖、係第92216860號專利案之立體外觀圖。

第九圖、係第92216860號專利案之水冷器和循環幫浦之立體分解圖。

【主要元件符號說明】

1、水冷器	10、散熱器
11、入水口	12、排出部
13、排水口	15、螺孔
2、循環幫浦	21、葉輪
22、磁塊	23、軸承
24、機座	240、軸孔
25、凹部	26、心軸
27、窪部	28、繞組
281、電路板	29、封蓋

圖式簡單說明

291、螺固元件　292、通孔
5、水冷器　51、水箱
52、入水口　53、排水口
54、冷卻室　H1、熱源
S、墊圈

四、中文創作摘要　（創作名稱：應用於電腦之水冷式散熱裝置）

本創作係有關一種應用於電腦之水冷式散熱裝置，包括由一水冷器、一散熱器和循環幫浦所組成，利用循環幫浦以迴轉力量將水冷器之排出部的水排至排水口，並循環至散熱器進行熱交換，其改良在於：該循環幫浦，其葉輪略呈一盤形體，並恰可與排出部對應蓋合，葉輪內壁環設一磁塊，其中央套裝有一軸承；該機座的底面對應葉輪環壁及軸承，設有凹部和心軸，使葉輪容設於機座底面，且於機座頂面成型有窪部；以及繞組和電路板組合一體容置於機座頂面窪部中；該封蓋，係蓋合於機座上方，藉螺固元件穿越封蓋和機座，而和水冷器鎖結一體；藉此得簡化其構件和組裝，並提昇循環幫浦的動力輸出，同時可依需求而提供不同的使用目的，達到最佳的散熱效果。

五、英文創作摘要　（創作名稱：The water cooler device for computer）

六、指定代表圖

（一）、本案代表圖為：第＿＿二＿＿＿圖

（二）、本案代表圖之元件符號簡單說明：

1、水冷器
11、入水口
12、排出部
13、排水口
15、螺孔
2、循環幫浦
29、封蓋
291、螺固元件
S、墊圈

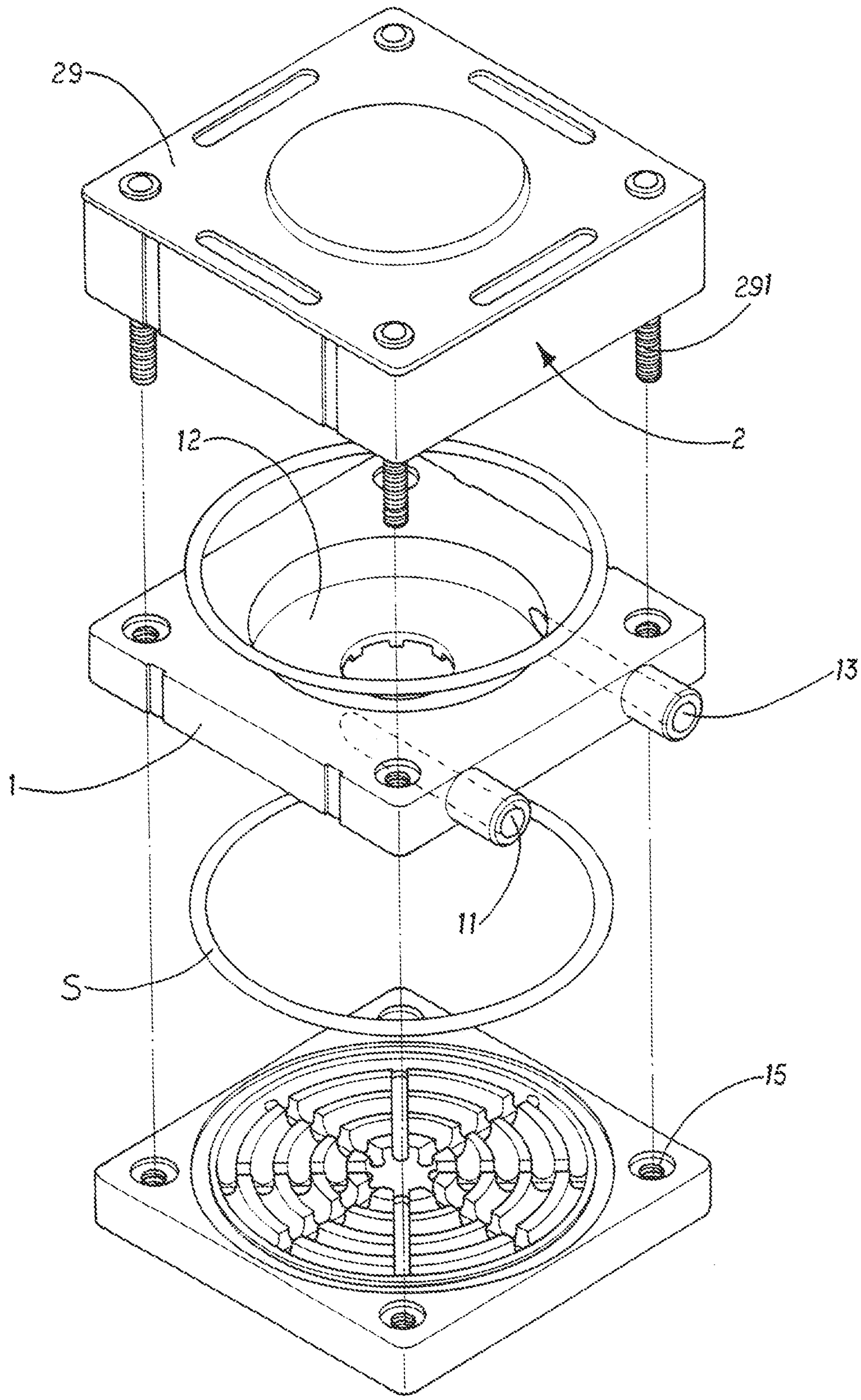
五、申請專利範圍

1、一種應用於電腦之水冷式散熱裝置，包括由一水冷器、一散熱器和循環幫浦所組成，其中水冷器的內部係為密閉的循環水道，經散熱器冷卻的水循環到水冷器的入水口，經水冷器內部的循環水道，且由水冷器之排出部湧出，利用循環幫浦以迴轉力量將排出部的水排至水冷器之排水口，並循環至散熱器進行熱交換，其改良在於：該循環幫浦，其葉輪略呈一盤形體，並恰可與排出部對應蓋合，葉輪內壁環設一磁塊，其中央套裝有一軸承；該機座，其底面對應葉輪環壁和軸承，設有凹部和心軸，使葉輪容設於機座底面，且於機座頂面成型有窪部，其周端具有軸孔；以及繞組和電路板組合一體容置於機座頂面窪部中；該封蓋，係蓋合於機座上方，藉螺固元件穿越封蓋端側之通孔和機座的軸孔，而和水冷器預設之螺孔鎖結一體。

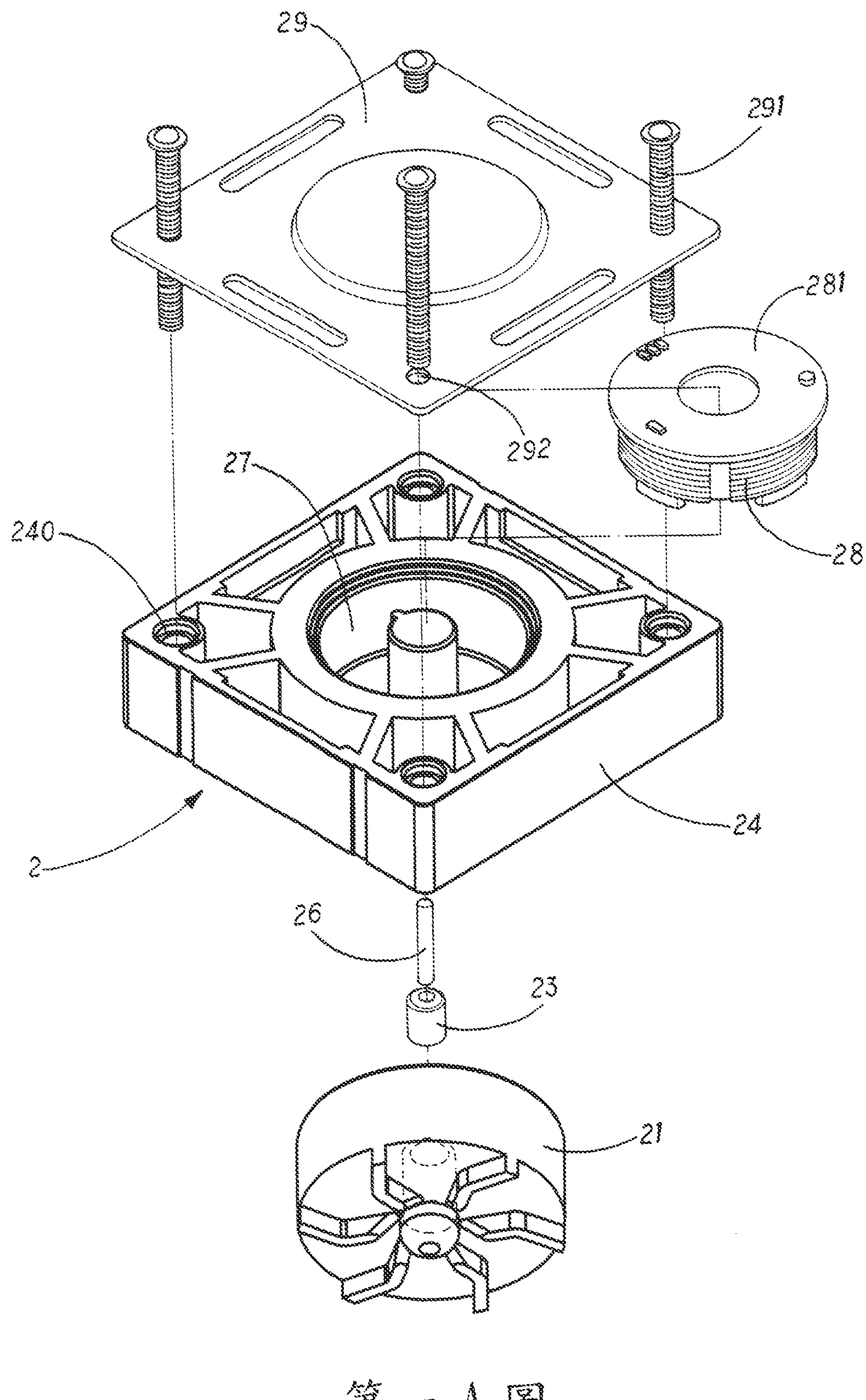
2、如申請專利範圍第1項所述之應用於電腦之水冷式散熱裝置，其中水冷器內部係為密閉的循環水道，以及其底面係以金屬材成型，並恰可定著於熱源上方者。

3、如申請專利範圍第1項所述之應用於電腦之水冷式散熱裝置，其中水冷器內部係為密閉的循環水道，以及該水冷器連通有一水箱，入水口和排水口設於其一側。

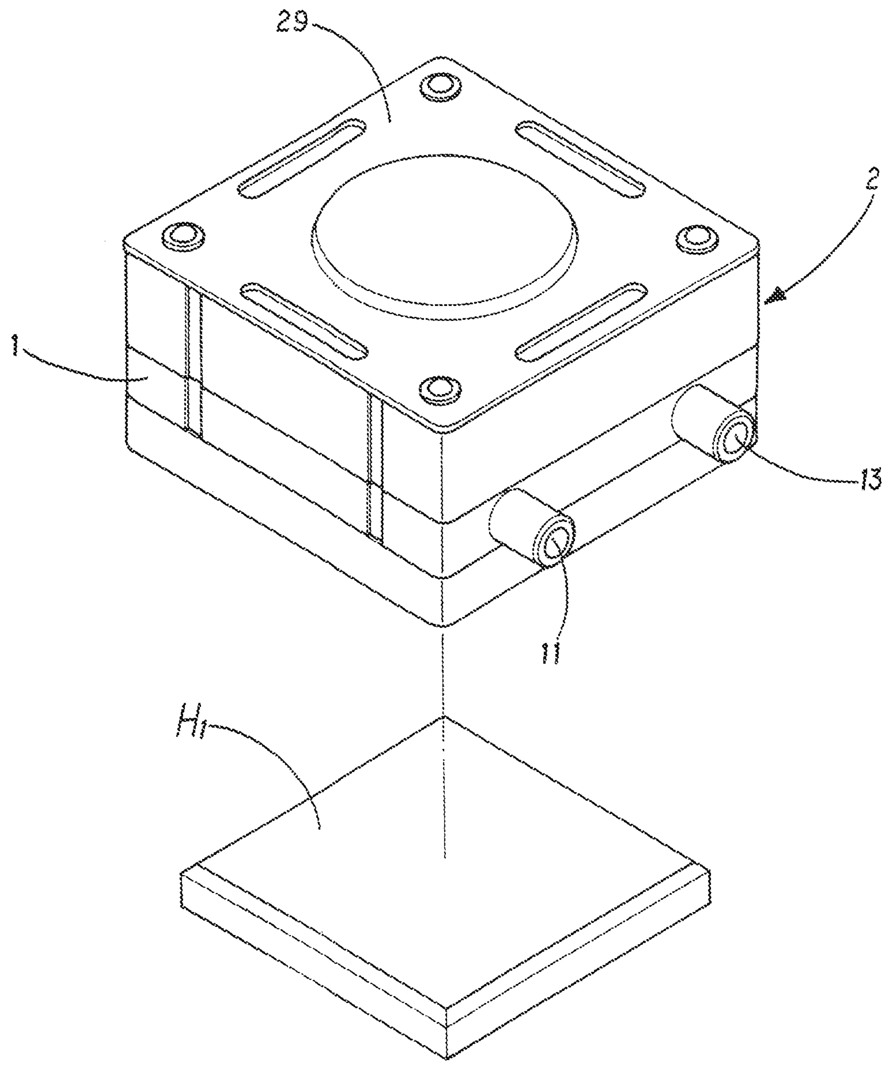
4、如申請專利範圍第1項所述之應用於電腦之水冷式散熱裝置，其中機座和水冷器間係設有一墊圈者。



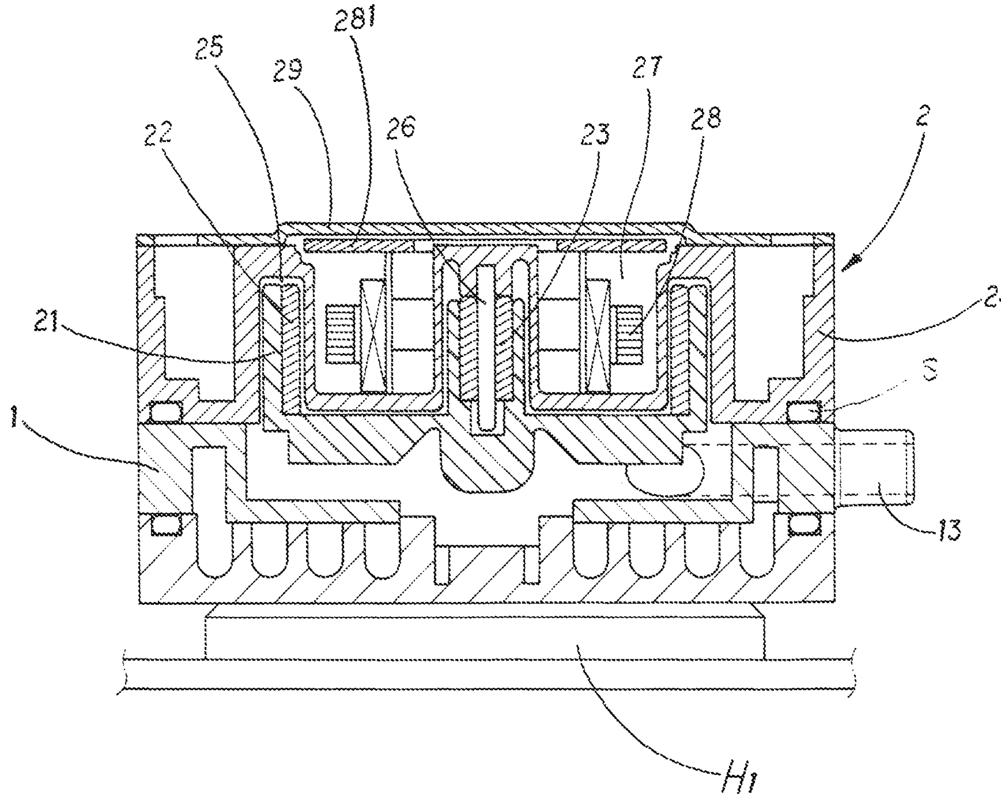
第一圖



第一A圖



第二圖



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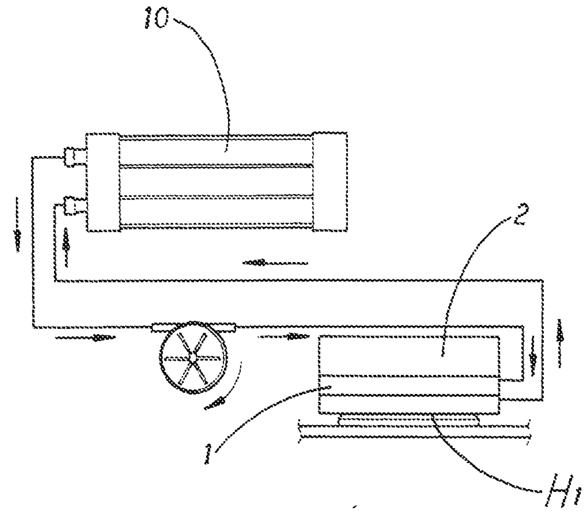
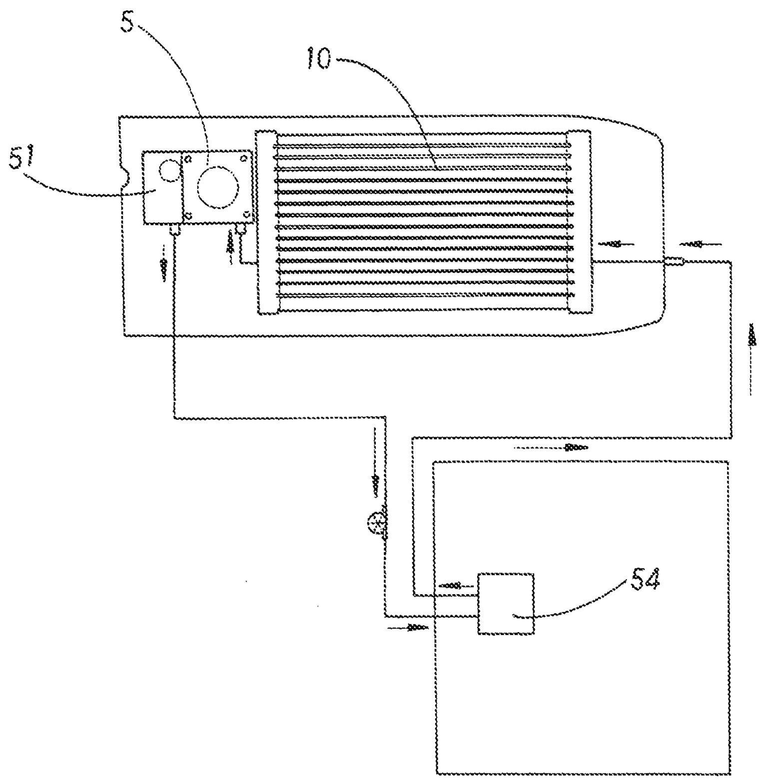
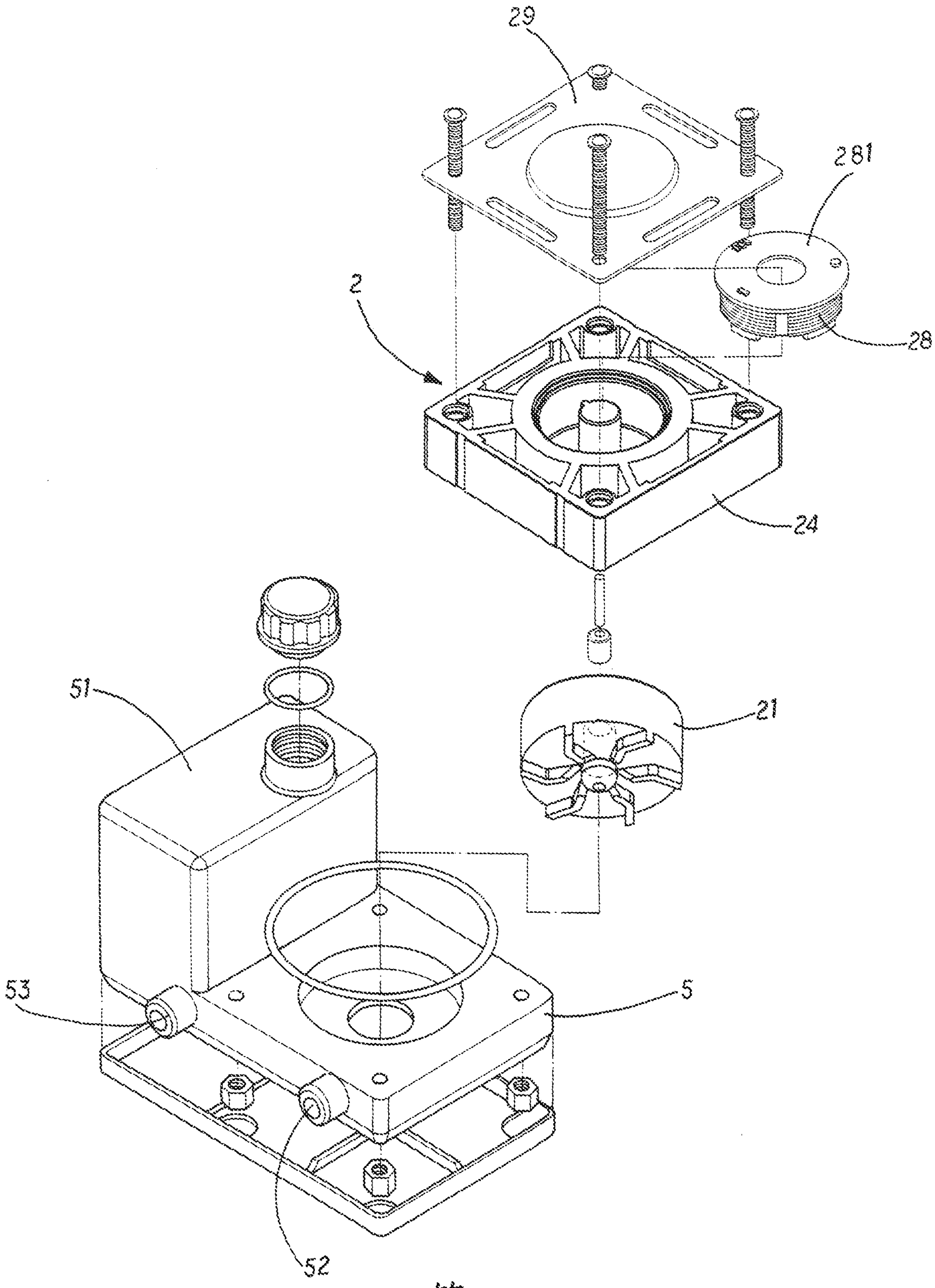


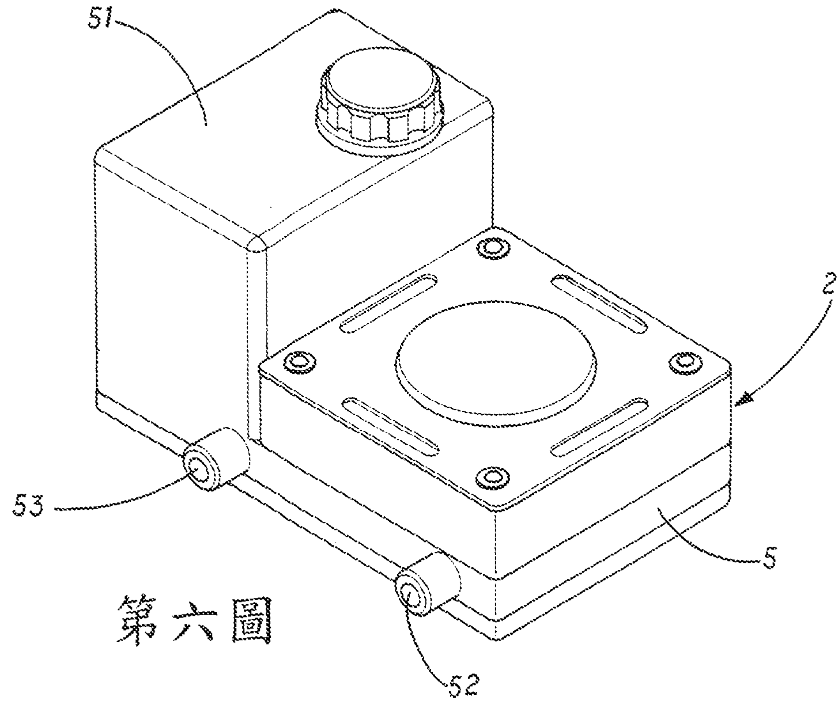
第四圖



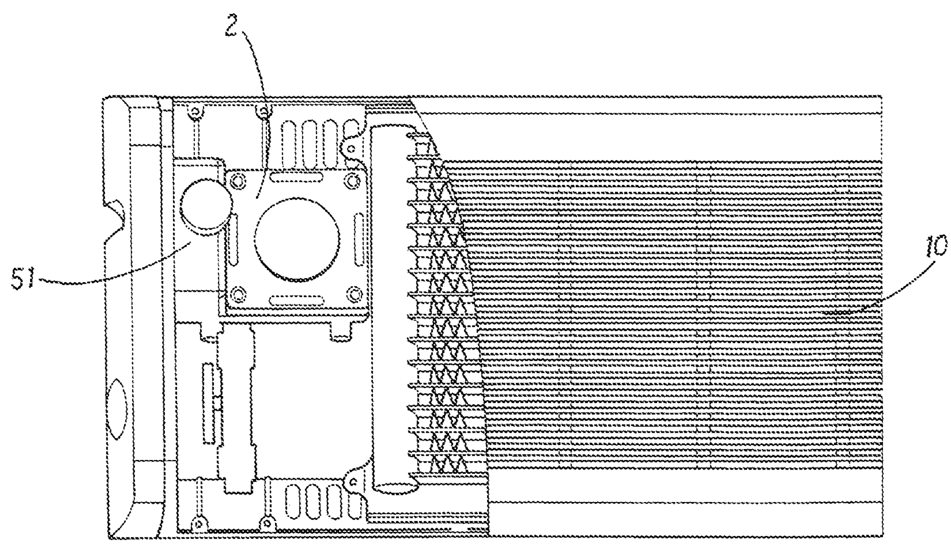
第七圖



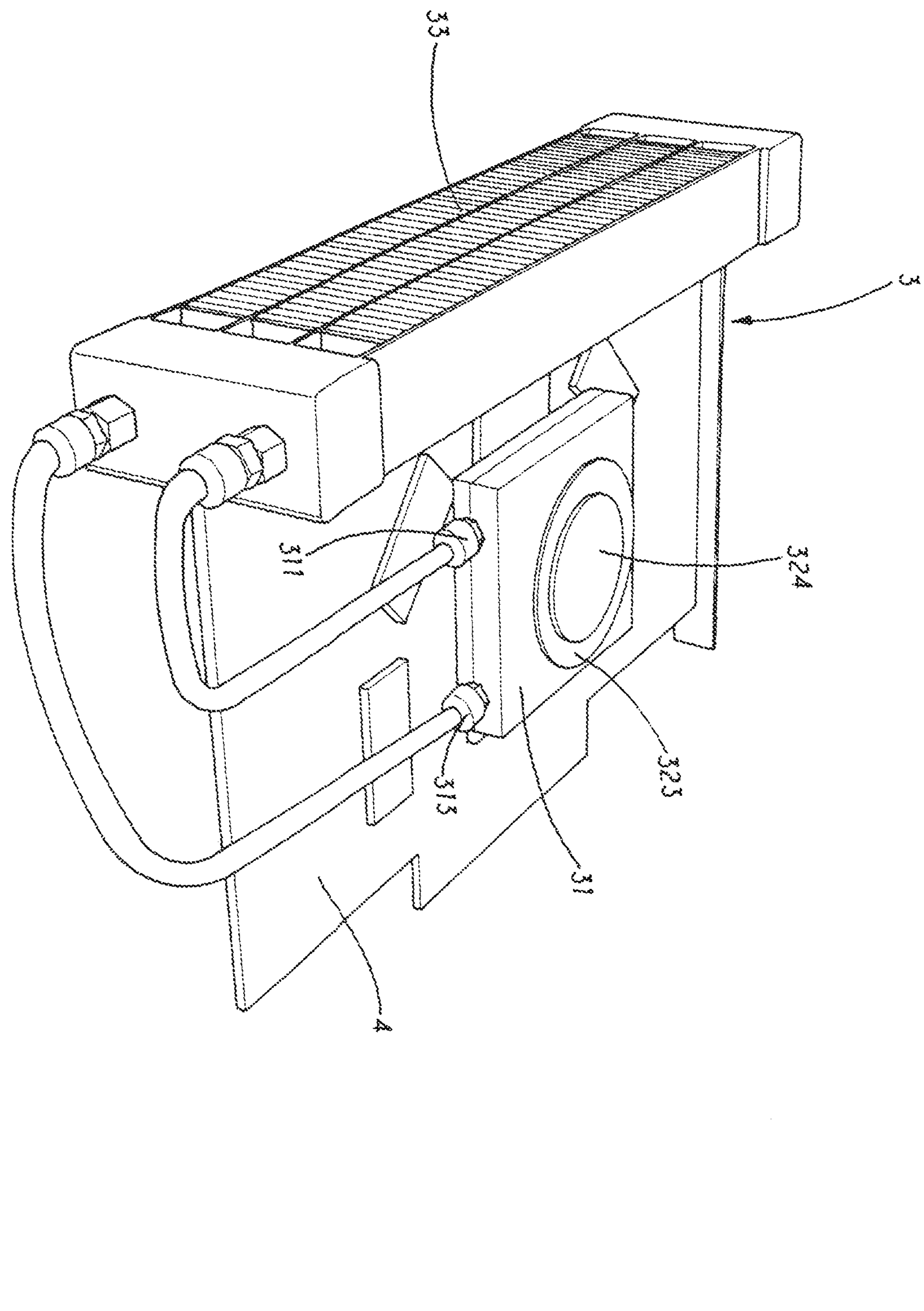
第五圖



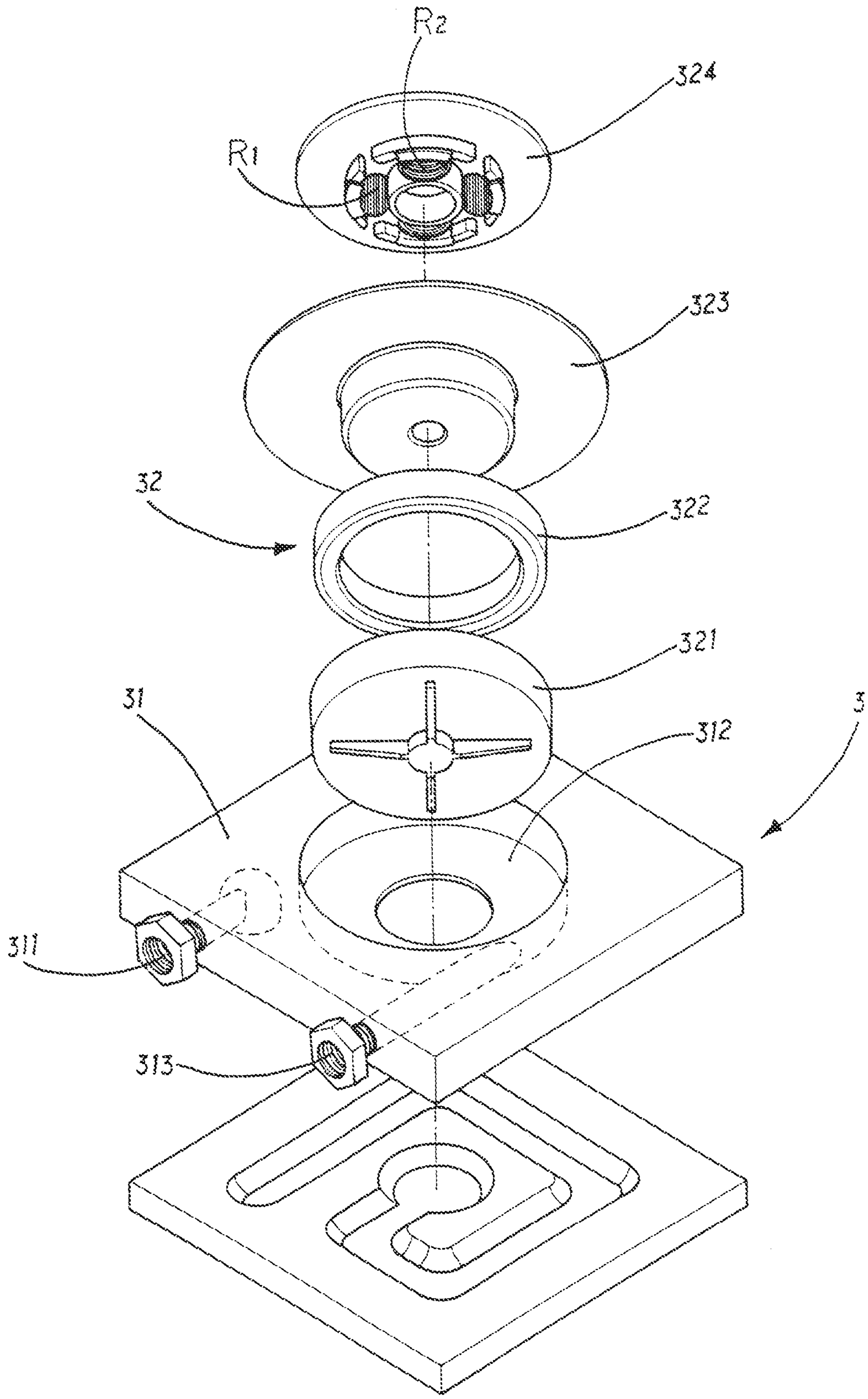
第六圖



第六A圖



第八圖



第九圖

[19] Republic Of China [12] Patent Gazette (U)
[11] Patent No.: M324810
[45] Publication Date: Republic Of China Jan.1, 2008
[51] Int. Cl.^{7}: G06F1/20 (2006.01)
Utility Model Total 7 pages

[54] Title: Circulating heat radiation device of water cooling type for computer motherboard

[21] Appln. No.: 096209264 [22]Appln. Date: June 5, 2007

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Circulating heat radiation device of water cooling type for computer motherboard

Claims

1. A circulating heat radiation device of water cooling type for computer motherboard, for dissipating heat from chips and transistors on the computer motherboard, and the circulating heat radiation device of water cooling type includes:

a first water cooling head whose bottom is contacted with surface of the chip, and there is a hollow chamber inside the first water cooling head, and a water inlet pipe and a water outlet pipe which are conducted to the hollow chamber are arranged at one side of the outside of the first water cooling head;

a pump arranged above the first water cooling head, a water inlet pipe is arranged on the top of the pump, and a water outlet pipe is arranged on one side of the pump;

a second water cooling head whose bottom is contacted with surface of the transistor, and there is a hollow chamber inside the first water cooling head, and a water inlet pipe and a water outlet pipe which are conducted to the hollow chamber are arranged at two end face of the outside of the second water cooling head;

a water cooling sink arranged on surface of the second water cooling head, the water cooling sink has multiple cooling fins and delivering tube traveling through said multiple cooling fins, and the delivering tube has a water outlet pipe on one end and a water outlet pipe on the other end;

multiple catheters respectively connected with the first water cooling head, the pump, the second water cooling head and the water cooling sink, so that first water cooling head, the pump, the second water cooling head, a third water cooling head and the water cooling sink form a continued circulating loop.

2. A circulating heat radiation device of water cooling type for computer motherboard according to claim 1, wherein the first water cooling head is a cube.

3. A circulating heat radiation device of water cooling type for computer motherboard according to claim 1, wherein two fixed connecting sheets are arrange on the other two side faces of the first water cooling head, the fixed connecting sheet is arranged with a screw hole, and a protruded sheet extends around the bottom of the fixed connecting sheet, the protruded sheet is arranged with two protruded ears, and said protruded ears are individually provided with a via hole.

4. A circulating heat radiation device of water cooling type for computer motherboard

四、聲明事項：

☐ 主張專利法第九十四條第二項☐第一款或☐第二款規定之事實，其事實發生日期為：　年　月　日。

☐ 申請前已向下列國家（地區）申請專利：

【格式請依：受理國家（地區）、申請日、申請案號　順序註記】

☐ 有主張專利法第一百零八條準用第二十七條第一項國際優先權：

☐ 無主張專利法第一百零八條準用第二十七條第一項國際優先權：

☐ 主張專利法第一百零八條準用第二十九條第一項國內優先權：

【格式請依：申請日、申請案號　順序註記】

八、新型說明：

【新型所屬之技術領域】

本創作係有關一種散熱裝置，尤指一種利用水冷式循環散熱裝置對電腦主機板上的晶片及電晶體進行散熱之裝置。

【先前技術】

在目前市面上所使用的電腦主機板上除了一顆微處理器（CPU）外，還有兩個南北橋晶片負責各個硬體的協調工作。在北橋晶片負責處理器、AGP及記憶體的協調工作，而南橋則負責控制一些較低速的元件，例如PCI、IDE及USB等，這設計為了不欲被其他低速元件影響，拖慢整體速度，才會分工於兩顆不同的南北橋晶片。

為了使電腦主機板上的CPU、南北橋晶片及電晶體（MOSFET）能夠正常的運作，皆在CPU、南北橋晶片及電晶體上安裝各自的散熱器或散熱裝置來散熱，經常造成電腦主機板上或機箱內部的空間不縛使用。甚至，因機箱內部的空間過於擁擠，使機箱內部的熱氣無法與外部的空氣產生對流交換，致使熱氣滯留在機箱內部，而大幅度縮短電腦主機板上各電子元件的使用壽命。

因此，有些多CPU及南北橋晶片，或者南北橋晶片共用的散熱裝置被設計出來，例如，本國專利公報所公告之證書號第M304892、M254644、M270649、M278218、M275684號。以克服電腦主機板上或機箱內部空間不縛使用之問題。由於隨著電腦的微處理器的運算速度不斷提昇，致使微處理

器近鄰的電晶體（MOSFET）所產生的熱量亦不斷地昇高，又受到電腦主機板上或機箱內部使用空間的限制下，如何對電腦主機板上的各晶片及電晶片設計出可共用的散熱裝置，以解決電腦主機板上或機箱內部空間的限制，乃是本創作所要解決的課題。

【新型內容】

因此，本創作之主要目的，提出一種用於晶片及電晶體的水冷式循環散熱裝置，不僅可達到水冷排及泵浦的共用，而大幅度簡化整體結構及成本，且能同時對南北橋晶片及電晶體進行散熱作用。

為達上述之目的，本創作之電腦主機板之水冷式循環散熱裝置，該裝置包括：一第一水冷頭、一泵浦、一第二水冷頭、水冷排及複數導管；其中，該第一水冷頭，其底部與晶片表面接觸，該第一水冷頭內部具有一中空容腔，其外部之一側面上設有與該中空容腔相通之進水管及出水管；該泵浦係以配置於該第一水冷頭上，其上設有一進水管及一側設有一出水管；該第二水冷頭其內部設有一中空容腔，其外部之二端面上設有與該中空容腔相通之進水管及出水管；該水冷排係以配置於該第二水冷頭表面上，係由複數散熱鰭片及出設於複數散熱鰭片中的輸送管，該輸送管一端為出水管，而另一端為進水管；該複數導管係分別連結於第一水冷頭、泵浦、第二水冷頭及水冷排之進水管及出水管上，使第一水冷頭、泵浦、第二水冷頭及水冷排形成一個供水連續循環流動的散熱迴路。

【實施方式】

茲有關本創作之技術內容及詳細說明，現配合圖式說明如下：

請參閱第一、二圖，係本創作之水冷式散熱裝置局部分解及外觀組立示意圖。如圖所示：本創作之電腦主機板之水冷式循環散熱裝置，該水冷裝置包括：第一水冷頭1、一泵浦2、第二水冷頭3、第三水冷頭4、水冷排5及複數導管6；其中，

該第一水冷頭1，係一立方體，其底部與晶片（圖中未示）表面接觸，而於第一水冷頭1內部具有一中空容腔，其外部之一側面上設有與該中空容腔相通之進水管11及出水管12；另於第一水冷頭1的另二側面上設有二相對稱之固接片13、13'，該固接片13、13'上設有一螺孔131、131'，藉以鎖接一泵浦2；再於第一水冷頭1底部四周延伸有一凸片14，該凸片14的一側上設有二相對稱之凸耳15、15'，該二凸耳15、15'上各設有一通孔16、16'，該通孔16、16'係以提供鎖固元件（圖中未示）穿過鎖接於該電腦主機板（圖中未示）。在本實施例中，該固接片13、13'為一L形；而鎖固元件為螺栓、卡榫、插銷之任一種。

該泵浦2，係以配置在該第一水冷頭1上方，其上設有一進水管21及一側設有一出水管22，該泵浦2周緣上設有二相對稱之凸耳23、23'，該二凸耳23、23'上各設有一通孔231、231'，該通孔231、231'係提供螺絲7

穿過與固接片13、13’的螺孔 131 、 131 ’鎖接，使泵浦 2 固接於該二固接片13、13’上。

該第二水冷頭 3 ，為一長方形體，其內部設有一中空容腔，其外部之二端面上設有與該中空容腔相通之進水管 31及出水管32，於該第二水冷頭 3 的底部二端延伸有二凸耳33、33’，該二凸耳33、33’上各設有通孔 331 、 331 ’，該通孔 331 、 331 ’係以提供鎖固元件（圖中未示）穿過與電腦主機板固接，使第二水冷頭 3 的底部與電腦主機板上的電晶體（圖中未示）表面接觸。

該第三水冷頭 4 ，為一長方形體，其內部設有一中空容腔，其外部之二端面上設有與該中空容腔相通之進水管 41及出水管42，於該第三水冷頭 4 的底部二端延伸有二凸耳43、43’，該二凸耳43、43’上各設有通孔 431 、 431 ’，該通孔 431 、 431 ’係以提供鎖固元件（圖中未示）穿過與電腦主機板固接，使第三水冷頭 4 底部與電腦主機板上的電晶體（圖中未示）表面接觸。

該水冷排 5 ，係以配置於該第二水冷頭 3 或第三水冷頭 4 之其一表面上，該水冷排具複數散熱鰭片51及穿設於複數散熱鰭片51中的輸送管52，該輸送管52一端形成一出水管 521 ，而另一端形成一進水管 522 。

該複數導管 6 ，係分別連結於第一水冷頭 1 、泵浦 2 、第二水冷頭 3 、第三水冷頭 4 及水冷排 5 之進水管 11、21、31、41、 522 及出水管12、22、32、42、 521 上，使第一水冷頭 1 、泵浦 2 、第二水冷頭 3 、第三水冷

頭4及水冷排5形成一可供水連續循環流動的散熱迴路。

請參閱第三圖，係本創作之水冷式散熱裝置安裝在電腦主機板上的示意圖。如圖所示：在本創作之水冷式散熱裝置在運用時，以鎖固元件8穿過第一水冷頭1的凸耳15、15'之通孔16、16'與電腦主機板9鎖固後，使該第一水冷頭1安裝於晶片（北橋晶片或南北橋整合晶片）91上，讓該第一水冷頭1的底部與晶片91表面接觸。再以鎖固元件8穿過第二水冷頭3及第三水冷頭4之凸耳33、33'、43、43'的通孔331、331'、431、431'與電腦主機板9鎖固後，使第二水冷頭3及第三水冷頭4安裝於該電晶體(MOSFET)92、93，讓第二水冷頭3及第三水冷頭4的底部與電晶體(MOSFET)92、93表面接觸。

在水冷式散熱裝置安裝完成，在電腦主機板9運作時，同時泵浦2被啟動，冷水由泵浦2的進水管21流入後（如箭頭方向），由出水管22流出，由第一水冷頭1的進水管11進入於中空容腔內吸熱，熱水由出水管12流出，由進水管31流入於第二水冷頭3內部中空容腔吸熱，再由出水管33流出，經進水管41流入於第三水冷頭4內部中空容腔吸熱後，熱水由出水管42流出，再由水冷排5之輸送管52的進水管522流入後，該熱水在輸送管52內部流動時，會將熱源傳遞於散熱鰭片51上，由散熱鰭片51進行散熱。然而，散熱後的冷水由輸送管52的出水管521流出，冷水再由泵浦2的進水管21流入，使水連續循環的流動，可以將晶片91及電晶體92、93工作所產生的熱源傳送到水冷排

5上散熱，使晶片91及電晶體92、93能夠正常運作。

請參閱第四、五圖，係本創作之另一實施例的水冷式與熱管式散熱裝置組接及第四圖安裝於電腦主機板組裝示意圖。如圖所示：本實施例所揭露之水冷式散熱裝置與第一、二圖相同，所不同處係在水冷式散熱裝置上增設有一熱管式散熱裝置，該熱管式散熱裝置具有一扁形熱管10，該熱管10的冷卻端101與第一水冷頭1底部以延伸的凸片14表面接觸，並且透過固定片20將熱管10的冷卻端101固接在凸片14的表面上，該固定片20具有一容置槽201，該容置槽201兩側延伸有二鎖固片202，該鎖固片202上具有通孔203，該通孔203供螺絲7穿過與凸片14鎖固，使固定片20將熱管10的冷卻端101固接在凸片14的表面上接觸，而熱管10的受熱端102穿設於具有複數散熱鰭片301之散熱片30上。在本實施例中，該容置槽201為一ㄇ形或U形之任一種；此外，該扁形熱管10的冷卻端101亦可用焊接方式與第一水冷頭1固接。

當水冷式散熱裝置的第一水冷頭安裝於電腦主機板9A的北橋晶片91A(如第五圖所示)，該熱管式散熱裝置的散熱片30則安裝於南橋晶片94A上。在電腦主機板9A運做時，該水冷式散熱裝置可以對北橋晶片91A、電晶片92A、93A進行散熱，而熱管式散熱裝置的散熱片30吸收南橋晶片94A的熱源後，透過熱管10的受熱端102傳遞於冷卻端101上，再由冷卻端101將熱源傳遞於該凸片14上，再隨水冷式散熱裝置進行散熱，使北橋晶片91A、南

橋晶片 94A 及電晶片 92A 、93 A 可正常運作。

上述僅為本創作之較佳實施例而已，並非用來限定本創作實施之範圍。即凡依本創作申請專利範圍所做的均等變化與修飾，皆為本創作專利範圍所涵蓋。

【圖式簡單說明】

第一圖，係本創作之水冷式散熱裝置分解示意圖。

第二圖，係本創作之水冷式散熱裝置外觀組立示意圖。

第三圖，係本創作之水冷式散熱裝置安裝在電腦主機板上的示意圖。

第四圖，係本創作之另一實施例的水冷式與熱管式散熱裝置組接示意圖。

第五圖，係為第四圖安裝於電腦主機板組裝示意圖。

【主要元件符號說明】

第一水冷頭 1	固接片 13、13'
螺孔 131 、 131'	泵浦 2
第二水冷頭 3	第三水冷頭 4
水冷排 5	散熱鰭片 51
輸送管 52	導管 6
螺絲 7	鎖固元件 8
電腦主機板 9 、9A	晶片 91
北橋晶片 91A	南橋晶片 94A
扁形熱管 10	冷卻端 101
受熱端 102	固定片 20
容置槽 201	鎖固片 202

散熱片 30　　　　　　　　散熱鰭片 301

進水管11、21、31、41、 522

出水管12、22、32、42、 521

電晶體92、93、 92A 、 93A

凸耳15、15’ 23、23’ 、33、33’ 、43、43’

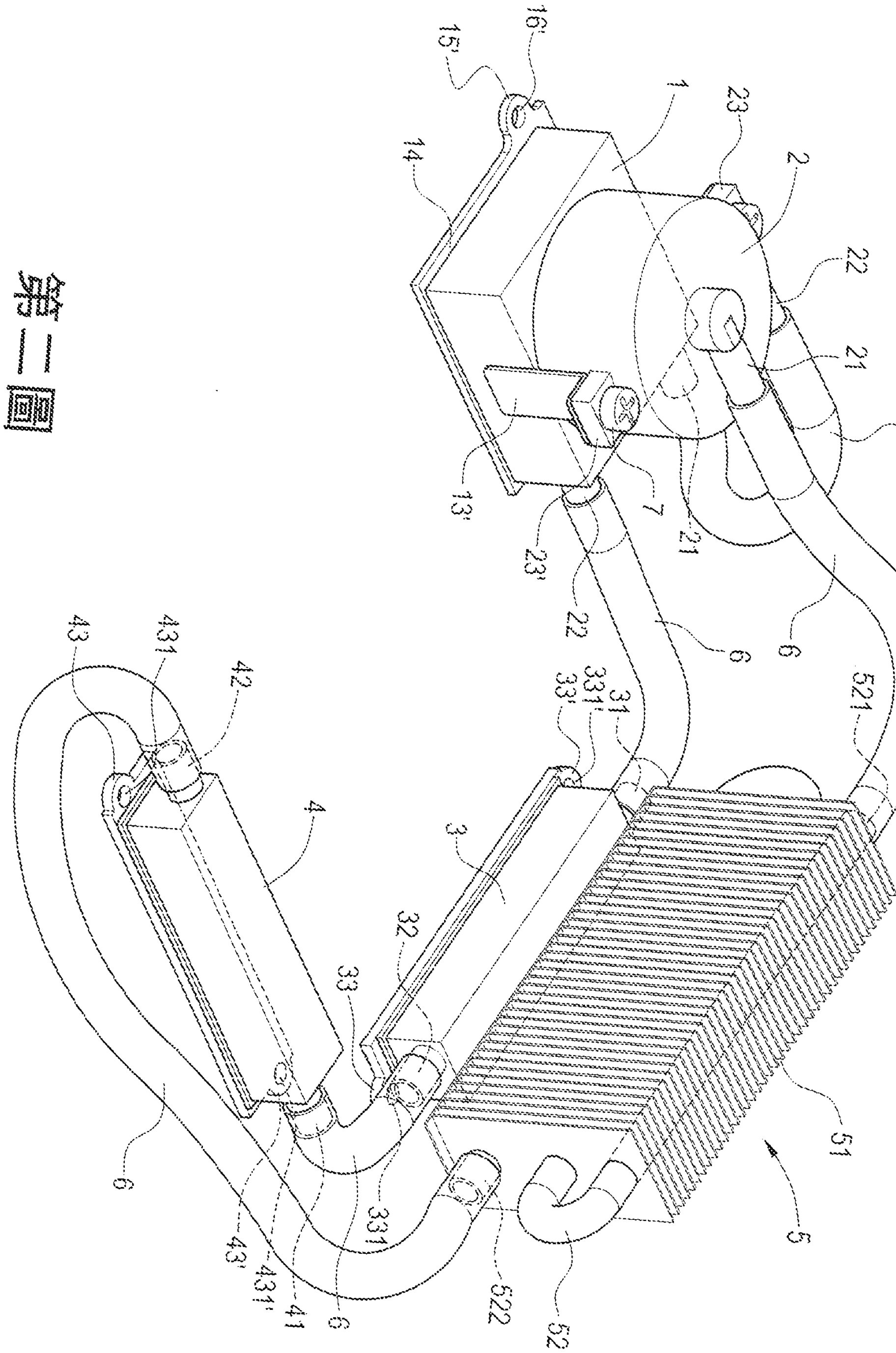
通孔16、16’ 、 231 、 231 ’ 、 331 、 331 ’ 、 431 、 431 ’ 、 203

五、中文新型摘要：

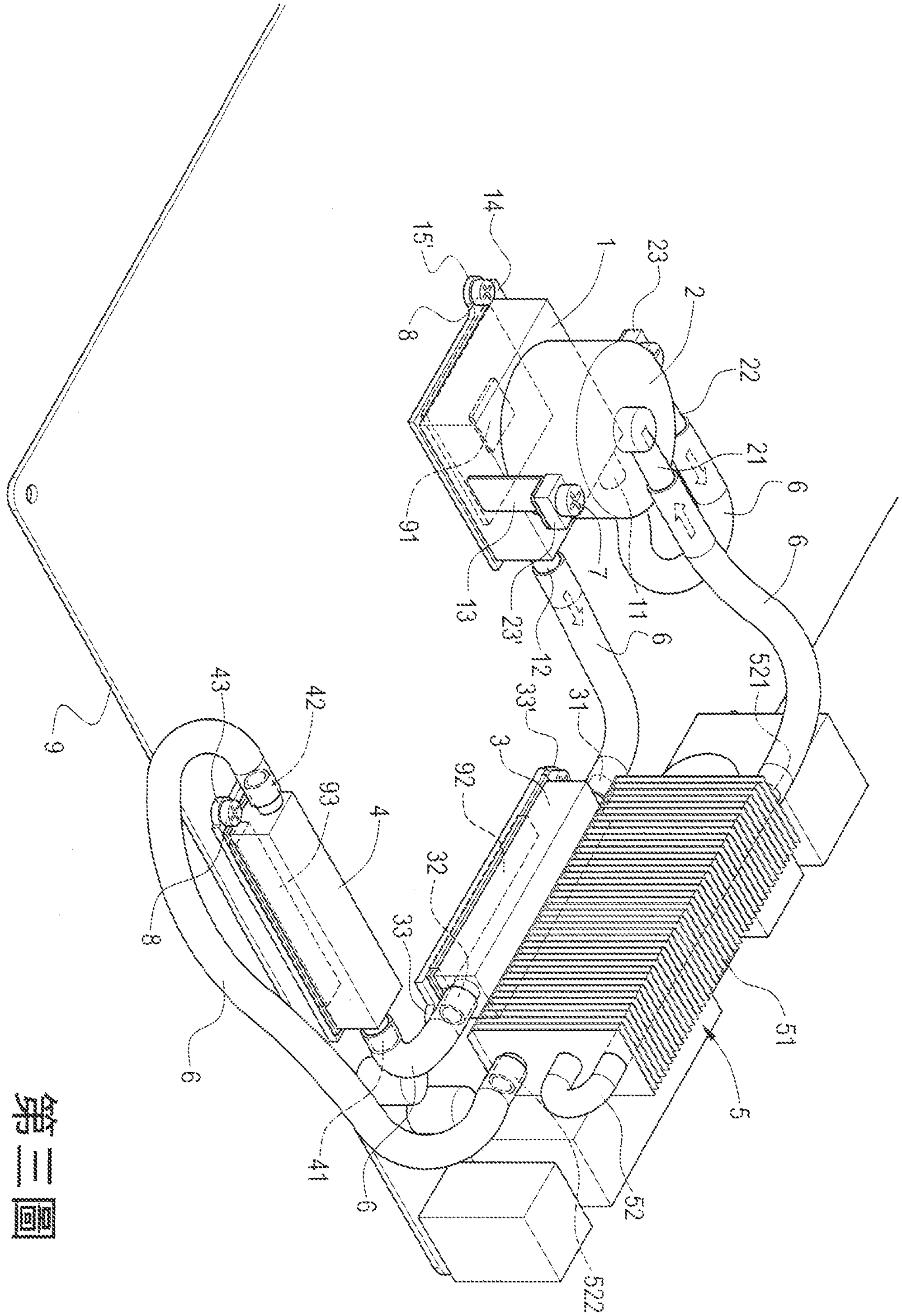
一種用於電腦主機板上的晶片及電晶體之水冷式循環散熱裝置，包括：一第一水冷頭、一泵浦、一第二水冷頭、水冷排及複數導管；其中，該第一水冷頭的底部與晶片表面接觸，其內部具有一中空容腔，而外部一側面上設有與該中空容腔相通之進水管及出水管；該泵浦配置於該第一水冷頭上，其上設有一進水管及一側設有一出水管；該第二水冷頭配置於電晶體表面上，其內部設有一中空容腔，而外部的二端面設有與該中空容腔相通之進水管及出水管；該水冷排配置於該第二水冷頭表面上，係由複數散熱鰭片及輸送管組成，該輸送管一端為出水管，而另一端為進水管；該複數導管係分別連結於第一水冷頭、泵浦、第二水冷頭及水冷排之進水管及出水管上，形成一可供水連續循環流動的散熱迴路，對電腦主機板上的晶片及電晶體進行散熱。

六、英文新型摘要：

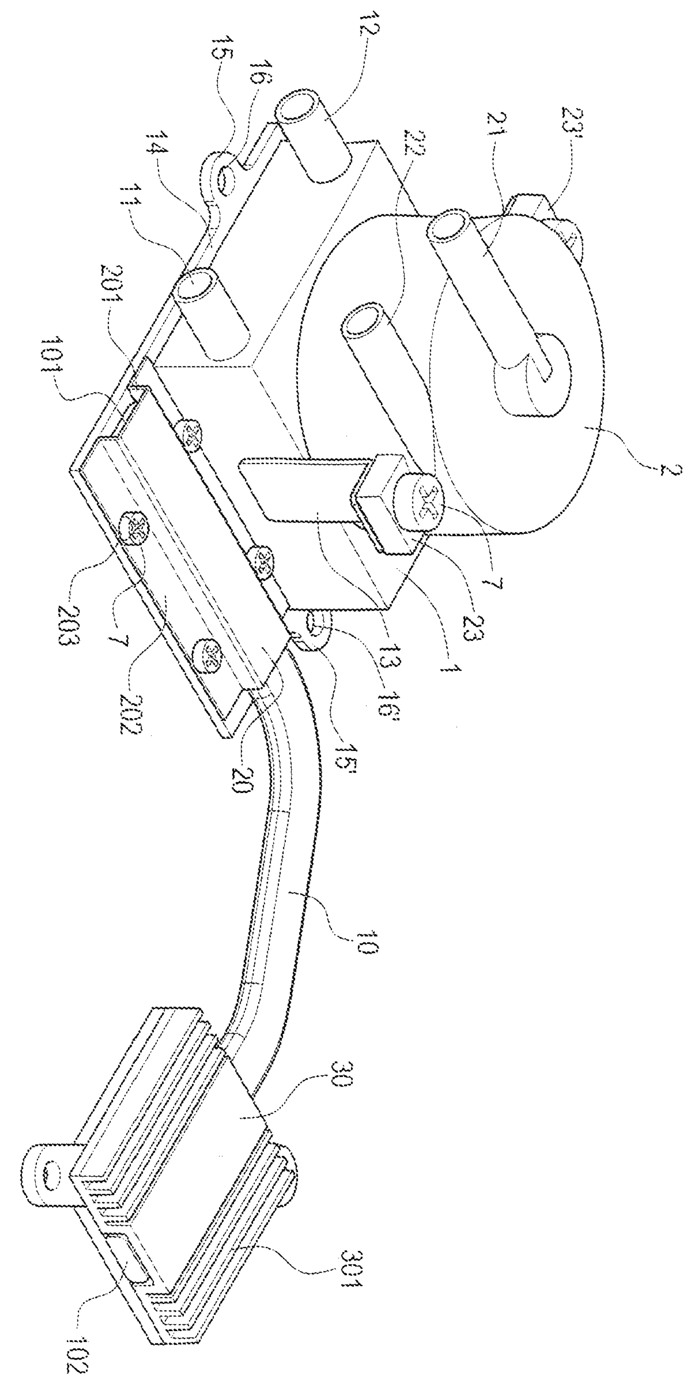
第二圖



1
2
3
4
5
6
7
13'
14
15'
16'
21
22
23
23'
31
32
33
33'
331
331'
41
42
43
43'
431
431'
51
52
521
522


14
15'
1
23
2
22
21
6
8
91
13
7
11
23'
12
6
521
33'
31
43
42
9
93
4
3
92
32
8
33
51
6
41
6
5
52
522

第三圖


12
15
16
14
11
201
101
22
21
23'
2
7
23
1
13
16'
15'
20
202
7
203
10
30
301
102

第四圖

七、指定代表圖：

（一）本案指定代表圖為：第（二）圖。

（二）本代表圖之元件符號簡單說明：

第一水冷頭 1	固接片 13、13'
螺孔 131、131'	泵浦 2
第二水冷頭 3	第三水冷頭 4
水冷排 5	散熱鰭片 51
輸送管 52	導管 6
螺絲 7	

進水管 11、21、31、41、522

出水管 12、22、32、42、521

凸耳 15、15' 23、23'、33、33'、43、43'

通孔 16、16'、231、231'、331、331'、431、431'

M324810

96年10月23日修正頁
補充

公告本

新型專利說明書

（本說明書格式、順序及粗體字，請勿任意更動，※記號部分請勿填寫）

※申請案號：096209264

※申請日期：96.6.5　　　※IPC分類：G06F 1/20 (2006.01)

一、新型名稱：（中文/英文）

電腦主機板之水冷式循環散熱裝置

二、申請人：（共2人）

姓名或名稱：（中文/英文）

1. 曜嘉科技股份有限公司
2. 技嘉科技股份有限公司

代表人：（中文/英文）（簽章）1. 馬孟明 2. 葉培城

住居所或營業所地址：（中文/英文）

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國　籍：（中文/英文）1. 中華民國 2. 中華民國

三、創作人：（共1人）

姓　名：（中文/英文）

施博仁

國　籍：（中文/英文）中華民國

96年10月23日修正補充

九、申請專利範圍：

1、一種電腦主機板之水冷式循環散熱裝置，用以對電腦主機板上的晶片及電晶體進行散熱，該水冷式循環裝置包括：

一第一水冷頭，係以底部與晶片表面接觸，於內部具有一中空容腔，而外部一側上設有與該中空容腔相通之進水管及出水管；

一泵浦，係配置在該第一水冷頭上方，其上設有一進水管及一側設有一出水管；

一第二水冷頭，係以底部與電晶體表面接觸，其內部設有一中空容腔，其外部之二端面上設有與該中空容腔相通之進水管及出水管；

一水冷排，係配置於該第二水冷頭之表面上，該水冷排具有複數散熱鰭片及穿設於複數散熱鰭片中的輸送管，該輸送管一端形成一出水管，而另一端形成一進水管；

複數導管，係分別與該第一水冷頭、泵浦、第二水冷頭及水冷排之進水管及出水管連結，使第一水冷頭、泵浦、第二水冷頭、第三水冷頭及水冷排形成一連續循環的迴路。

2、如申請專利範圍第1項所述之電腦主機板之水冷式循環散熱裝置，其中，該第一水冷頭為一立方體。

3、如申請專利範圍第1項所述之電腦主機板之水冷式循環散熱裝置，其中，該第一水冷頭的另二側面上設有二固接片，該固接片上設有一螺孔，於底部四周延伸有一

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凸片，該凸片的二側上設有二凸耳，該二凸耳上各設有一通孔。

4、如申請專利範圍第3項所述之電腦主機板之水冷式循環散熱裝置，其中，該凸片一側表面固接一熱管式散熱裝置。

5、如申請專利範圍第4項所述之電腦主機板之水冷式循環散熱裝置，其中，該熱管式散熱裝置包括：

一扁形熱管，其上一端為冷卻端，另一為受熱端，該冷卻端係與第一冷水頭固接；

一散熱片，係與扁形熱管之受熱端固接，其上具有複數散熱鰭片。

6、如申請專利範圍第1項所述之電腦主機板之水冷式循環散熱裝置，其中，更包括有一將扁形熱管固接於該第一冷水頭之固定片，該固定片上具有一容置扁形熱管之冷卻端的容置槽，該容置槽二側延伸有二鎖固片，該鎖固片上具有通孔，以固定片亦可將扁形熱管的冷卻端固接於第一水冷頭上。

7、如申請專利範圍第1項所述之電腦主機板之水冷式循環散熱裝置，其中，該泵浦周緣上設有二凸耳，該二凸耳上各設有一通孔。

8、如申請專利範圍第7項所述之電腦主機板之水冷式循環散熱裝置，其中，更包括有螺絲穿過泵浦之二凸耳的通孔與固接片的螺孔鎖接，使泵浦固接於該二固接片上。

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9、如申請專利範圍第1項所述之電腦主機板之水冷式循環散熱裝置，其中，該第二水冷頭底部二端各延伸有一凸耳，該二凸耳上各設有通孔。

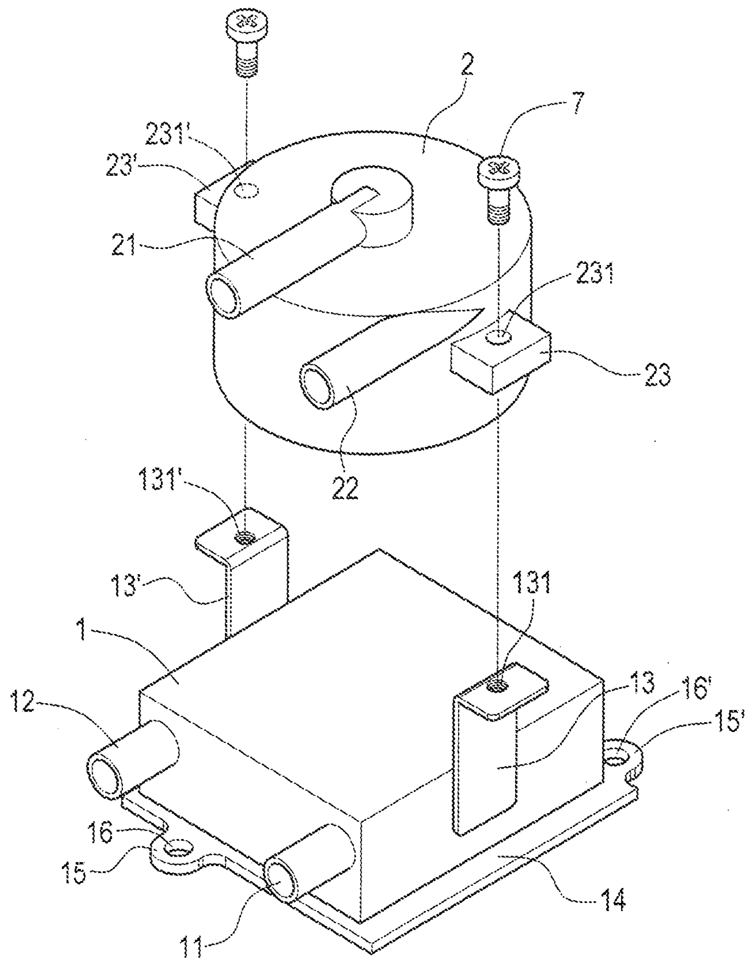
10、如申請專利範圍第9項所述之電腦主機板之水冷式循環散熱裝置，其中，更包括有複數鎖固元件穿過第二水冷頭之二凸耳的通孔與電腦主機板固接，使第二水冷頭底部與電腦主機上的電晶體表面接觸。

11、如申請專利範圍第10項所述之電腦主機板之水冷式循環散熱裝置，其中，該鎖固元件為螺栓、卡榫、插銷之任一種。

12、如申請專利範圍第1項所述之電腦主機板之水冷式循環散熱裝置，其中，更於第二水冷頭與水冷排之間，透過導管再連結一個與第二水冷頭相同結構的第三水冷頭於該電腦主機板的電晶體表面上。

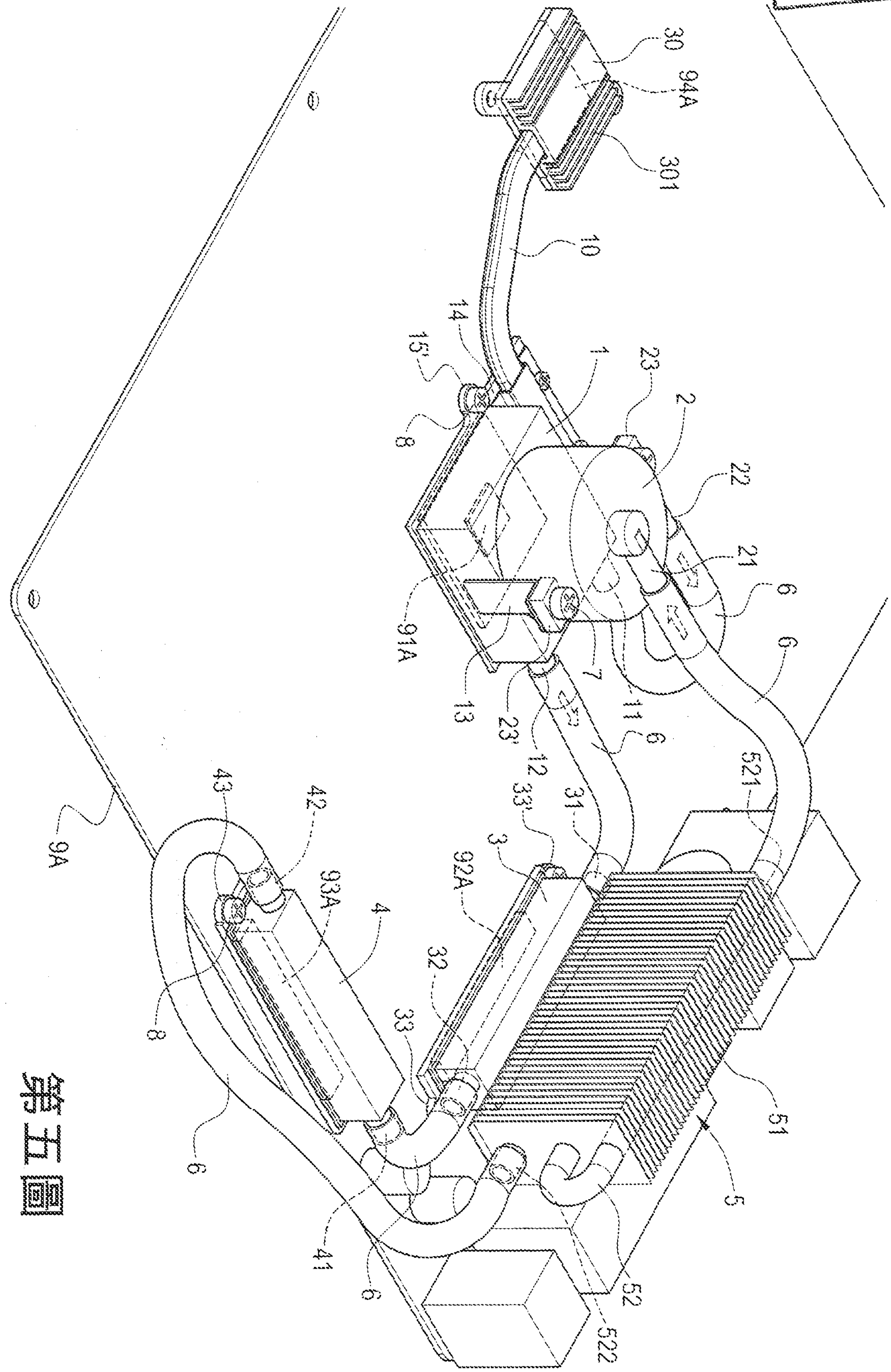
96年10月23日修正補充

十、圖式



第一圖

96年7月13日 修正補充



第五圖

公告本

申請日期：92-5-16	IPC分類 G06F 1/20, H05K 7/20
申請案號：92208939	

(以上各欄由本局填註)

新型專利說明書

578997

一、新型名稱	中文	電腦中央處理器水冷式冷卻裝置
	英文	
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一、本案已向

國家(地區)申請專利	申請日期	案號	主張專利法第一百零五條準用第二十四條第一項優先權
韓國 KR	2003/02/25	2003-0011567	有

二、□主張專利法第一百零五條準用第二十五條之一第一項優先權:

申請案號:

日期:

三、主張本案係符合專利法第九十八條第一項□第一款但書或□第二款但書規定之期間

日期:

四、中文創作摘要　（創作名稱：電腦中央處理器水冷式冷卻裝置）

本創作係有關一種電腦中央處理器水冷式冷卻裝置，更詳細說明是將散熱器(RADIATOR)冷卻的水，循環到電腦中央處理器(CPU)上面的水冷器(WATER JACKET)，進而冷卻該中央處理器(CPU)所產生熱氣的一種電腦中央處理器水冷式冷卻裝置，且中央處理器(CPU)上面，已冷卻的水自第1進水口進入，經內部循環過的水，則流到凹部後至第1排水口的排水循環部，以及循環部的排出部底面具有雙風扇，以迴轉力將排出部的水排至排水口的葉輪(IMPELLER)，並利用自外部供電的電源來啟動葉輪的驅動馬達。

英文創作摘要　（創作名稱：）

四、中文創作摘要 （創作名稱：電腦中央處理器水冷式冷卻裝置）

伍、（一）、本案代表圖為：第 ___一____圖

（二）、本案代表圖之元件代表符號簡單說明：

20、水冷器	30、幫浦
32、進水口	34、排水口
40、防水蓋	45、驅動馬達
55、扣具	60、散熱器
62、進水口	64、排水口
66、排水管	68、進水管
70、風扇	100、外殼

英文創作摘要 （創作名稱：）

五、創作說明 (1)

（一）、新型所屬之技術領域：

本創作係有關電腦中央處理器水冷式冷卻裝置，更詳細的說是，係將散熱器(RADIATOR)冷卻的水，循環到電腦中央處理器(CPU)上面的水冷器(WATER JACKET)，進而冷卻中央處理器(CPU)所產生熱氣的電腦中央處理器水冷式冷卻裝置。

（二）、先前技術：

近來電腦技術發達，中央處理器(CPU)的運作時脈也急遽上升，中央處理器(CPU)的每個動作所產生的熱，會隨中央處理器速度而增加，一般來說中央處理器的溫度越接近高溫時越能保持良好的動作性能，但至高溫時處理速度會減弱，並且產生錯誤的可能性也較高。中央處理器(CPU)的發熱量過高時電腦會當機，而會發生資料毀損，此狀況繼續發生時，高價的中央處理器(CPU)會故障或毀損。因此，為解決這樣的問題，從中央處理器(CPU)所發生的熱必需要冷卻，以前是使用風扇迴轉降低中央處理器(CPU)的氣冷式散熱器.

氣冷式散熱器是中央處理器(CPU)處理速度超過100MHZ最普遍採用的冷卻器，在中央處理器(CPU)上面安裝散熱片和風扇組成氣冷式散熱器後，將風扇高速迴轉使中央處理器(CPU)溫度下降。亦即，在中央處理器(CPU)上產生的熱傳導至散熱器，而以風扇迴轉方式冷卻中央處理器(CPU)。

另一方面，最近由於中央處理器(CPU)的高性能，同

五、創作說明 (2)

時也會增加發熱量，為解決大量的發熱量，出現氣冷式散熱器越大且速度越高現象，一般會要求500 RPM速度以上，最近出產的氣冷式散熱器的風扇速度是一分鐘600以上迴轉。

但是，如此的氣冷式卻存在很多的問題，說明如下：

第一、使用高性能散熱器的風扇，噪音也會增加的問題。中央處理器(CPU)性能愈發達，發熱量也會增加，發熱量越增加需要風扇迴轉速度也越快。但是，迴轉速度與噪音是相對的。噪音讓使用者產生很大的壓力。

第二、氣冷式循環機殼內部的空氣，會降低冷卻效率的問題。

一般使用者使用電腦時機殼蓋罩在外面。此時，從外部進入之空氣是微少的量，而氣冷式散熱是一直循環內部空氣來使中央處理器(CPU)冷卻。長時間沒有使用電腦時內部空氣在該冷卻的情況之下冷卻效果不錯，但是長時間使用時一直循環機殼內部的熱氣，機殼內部溫度會提昇反而冷卻效果急速降低。尤其是最近的2GHZ中央處理器之氣冷式散熱器效果已達極限。

第三、CPU在上溫能發揮最好的性能。傳統的氣冷散熱器在氣溫高的夏天，以及氣溫較低的冬天都以同樣速度以風扇迴轉冷卻，該冷卻效率會降低甚或產生毀損CPU的問題。

(三)、新型內容：

《本創作要解決的技術問題》

本創作目的是為解決上述之問題，故提供一種利用冷卻循環的冷水散熱在中央處理器(CPU)上之熱氣的電腦中央處理器水冷式冷卻裝置。亦即，經散熱片時已冷卻的水經過中央處理器(CPU)上面的小水箱來降低溫度，是一種以中央處理器(CPU)所發生的熱氣通過抽水驅動部至散熱器後冷卻循環之電腦中央處理器(CPU)水冷式冷卻裝置。

《本創作的技術手段》

為達成上述之目的，本創作的電腦中央處理器(CPU)水冷式冷卻裝置是以冷卻的水循環到電腦中央處理器(CPU)內部來冷卻電腦中央處理器(CPU)的電腦中央處理器(CPU)水冷式冷卻裝置。

在中央處理器(CPU)上面，已冷卻的水自進水口進入，經內部循環過的水，則流到凹部後至排水口的循環部，循環部的排出部具有底面雙風扇，以迴轉力將排出部的水排至排水口的葉輪(IMPELLER)，並利用自外部供電的電源來驅動葉輪的驅動馬達。

另，本創作乃配備有循環部、葉輪和驅動馬達全套能堅固安裝的扣具。

循環部之第 1進水口、排出部和第 1排水口的幫浦驅動部安裝在幫浦下端中央處理器(CPU)上面，冷卻水會流入第 2進水口，已流入的冷水能順利循環內部形成水路後自第 2排水口排出至排出部下端水冷器。

或第 1進水口、排出部和第 1排水口的幫浦驅動部安裝在幫浦下端中央處理器(CPU)上面，冷卻水會流入第 2進水

口，已流入的冷水能順利循環內部形成水路後自第2排水口排出至排出部下端水冷器;連接第1進水口和第2進水口，還有水冷器和幫浦驅動部中間形成的進水管;連接排出部和第2排水口，還有水冷器和幫浦驅動部中間形成的排水管;連接排出部和第2排水口，這時扣具必須安裝在中央處理器(CPU)上面。

水冷器是採用鋁材質製造的，尤其水冷器內部是由堆層多孔性形成的鋁板利用焊接(BRAZING)方式來結合而形成多種水路。

還有要準備循環部和葉輪上面能蓋住葉輪周邊的防水蓋，此防水蓋應使用硅酮橡膠處理材質。

驅動馬達在低面露出形成雙磁鐵軸，葉輪與各磁鐵同位置具雙金屬軸並與各磁鐵軸和各金屬軸互相連動，使驅動馬達的驅動力傳到葉輪。

散熱片內部通過循環部的冷水，在內部循環冷卻後排出，從第1排水口排出至第3進水口，已進入的水在內部多數的水路分散循環後排出至第3排水口。風扇裝在散熱器的一面，以外部的電源來迴轉，冷卻散熱片內部循環的水。散熱片是採用鋁材質，散熱片內部有形成Z字形的水路。

(四)、實施方式：

如下圖式說明本創作之優點，特徵和實例：

圖示 1：本創作組裝之電腦中央處理器(CPU)水冷式冷卻裝置的電腦內部結構圖。圖式1是為了解本創作的電腦中

央處理器 (CPU)水冷式冷卻裝置的組裝狀況和驅動說明。
本創作之電腦中央處理器 (CPU)水冷式冷卻裝置是安裝在中央處理器 (CPU)上面組成冷卻部和散熱器 (60)。冷卻部安裝在中央處理器 (CPU)上面，散熱器 (60)則是裝在機殼 (100)內部的背面，並安裝有散熱片 (60)，前面或後面安裝散熱風扇 (70)。

冷卻部安裝在中央處理器 (CPU)上，有組成冷水經過的水冷器 (20)和經過水冷器從中央處理器 (CPU)受傳熱之熱水隨葉輪的迴轉力排出至散熱器 (60)的幫浦驅動部 (30)以及啟動葉輪的驅動馬達 (45)。冷卻部由水冷器、幫浦驅動部和驅動馬達組成互相結合之扣具 (55)，安裝在中央處理器 (CPU)上。扣具 (55)呈 H字形，扣具下端固定在主機板或中央處理器 (CPU)下端的機板，上端固定在驅動馬達上端。此為固定冷卻部。

還有幫浦驅動部和葉輪連接部位有可能會漏水，所以為防止漏水在幫浦驅動部和葉輪上面密封安裝防水蓋。

冷卻部和散熱器之間為通過水冷器 (20)的冷水互相循環，幫浦驅動部 (30)和散熱器 (60)之間連接兩個水管 (66，68)。經過散熱器時已冷卻的水通過排水管 (66)排出，經幫浦驅動部流入到水冷器 (20)，經水冷器的水是通過幫浦驅動部和進水管 (68)流入到散熱器。進水管和排水管與抽水幫浦驅動部和散熱器的進水口 (32，62)及排水口 (34，64)連接，為防止連接部位漏水，故使用管束來鎖緊。排水管不接到幫浦驅動部 (30)，而直接連接到水冷器

(20)，從散熱器(60)排出的冷水也不經過幫浦驅動部直接流到水冷器。

散熱器(60)經過水冷器(20)時，升溫的水循環時因風扇(70)啟動而冷卻。風扇(70)安裝在散熱片前方循環機殼(100)內部空氣，或是安裝在散熱片後方之機殼背面有多個孔供風扇循環外面空氣以提高冷卻效率。風扇的安裝位置可依電腦系統變化。

圖式 2A是本創作之冷卻部安裝在中央處理器(CPU)上的情況。依本創作，冷卻部(50)位於中央處理器(10)上面固定裝置，中央處理器(CPU)上方有水冷器(20)、幫浦(30)、防水蓋(40)及馬達(45)。依照順序排置後使用扣具固定其裝置。而水冷器、幫浦、防水蓋及馬達互相之間是比較適合使用另外固定方法來固定。

在散熱器(60)已冷卻的冷水經過幫浦驅動部(30)流入到水冷器(20)冷卻後裝在水冷器(20)下端的中央處理器(CPU)，經過水冷器(20)的水以幫浦驅動部再排出到散熱器(60)。更詳細的說明是，從散熱器(60)經過排出管(66)排出的冷水流入幫浦的進水口(32)後，跟幫浦的進水口互相連接水冷器的進水口。經過水冷器(20)的水是通過水冷器排水口(24)排出到幫浦驅動部(30)後，葉輪啟動將水排出到抽水幫浦(30)排水口(34)經過進水管(68)流入到散熱片(60)。

在幫浦驅動部(30)內，散熱片的進水口流入的冷水流入水冷器(20)第 1水路，和從水冷器排出的水連接與排水

五、創作說明 (7)

口第 2水路貫通，各水路跟水冷器(20)的進水口(22)和排水口(24)互相連接。

依照本創作，冷卻部(50)在幫浦(30)下面和水冷器(20)上面互相密封，可降低冷卻部的高度。為了防止幫浦(30)和水冷器(20)之間漏水，必須使用防水蓋。

圖式 2B是本創作冷卻部安裝在中央處理器的另一個實施例。

幫浦(30)和水冷器(20)之間水循環的連接管子會形成適當的高度，幫浦(30)跟水冷器(20)之間需要適當的距離。冷卻部(50)安裝在中央處理器(CPU)時，扣具上端部分應連結水冷器上面後，在中央處理器(CPU)固定安裝。亦即幫浦(30)通過連接管(28)與水冷器(20)固定連接，防水蓋(40)和馬達(45)也固定在幫浦上面，水冷器以扣具固定冷卻部後固定在中央處理器。此外尚須準備幫浦(30)和水冷器(20)之間的固定設備。

圖式 3是本創作冷卻部之分解圖，圖式 4為冷卻部各部分結構，圖式 4A是水冷器剖面圖，4B是幫浦(30)剖面圖，圖式 4C是從下面看葉輪斜視圖，圖式 4D是從下面看驅動馬達(45)斜視圖。尤其是圖式 4A詳細說明水冷器部份剖面圖。圖式 3和圖式 4說明了本創作的各冷卻部分。

依照本創作，冷卻部(50)組成有冷水經過水冷器內部後冷卻中央處理器;冷水流入水冷器;會排出水冷器的水的幫浦(30);幫浦(30)上面密封蓋的防水蓋(40);幫浦傳達驅動力的驅動馬達(45)和冷卻部(50)裝在中央處理器(10)的

扣具;幫浦(30)的排出部(35);在水冷器(20)將水排出的葉輪。

依照本創作，水冷器(20)安裝在中央處理器上面，散熱器(60)冷卻排出的冷水經過幫浦和通過內部時冷卻中央處理器，通過內部時因受到熱氣變熱的水通過幫浦再排出到散熱器。水冷器(20)配備有從幫浦流入冷水的進水口(22)和從幫浦排出的排水口(24)。水冷器的進水口(22)和幫浦的進水口(22)呈垂直方向位置，而幫浦和水冷器結合時兩進水口(32，22)應該連接。還有可設計從散熱器(60)直接流入到水冷器(20)，此時散熱器的排水管(66)可直接連結水冷器的進水口(22)。

水冷器(20)是採用優良的熱傳導和熱交換的鋁或銅材質，但考慮加工成本時比較適合使用鋁材質。

水冷器(20)內部結構是多孔形鋁板(26)積層後利用焊接(BRAZING)方式結合而形成多種水路。比較詳細的說明是像蜂窩形的多孔形鋁板(26)積層鋁分子粉末到鋁板(26)空間後結合，通過這樣的結合鋁板是採用同樣的材質，在水冷器(20)內部會形成像蜂窩形的多種水路。所以水冷器流入的冷水是分散通過內部的多種水路，這樣更會提高熱交換效率。提高水冷器(20)的熱傳導和熱交換效率和保持平衡冷水和中央處理器的溫度，才會提高中央處理器冷卻效果。

經過水冷器時提昇溫度的水，通過水冷器的排水口(24)排出到抽水幫浦(30)的排出部(35)後，啟動葉輪將水

排到幫浦的排水口(34)，通過進水管(68)流入到散熱器(60)。

依照本創作，幫浦(30)安裝在水冷器(20)上面，從散熱器(60)排出的冷水流入到水冷器，通過水冷器的水流到散熱器(60)後排出。幫浦(30)連接排水管(66)，從散熱片(60)排出的冷水流入進水口(32)，經過水冷器(20)的水排到進水管之排水口而從水冷器排出的水是呈凹形狀，在內部安裝葉輪(36)將水引至排出部(35)。

排出部(35)啟動葉輪從水冷器引出的一定量的水會呈凹形狀，另一側流水是以葉輪排出到排水口(34)。還有排出部下端水冷器(20)的排水口(24)會露出形成開放空間(35A)，通過空間(35A)水冷器(20)的水排出到排出部。所以經過水冷器的水是以葉輪(36)引至排出部(35)後排出到幫浦(30)的排水口(34)，再通過進水管(68)流入到散熱器(60)。

幫浦(30)的進水口和排水口與排水管(66)和進水管連接後循環散熱器(60)，為防止各管子的進水口和排水口中間連接部位漏水，要使用螺栓(39A)和螺帽(39)。栓緊抽水幫浦(30)的材質是比較適合塑膠也可使用與水冷器(20)同樣的鋁或銅材質。

依照本創作，葉輪(35)是安裝在抽水幫浦的排出部，在下端水冷器(20)的水引到排出部(35)後排出到具備有雙風扇(37)的排水口(34)。葉輪(36)是受驅動馬達之動力，它具備雙金屬軸。一般馬達的驅動力是以驅動軸傳達，但

五、創作說明 (10)

本創作之驅動馬達(45)為雙磁鐵軸(45A)傳達驅動力，葉輪(36)通過上述磁鐵軸(45A)，驅動馬達(45)的驅動力具備雙金屬軸，使用磁性幫浦方式驅動。驅動馬達之磁鐵具備金屬軸，葉輪也具備磁鐵軸。上述磁鐵軸(45A)和金屬軸(36A)縱方向驅動馬達(45)和葉輪(36)，互相裝置在同一位置。葉輪(36)不需要另外驅動軸而以磁力迴轉。使用磁性幫浦方式可除驅動軸摩擦的噪音。

葉輪(36)的迴轉扇片(37)有循環型或自轉型，比較適合的是自轉型。循環型迴轉扇片的側面狀態是四方形，自轉型迴轉扇片有一定的角度，迴轉扇片的側面狀態是三角型。迴轉扇片角度可呈任意的角度。

循環型只在排出部滿水時正常動作，若排出部的水跟空氣混合不能正常動作時會停止。所以使用循環型迴轉扇片會有在水冷器混合空氣時產生葉輪停止的缺點。反而自轉型在排出部有空氣的狀態之下也能正常運作，所以水冷器有空氣也可使用沒有問題。

葉輪(36)在抽水幫浦(30)的排出部(35)動作時，葉輪周邊有可能會漏水，會損傷電腦內部的裝置設備。因此，在幫浦跟葉輪上需有防水蓋(40)密封裝置。

防水蓋應使用防水性卓越的硅碢橡膠材質，至少要蓋住葉輪周邊的部份。所以幫浦(30)和葉輪(36)上部是完全密封防水的。防水蓋之驅動馬達和葉輪是互相不會接觸與驅動部和循環部完全分離。如上說明，本創作的驅動馬達(45)和葉輪之間是不需要物理接觸，只以磁力連動，可分

離驅動部和循環部，這樣可降低噪音。

依照本創作，驅動馬達(45)是自外部的電源產生驅動力來啟動葉輪(36)，葉輪傳達驅動力配備有露出地面的雙磁鐵軸(45A)。上述各磁鐵軸(45A)安裝在與葉輪(36)和金屬軸(36A)同樣的位置，與葉輪金屬軸連動，由驅動馬達發生的驅動力傳導葉輪。

為了順利將水冷器(20)的水引至散熱片，驅動馬達保持(45)2000RPM以上的迴轉速度，最適合的速度是保持2800RPM左右。傳統氣冷式扇片是要5000RPM以上迴轉，所以有噪音問題。依照本創作的驅動馬達(45)只需要傳統風扇一半的迴轉速度，所以驅動馬達噪音會大幅降低。

圖式5是本創作的散熱器顯示圖，圖5A是散熱器斜視圖，圖5B是散熱器剖面圖。尤其，圖5B更詳細說明散熱器(60)內部，散熱器上面一部分和側面剖解的剖面圖。如圖5A和圖5B，依照本創作，散熱器(60)正面配備有經過水冷器的水流入的進水管(68)會連接進水口(62)和為排除冷水排出管(66)連接的排水口(64)。散熱器內部有Z字形成的雙板子(65)並列配置多種水路。

散熱器(60)內部具備的各板子是採用優良熱傳導度和熱交換的鋁或銅材質，但考慮加工成本時比較適合使用鋁材質。

在散熱器(60)正面的進水口(62)和排水口(64)跟各板子(65)形成的水路相通。而且自進水口(62)流入的水是各水路分散後再集合到排水口後排水。因此，散熱器(60)是

五、創作說明 (12)

將流入的水分散後同時冷卻，這樣會提昇冷卻效率。

為冷卻散熱器(60)正面或背面經過各水路的水而安裝風扇(70)。風扇(70)安裝在散熱器正面以循環機殼內部空氣。

依照本創作的電腦中央處理器水冷式冷卻裝置，經過散熱器(60)內部的水可以注入或更換。即散熱器(60)可以準備另外的注入口或在散熱器(60)的進水口和排水口和別的水管連接來注入水或換水。而且水冷器(20)注入水時空氣混合也不會產生影響。

《新型效果》

本創作之電腦中央處理器水冷式冷卻裝置比傳統的氣冷式散熱風扇更能提供卓越冷卻效果，該中央處理器能發揮最好的性能，使用時幾乎不會產生噪音，可提昇良好的作業環境。

第一、因利用水冷卻可提高中央處理器的冷卻效率。

第二、中央處理器一直使水保持高溫，讓中央處理器能發揮最好的性能，而預防中央處理器故障的可能性。

第三、水冷器採用優良的熱傳導度和熱交換的鋁或銅材質，內部結構是多孔性蜂窩狀讓冷水分散通過，在中央處理器發生熱氣交換，提高冷卻效率。

第四、使用磁性幫浦，清除驅動軸摩擦的噪音，驅動馬達速度可減小，可減低傳統的氣冷式的一半噪音。

最後，不需要變化形態，可適用AMD、INTEL的中央處理器(CPU)。

圖式簡單說明

第一圖、本創作之中央處理器水冷式冷卻裝置之內部構造圖。

第二A圖、本創作之冷卻部安裝在中央處理器之圖示。

第二B圖、本創作之冷卻部安裝在中央處理器之另外實施圖。

第三圖、本創作之冷卻部分解圖。

第四A圖、本創作之水冷器剖面圖。

第四B圖、本創作之抽水幫浦驅動部之剖面圖。

第四C圖、本創作之從下面看葉輪斜視圖。

第四D圖、本創作之從下面看驅動馬達斜視圖。

第五A圖、本創作之散熱器斜視圖。

第五B圖、本創作之散熱器剖面圖。

圖號說明

10、中央處理裝置　　20、水冷器

22、32、62、進水口　　24、34、64、排水口

26、鋁板　　28、連接管

30、幫浦　　35、排出部

35A、空間　　36、葉輪

36A、金屬軸　　37、葉片

39、螺帽　　39A、螺栓

40、防水蓋　　45、驅動馬達

45A、磁鐵軸　　50、冷卻部

圖式簡單說明

55、扣具

60、散熱器

65、板子

66、排水管

68、進水管

70、風扇

100、外殼

六、申請專利範圍

1、一種電腦中央處理器水冷式冷卻裝置，主要係將散熱器(RADIATOR)冷卻的水，循環到電腦的中央處理器(CPU)上面所附的小水箱(WATER JACKET)，進而冷卻在中央處理器(CPU)所產生熱氣，在中央處理器(CPU)上面，已冷卻的水自第1進水孔進入，經內部循環過的水，則流到凹部後至第1排水口的排水循環部，循環部的排出部具有底面雙風扇，以迴轉力將排出部的水排至排水口的葉輪(IMPELLER)，並利用葉輪以自外部供電的電源來驅動葉輪的驅動馬達。

2、如申請專利範圍第1項所述之一種電腦中央處理器水冷式冷卻裝置，其中配備有結合循環部、葉輪及驅動馬達安裝在中央處理器之扣具。

3、如申請專利範圍第1項所述之一種電腦中央處理器水冷式冷卻裝置，其中循環部具有第1進水口、排出部和第1排水口的幫浦驅動部安裝在幫浦下端中央處理器(CPU)上面，已冷卻的水會流入第2進水口，已流入的冷水能順利循環內部形成的水路後，排至第2排出水口的水冷器。

4、如申請專利範圍第1項所述之一種電腦中央處理器水冷式冷卻裝置，其中第1進水口、排出部和第1排水口的幫浦驅動部安裝在幫浦下端中央處理器(CPU)上面，已冷卻的水會流入第2進水口，已流入的冷水能順利循環內部形成的水路後，在第2排水口排出至排出部下端水冷器，連接第1進水口和第2進水口，以及水冷器和幫浦驅動部中間的進水管，連接排出部和第2排水口，以及水冷器和幫浦驅

六、申請專利範圍

動部中間的排水管。

5、如申請專利範圍第4項所述之一種電腦中央處理器水冷式冷卻裝置，其中配備有結合水冷器配件安裝在中央處理器的扣具。

6、如申請專利範圍第3或第4項所述之一種電腦中央處理器水冷式冷卻裝置，其中水冷器是採用鋁材質製造者。

7、如申請專利範圍第3或第4項所述之一種電腦中央處理器水冷式冷卻裝置，其中水冷器內部有堆層多孔性的鋁板利用焊接(BRAZING)方式來結合而形成多種水路。

8、如申請專利範圍第1項所述之一種電腦中央處理器水冷式冷卻裝置，其中電腦中央處理器水冷式冷卻裝置，配備有循環部和葉輪上面至少蓋到葉輪周邊部的防水蓋。

9、如申請專利範圍第8項所述之一種電腦中央處理器水冷式冷卻裝置，其中該防水蓋是使用硅酮橡膠處理的材質。

10、如申請專利範圍第1項所述之一種電腦中央處理器水冷式冷卻裝置，其中驅動馬達在低面露出雙磁鐵軸，葉輪與各磁鐵同位置，雙金屬軸與各磁鐵軸和各金屬軸互相連動驅動馬達的驅動力傳到葉輪。

11、如申請專利範圍第10項所述之一種電腦中央處理器水冷式冷卻裝置，其中該磁鐵軸是ALNICO磁鐵軸。

12、如申請專利範圍第1項所述之一種電腦中央處理器水冷式冷卻裝置，其中葉輪各迴轉扇片是自轉型，下端部分有一點角度。

13、如申請專利範圍第12項所述之一種電腦中央處理器水

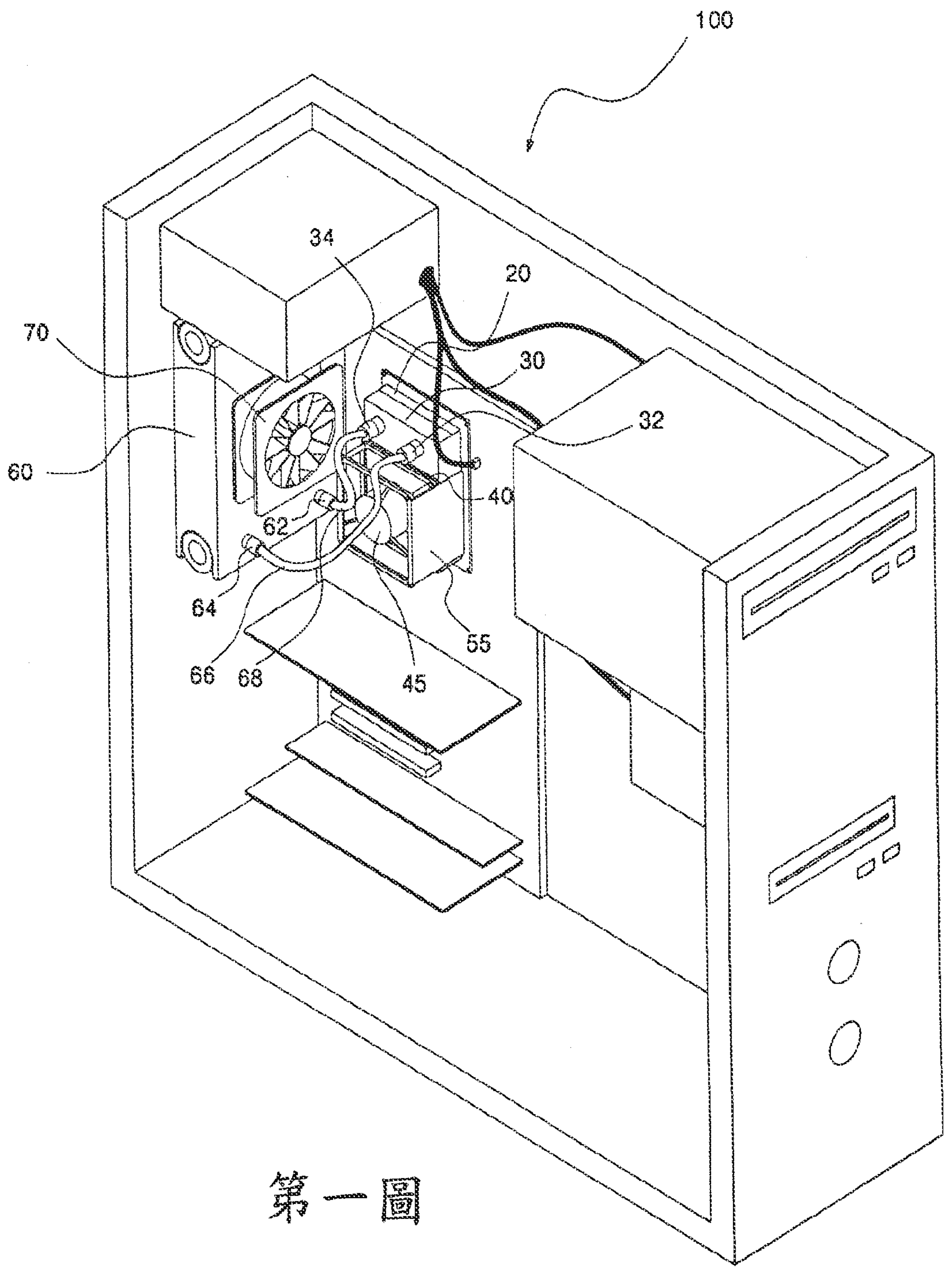
六、申請專利範圍

冷式冷卻裝置，其中電腦中央處理器水冷式冷卻裝置經過循環部的水，在內部循環冷卻後排出，從第1排水口排出至第3進水口，已進入的水在內部多數的水路和各水分散循環後排出至第3排水口。

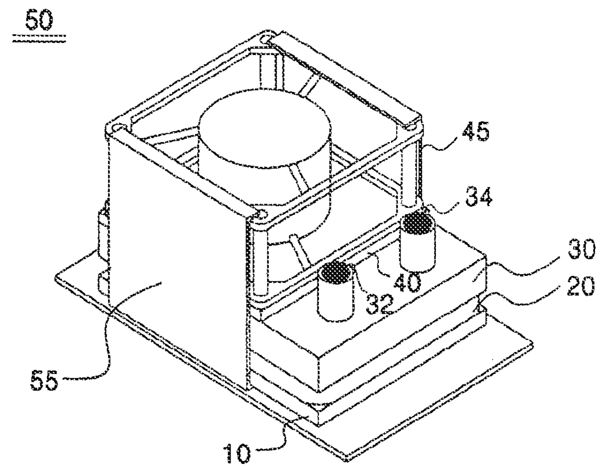
14、如申請專利範圍第13項所述之一種電腦中央處理器水冷式冷卻裝置，其中電腦中央處理器水冷式冷卻裝置，安裝在散熱器一邊，以外部的電源來迴轉冷卻散熱器內部循環的水。

15、如申請專利範圍第13項所述之一種電腦中央處理器水冷式冷卻裝置，其中散熱器內部有Z字形的水路形成的雙板子積層。

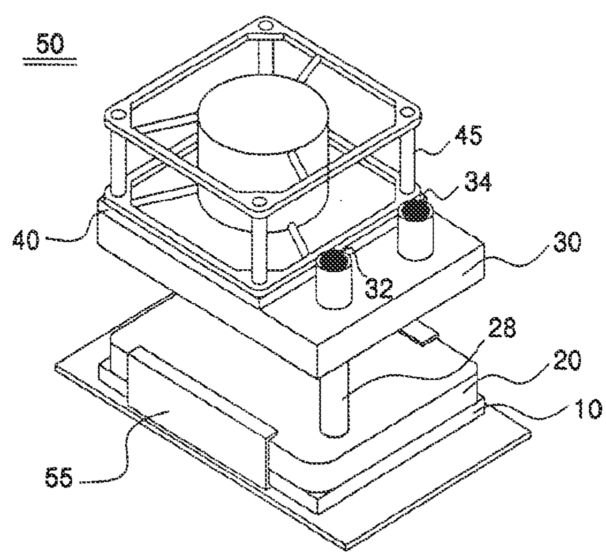
16、如申請專利範圍第13項所述之一種電腦中央處理器水冷式冷卻裝置，其中散熱器是採用鋁材質。



第一圖

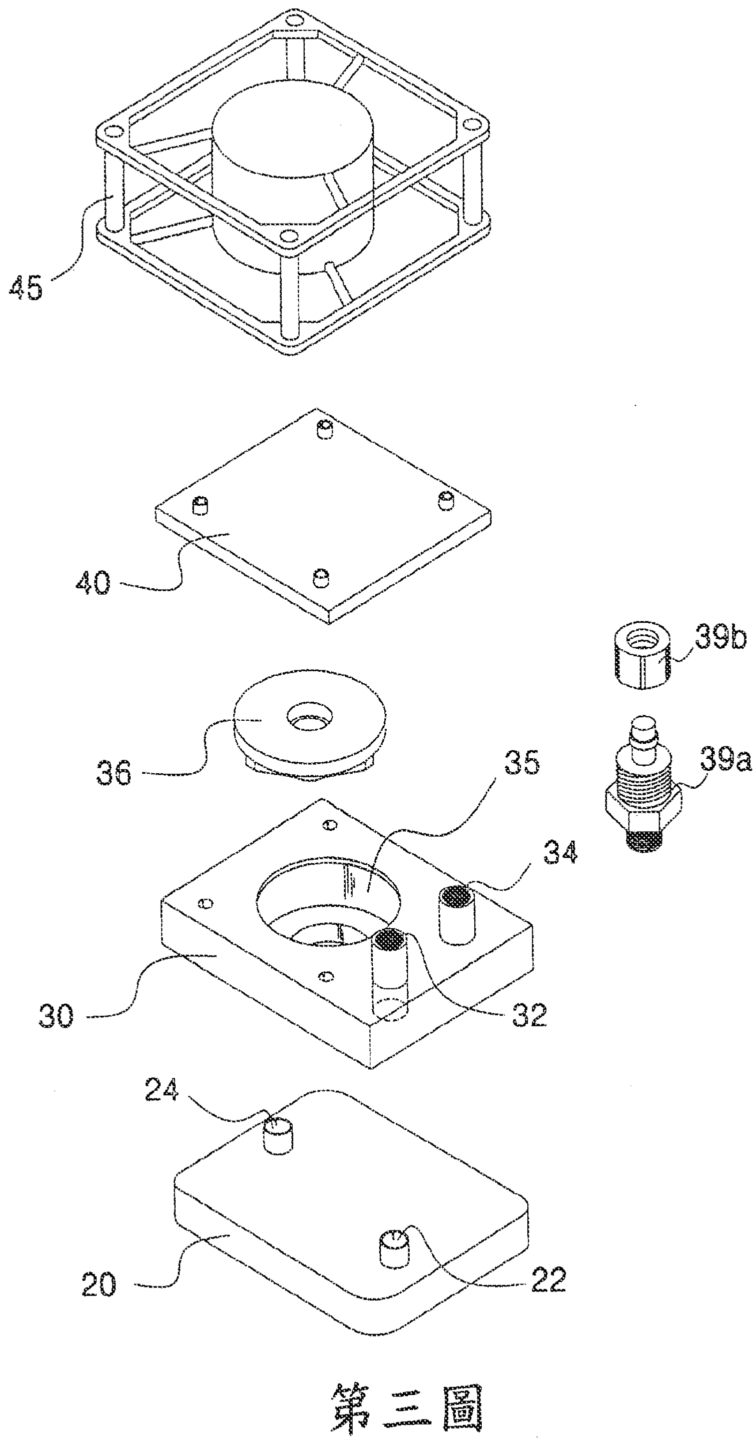


第二A圖

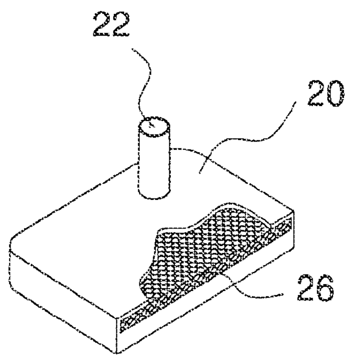


(b)

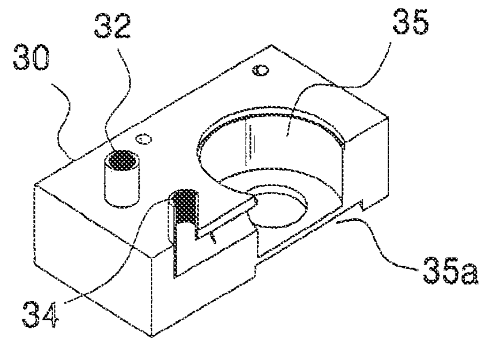
第二B圖



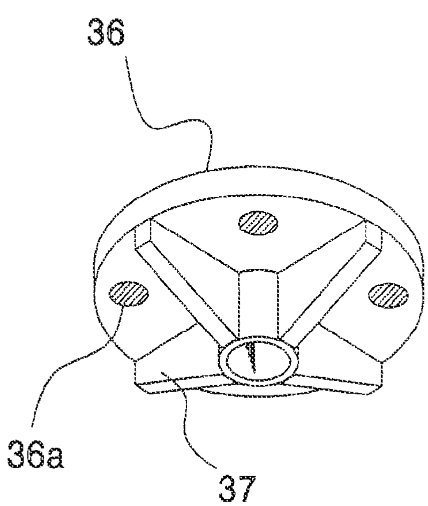
第三圖



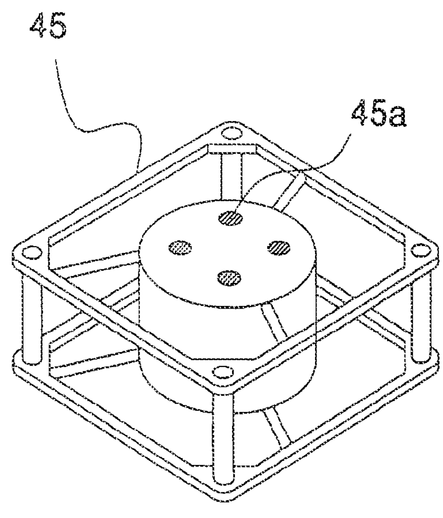
第四A圖



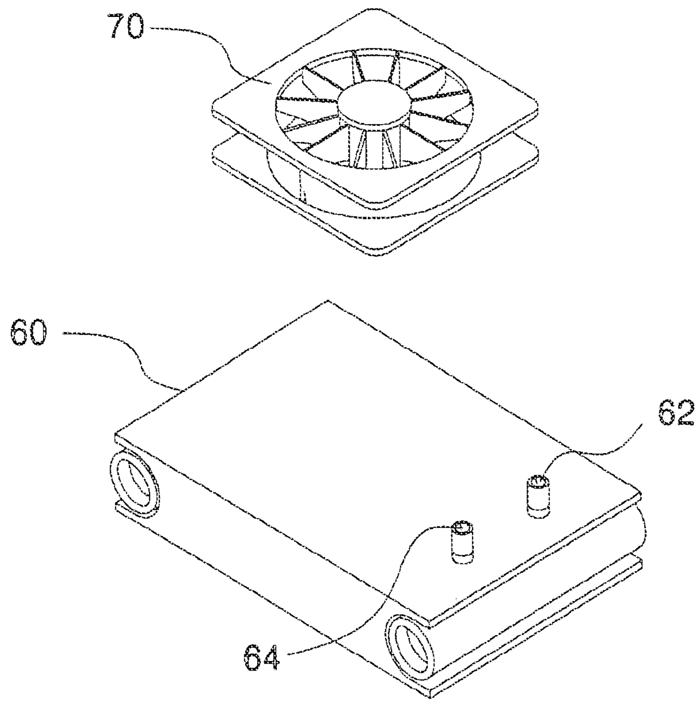
第四B圖



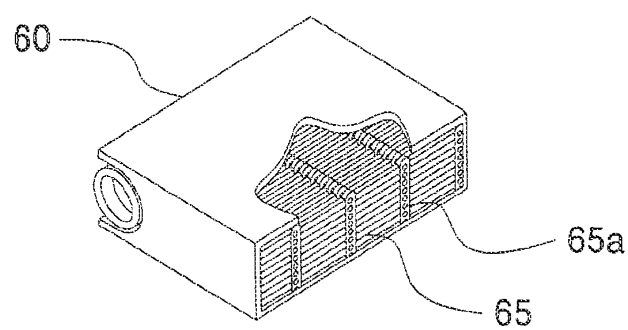
第四C圖



第四D圖



第五A圖



第五B圖

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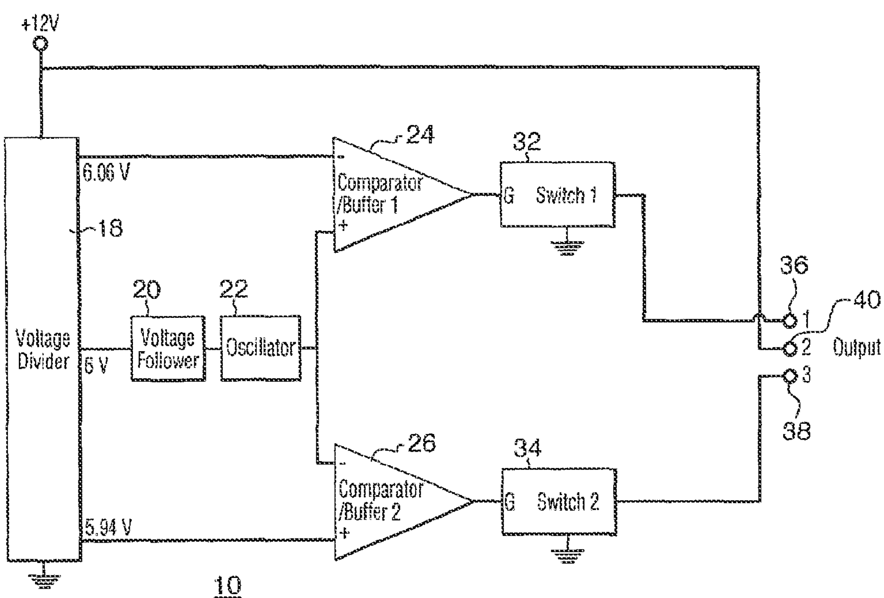
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: INVERTER



(57) Abstract: AC to DC inverters that are formed from electronic switches, such as MOSFETs, that are controlled by gating pulses obtained from comparators. The comparators compare a varying signal against two closely spaced reference voltages so as to provide gating pulses with delays needed to prevent shoot-through in the electronic switches.

WO 03/055055 A1

INVERTER

The invention relates to the field of DC-to-AC inverters and, in particular, to DC-to-AC inverters for use with AC synchronous motors.

Background

In many cases it is necessary or desirable to power AC synchronous motors from a single voltage DC supply voltage. Typically, MOSFETs or other electronic switches are used to invert DC to AC power. Conventionally, inverters include driver circuits that require dual polarity supply voltages that may not be readily available in some applications.

Driver circuits must provide protection against shoot-through for the inverter to operate safely and efficiently.

There is a need for a driver circuit that can operate efficiently from a single polarity DC supply voltage with a minimum of components.

Brief Description of the Drawings

Figure 1 is a block diagram of one preferred embodiment of the invention.

Figure 2 is a block diagram of a second preferred embodiment of the invention.

Figure 3 is an idealized timing diagram of signals that would be measured in the block diagrams of Figures 1 and 2 during operation.

Figures 4A, 4B, 4C, and 4D are variants of the block diagram of Figure 2 in which MOSFETs are used as electronic switches.

Figures 5, 6, 7, and 8 are an idealized timing diagrams of signals that would be measured in the block diagrams of Figures 4A, 4B, 4C, and 4D, respectively, during operation.

Figure 9 is a block diagram of a third preferred embodiment of the invention.

Figure 10 is an idealized timing diagram of signals that would be measured in the block diagram of Figure 9 during operation.

Figure 11 is an exemplary schematic circuit diagram corresponding to the block diagram of Figure 1.

Figure 12 is an exemplary schematic circuit diagram corresponding to the block diagram of Figure 4B.

Figure 13 is an exemplary schematic circuit diagram corresponding to the block diagram of Figure 9.

Detailed Description

The circuits shown in block diagram form in Figures 1, 2, and 9 are preferred embodiments of the invention. They are specifically designed to power a small AC synchronous pump operating at a frequency of 60 Hz for use in circulating coolant in a fluid-cooling system for a personal computer, but could be used with advantage for other purposes that will be evident to those skilled in the art. The circuit indicated generally by reference numeral 10 in Figure 1 is designed to power a pump motor having a center-tapped winding. The circuits indicated generally by reference numeral 12 in Figure 2, reference numerals 14, 15, 16, and 17 in Figures 4A – 4D, and reference numeral 62 in Figure 9 are designed to power a pump motor requiring 60 Hz AC across its winding.

The circuits 10, 12 shown in Figures 1 and 2 use what will be referred to herein as "electronic switches". All that is assumed about the electronic switches in the discussion of Figures 1 and 2 is that electronic switches have a control terminal indicated by reference letter G, which when a voltage is applied to it closes a connection between two other terminals that are referred to herein as "switched terminals" and keeps the connection closed until the applied voltage stops. Figures 1 and 2 are intended to illustrate the overall concept; as will be discussed below, additional circuit elements may be required to be added to Figure 2 depending upon the type of electronic switch used. Specifically, modified block diagrams for the use of MOSFETs as electronic switches are provided in Figures 4A – 4D and in Figure 9.

One limitation of all known electronic switches is that they do not operate instantaneously. For that reason, in many applications a short delay must be provided between the time one switch is turned off and the time another switch is turned on. For example, not providing a delay in the circuit 10 shown in Figure 1 would cause reduced efficiency in the center-tapped pump motor connected to the output of the circuit because current could flow from the center tap through both halves of the motor winding at the same time in opposite directions if both of the switches were on simultaneously. In the circuits 12, 14, 15, 16, 17, 62 shown in Figures 2, 4A – 4D, and 9 lack of a delay could cause excessive current through the switches, possibly destroying them, because a current could flow directly through the both pairs of switches to ground without passing through the motor winding if all of the switches stayed closed long enough. In all circuits a delay is provided by the combination of a voltage divider 18, a voltage follower 20, an oscillator 22, and a first comparator and a second comparator, labeled with reference numerals 24 and 26, respectively, in Figures 1 and 2, with reference numerals 28 and 30, respectively, in Figures 4A – 4D, and with reference numerals 64, 66, 68, and 70 in Figure 9.

A distinction is drawn between the comparators 24, 26 used in Figures 1 and 2 and the comparators 28, 30 used in Figures 4A – 4D. In the circuit 10, 12 shown in Figures 1 and 2, the comparators 24, 26 also function as buffers and are hereinafter referred to as "comparator/buffers 24, 26". For the same reason, the comparators 64, 66, 68, 70 shown in Figure 9 are hereinafter referred to as "comparator/buffers 64, 66, 68, 70".

In each circuit 10, 12, 14, 15, 16, 17, 62 the voltage divider 18 provides three closely spaced voltages from the DC supply voltage: an offset voltage half-way between the supply voltage and ground and two reference voltages bracketing the offset voltage and differing from it by approximately 1%. Specifically, if the supply voltage is 12 VDC, then the offset voltage is 6 VDC and the reference voltages are 5.94 VDC and 6.06 VDC.

The voltage follower 20 is connected between the offset voltage provided by the voltage divider 18 and the oscillator 22 so as to provide a low impedance 6 VDC source for the oscillator 22. The oscillator 22 is operational amplifier configured as a relaxation oscillator so as to produce a waveform that is approximately a triangular wave signal varying from approximately 4.5 volts to 7.5 volts. In general, the waveforms shown in the drawings and discussed herein are idealizations of the actual waveforms that would be observed in the circuits described herein. In particular, the spacing between the reference voltages shown in Figures 5A, 6A, 7A, 8A, and 10A is greatly exaggerated so that the resulting delays are more clearly visible in the drawings.

In all circuits 10, 12, 14, 15, 16, 17, the triangular waveform signal produced by the oscillator 18 is provided to both comparators 24, 26 or comparator/buffers 28, 30. In circuits 10, 12 shown in Figures 1 and 2, the triangular wave signal is provided to the non-inverting input terminal of the first comparator/buffer 24 and to the inverting input terminal of the second comparator/buffer 26. In the circuit 14 shown in Figure 4A, the triangular wave signal is provided to the non-inverting input terminal of the first comparator 28 and to the inverting input terminal of the second comparator 30. In the circuit 15 shown in Figure 4B, the triangular wave is provided to the non-inverting input terminals of both comparators 28, 30. In the circuit 16 shown in Figure 4C, the triangular wave is provided to the inverting input terminals of both comparators 28, 30. In the circuit 17 shown in Figure 4D, the triangular wave signal is provided to the inverting input terminal of the first comparator 28 and to the non-inverting input terminal of the second comparator 30. The corresponding connections in circuit 62 shown in Figure 9 are discussed below.

The input terminal of each of comparators or comparator/buffers not connected to the oscillator 22 is connected to one or the other of the reference voltages provided by the voltage divider 18. In the circuits 10, 12 shown in Figures 1 and 2, the inverting input terminal of the first comparator/buffer 24 is connected to the 6.06 VDC reference voltage and the non-inverting input terminal of the second comparator/buffer 26 is connected to the 5.94 VDC reference voltage. In the circuit 14 shown in Figure 4A, the inverting input terminal of the first comparator 28 is connected to the 6.06 VDC reference voltage and the non-inverting input terminal of the second comparator 30 is connected to the 5.94 VDC reference voltage. In the circuit 15 shown in Figure 4B, the inverting input terminal of the first comparator 28 is connected to the 6.06 VDC reference voltage and the inverting input terminal of the second comparator 30 is connected to the 5.94 VDC reference voltage. In the circuit 16 shown in Figure 4C, the non-inverting input terminal of the first comparator 28 is connected to the 6.06 VDC reference voltage and the non-inverting input terminal of the second comparator 30 is connected to the 5.94 VDC reference voltage. In the circuit 17 shown in Figure 4D, the non-inverting input terminal of the first comparator 28 is connected to the 6.06 VDC reference voltage and the inverting input terminal of the second comparator 30 is connected to the 5.94 VDC reference voltage. The corresponding connections in circuit 62 shown in Figure 9 are discussed below.

In the circuit 10 shown in Figure 1, the comparator/buffer 24 is connected to the control terminal of a first electronic switch 32 and the comparator/buffer 26 is connected to the control terminal of a second electronic switch 34. The electronic switches 32, 34 each have two switched terminals that are effectively connected together when a control voltage is applied to their control terminals. One switched terminal of first electronic switch 32 is connected to a first output terminal 36 and the other switched terminal of first electronic switch 32 is connected to ground. Similarly, one switched terminal of second electronic switch 34 is connected to a second output terminal 38 and the other switched terminal of second electronic switch 28 is connected to ground. A third output terminal 40 is connected to the 12VDC supply voltage. In the application for which the circuit 10 of Figure 1 was designed, the first and second output terminals 36, 38 are for connection to opposite ends of the winding of a pump motor (not shown in Figure 1). The third output terminal 40 is for connection to a center tap of the winding of the pump motor.

In the circuit 12 shown in Figure 2, the comparator/buffer 24 is connected to the control terminal of a second electronic switch 44 and to the control terminal of a third electronic switch 46. The comparator/buffer 26 is connected to the control terminal of a first electronic switch 42 and to the control terminal of a fourth electronic switch 48. The electronic switches 42, 44, 46, 48 each have two switched terminals that are effectively connected together when a control voltage is applied to their control terminals. One switched terminal of first electronic switch 42 and one switched terminal of the third electronic switch 46 are connected to the 12VDC supply voltage. One switched terminal of second electronic switch 44 and one switched terminal of the fourth electronic switch 48 are connected to ground. The other switched terminals of the first electronic switch 42 and the second electronic switch 44 are connected to a first output terminal 50. The other switched terminals of the third electronic switch 46 and the fourth electronic switch 48 are connected to a second output terminal 52. The resulting circuit configuration of electronic switches 42, 44, 46, 48 is commonly referred to as an H-bridge. In the application for which the circuit 12 of Figure 2 was designed, the first and second output terminals 50, 52 are for connection to a pump motor.

Figure 3 is a combined timing diagram for the circuit 10 shown in Figure 1 that also applies to the circuit 12 shown in Figure 2. The output of the oscillator 22 is shown in Figure 3A and the outputs of the first and second comparator/buffers 24, 26 are shown in Figures 3B and 3C, respectively, when the circuit 10, 12 is connected to a 12 VDC supply. The comparator/buffer 24 produces at its output terminal a train of positive-going pulses shown in Figure 3B each of which lasts from the time that the triangular wave signal shown in Figure 3A from the oscillator 22 rises above 6.06 VDC and ends when that signal drops below 6.06 VDC The comparator/buffer 26 produces at its output terminal a train of positive-going pulses each of which lasts from the time that the triangular wave signal shown in Figure 3A from the oscillator 22 drops below 5.94 VDC and ends when that signal rises above 5.94 VDC. As can be seen from Figures 3B and 3C, the two trains of pulses alternately go positive and are spaced so that the rise of a pulse from one train is delayed following the fall of the last pulse from the other train.

When the circuit 10 shown in Figure 1 is provided with a 12 VDC supply voltage and connected to a center-tap winding pump motor at the output terminals 36, 38, 40, then whenever a voltage pulse arrives from the first comparator/buffer 24 at the control terminal of the first electronic switch 32, the first electronic switch 32 closes so as to connect the end of the winding of the pump motor that is connected to output terminal 36 to ground. Conversely, whenever a voltage pulse arrives from the second comparator/buffer 26 at the control terminal of the second electronic switch 34, then the second electronic switch 34 closes so as to connect the end of the winding of the pump motor that is connected to output terminal 38 to ground. The result is that a current will flow, induced by the application of the 12 VDC supply voltage, through half of the winding of the pump motor and to ground through the electronic switch 32, 34 that is closed for as long as the pulse presented to the control terminal of the electronic switch 32, 34 lasts. In operation, a voltage is applied alternately to the control terminals of the electronic switches 32, 34, so that current will alternately flow in opposite directions through alternate halves of the pump motor winding. Due to the delay discussed above, the electronic switches 32, 34 will not be closed at the same time, thereby preventing current from flowing in both halves of the winding at the same time, a situation that would tend to reduce the efficiency of the pump motor. If the pump motor winding were a purely resistive load, the resulting voltage across the output terminals 36, 38 would be as is shown in Figure 3D.

The operation of the circuit 12 shown in Figure 2 is somewhat different from that of the circuit 10 shown in Figure 1, although the timing diagram of Figure 3 also applies. When the circuit 12 shown in Figure 2 is provided with a 12 VDC supply voltage and connected to a pump motor at the output terminals 50, 52, then whenever a voltage pulse arrives from the first comparator/buffer 24 at the control terminals of the second and third electronic switches 44, 46, the second electronic switch 44 closes so as to connect the first output terminal 50 to ground and the third electronic switch 46 also closes to connect the second output terminal 52 to the 12 VDC supply voltage. Conversely, whenever a voltage pulse arrives from the second comparator/buffer 26 at the control terminals of the first and fourth electronic switches 42, 48, the fourth electronic switch 48 closes so as to connect the second output terminal 52 to ground and the first electronic switch 42 also closes to connect the first output terminal 50 to the 12 VDC supply voltage. In operation, current will alternately flow in opposite directions through the pump motor winding. Due to the delay discussed above, the first and fourth electronic switches 42, 48 will not be closed at the same time that the second and third electronic switches 44, 46 are closed, thereby preventing current from bypassing the pump motor and flowing directly through in two paths, one through both the first and second electronic switches 42, 44 and the other through both the third and fourth electronic switches 46, 48, a situation that could destroy the electronic switches 42, 44, 46, 48. If the pump motor winding were a purely resistive load, the resulting voltage across the output terminals 50, 52 would be as is shown in Figure 3D.

However, the circuit 12 shown in Figure 2 will not operate properly if all N-channel MOSFETs are used as electronic switches 42, 44, 46, 48 because the circuit cannot supply sufficient positive gate voltage. Preferably, P-channel MOSFETs should be used for first and third electronic switches 42, 46, as will now be described in relation to Figures 4A, 4B, 4C, and 4D.

The circuit 14 shown in Figure 4A is a modification of the circuit 12 shown in Figure 2 in which first and third electronic switches 42, 46 are P-channel MOSFETs and the second and fourth electronic switches 44, 48 are N-channel MOSFETs. In addition, a first buffer 54 has been added between the comparator 28 and the second electronic switch 44, a first buffer/inverter 56 has been added between the comparator 28 and the third electronic switch 46, a second buffer/inverter 58 has been added between the comparator 30 and the first electronic switch 42, and a second buffer 60 has been added between the comparator 30 and the fourth electronic switch 48.

The operation of the circuit 14 shown in Figure 4A is similar to that of the circuit 12 shown in Figure 2, with the exception that pulses to the P-channel MOSFETs used as the first and third electronic switches 42, 46 must be inverted due to the characteristics of P-channel MOSFETs. The first and second buffer/inverters 56, 58 provide the inversion as well as buffering. The first and second buffers 54, 60 simply provide buffering between the comparators 28, 30 and the second and fourth electronic switches 44, 48 as the N-channel MOSFETs used for those electronic switches do not require inversion. Figure 5 is a timing diagram for the circuit 14. Figure 5A shows the output of oscillator 22. Figures 5B and 5C show the outputs of the first and second comparators 28, 30. Figures 5D, 5E, 5F, and 5G show the inputs to the control terminals of the second, third, fourth and first electronic switches, respectively. Figure 5H shows the output voltage across a resistive load connected between the output terminals 50, 52.

The circuit 15 shown in Figure 4B is a variant of the circuit 14 shown in Figure 4A. The only differences are that the inputs of the second comparator 30 have been reversed and the output connections of the second buffer/inverter 58 and the second buffer 60 have been interchanged so that the second buffer/inverter 58 is connected to the fourth electronic switch 48 and the second buffer 60 is connected to the first electronic switch 42. Because the reversal of inputs to the second comparator 30 cancels out the interchanging of the output connections of the second buffer/inverter 58 and the second buffer 60, the resulting pulse train applied to the electronic switches 42, 44, 46, 48 is unchanged. Figure 6 is a timing diagram for the circuit 15. Figure 6A shows the output of oscillator 22. Figures 6B and 6C show the outputs of the first and second comparators 28, 30. Figures 6D, 6E, 6F, and 6G show the inputs to the control terminals of the second, third, fourth and first electronic switches, respectively. Figure 6H shows the output voltage across a resistive load connected between the output terminals 50, 52.

The circuit 16 shown in Figure 4C is a further variant of the circuit 14 shown in Figure 4A. The inputs of both the first comparator 28 and the second comparator 30 have been reversed. To provide the same gate signals as provided in circuits 14 and 15, the output connection of the first buffer 54 is connected to the first electronic switch 42, the output connection of the first buffer/inverter 56 is connected to the fourth electronic switch 48, the output connection of the second buffer 60 is connected to the second electronic switch 44, and the second buffer/inverter 58 is connected to the third electronic switch 46. The resulting pulse train applied to the electronic switches 42, 44, 46, 48 is unchanged. Figure 7 is a timing diagram for the circuit 16. Figure 7A shows the output of oscillator 22. Figures 7B and 7C show the outputs of the first and second comparators 28, 30. Figures 7D, 7E, 7F, and 7G show the inputs to the control terminals of the second, third, fourth and first electronic switches, respectively. Figure 7H shows the output voltage across a resistive load connected between the output terminals 50, 52.

The circuit 17 shown in Figure 4D is a further variant of the circuit 16. The only differences are that the inputs of the second comparator 30 have been reversed and the output connections of the second buffer/inverter 58 and the second buffer 60 have been interchanged so that the second buffer/inverter 58 is connected to the third electronic switch 46 and the second buffer 60 is connected to the second electronic switch 44. Because the reversal of inputs to the second comparator 30 cancels out the interchanging of the output connections of the second buffer/inverter 58 and the second buffer 60, the resulting pulse train applied to the electronic switches 42, 44, 46, 48 is unchanged. Figure 8 is a timing diagram showing for the circuit 17 shown in Figure 4D. Figure 8A shows the output of oscillator 22. Figures 8B and 8C show the outputs of the first and second comparators 28, 30. Figures 8D, 8E, 8F, and 8G show the inputs to the control terminals of the second, third, fourth and first electronic switches, respectively. Figure 8H shows the output voltage across a resistive load connected between the output terminals 50, 52.

In the circuits 14, 15, 16, 17 shown in Figures 4A – 4D, the buffers 54, 60 are optional, as is the buffering function provided by the buffer/inverters 56, 58. However, buffering is preferred.

Figure 9 shows another alternative circuit 62 for use with MOSFETs as electronic switches in which four comparators/buffers and no inverters are used. A separate comparator/buffer is used for each MOSFET. The circuit 62 shown in Figure 9 is identical to the circuits 14, 15, 16, 17 shown in Figures 4A, 4B, 4C, and 4D up to the point at which the two reference voltages and the oscillator output are provided to comparators. However, rather than using buffer/inverters 58, 60 to obtain proper gate signals for the P-channel MOSFETs, two additional comparator/buffers are added in parallel with the two comparators used in circuits 14, 15, 16, 17, but with their inputs reversed so as to provide inverted pulses. More specifically, the triangular waveform signal produced by the oscillator 18 is provided to the inverting input terminal of a first comparator/buffer 64, the inverting input terminal of a second comparator/buffer 66, the non-inverting input terminal of a third comparator/buffer 68, and the non-inverting input terminal of a fourth comparator/buffer 70. The non-inverting input terminal of a first comparator/buffer 64 and the non-inverting input terminal of a second comparator/buffer 66 are connected to the 6.06 VDC reference voltage and the inverting input terminal of a third comparator/buffer 68 and the inverting input terminal of a fourth comparator/buffer 70 are connected to the 5.94 VDC reference voltage. The output of the first comparator/buffer 64 is connected to the gate of the first electronic switch 42, the output of the second comparator/buffer 66 is connected to the gate of the second electronic switch 44, the output of the third comparator/buffer 68 is connected to the gate of the third electronic switch 46, and output of the fourth comparator/buffer 70 is connected to the gate of the fourth electronic switch 48. As in the circuits 14, 15, 16, 17 shown in Figures 4A, 4B, 4C, and 4D, the first and third electronic switches are P-channel MOSFETs and the second and fourth electronic switches are N-channel MOSFETs.

Figure 10 is a timing diagram showing for the circuit 62 shown in Figure 9. Figure 10A shows the output of oscillator 22. Figures 10B, 10C, 10D and 10E show the outputs of the first, second, third, and fourth comparators 64, 66, 68, 70, respectively, as well as the inputs to the control terminals of the first, second, third, and fourth electronic switches 42, 44, 46, 48, respectively. Figure 10F shows the output voltage across a resistive load connected between the output terminals 50, 52. Figure 10G shows the output voltage across an inductive load connected between the output terminals 50, 52.

Figures 11, 12, and 13 are schematic circuit diagrams showing examples of how the circuits 10, 15, 62 shown in block diagram form in Figures 1, 4B, and 9 may be constructed. The subcircuits corresponding to the blocks of Figures 1, 4B, and 9 are labeled with corresponding reference numerals. All resistors are ¼ watt 1%, unless otherwise indicated. The operational amplifiers are provided, for example, by LM324 integrated circuits. In Figure 11, Q1 and Q2 are IRFZ44N MOSFETs in TO220 cases. In Figures 12 and 13, Q1 and Q3 are IRF5305 MOSFETs and Q2 and Q4 are IRFZ44N MOSFETs, all of which are in TO220 cases. Other MOSFETs may be used, as well as other case sizes. The component values shown in the oscillator subcircuit 20 in Figures 11, 12, and 13 are selected to provide a 60 Hz triangular waveform reference signal. The circuits 14, 16, 17 shown in block diagram form in Figures 4A, 4C, and 4D may be constructed using the same component values.

In the exemplary circuits shown in Figures 11, 12, and 13, a resistive voltage ladder is used to provide the voltage divider 18. The resistance of the resistor that connects to the 12V supply and that is shown as a 10K resistor in the resistive voltage ladder in Figures 11, 12, and 13 should be adjusted to obtain a triangular waveform at the output of the oscillator that is rising for approximately the same time as it is falling. Otherwise a net DC voltage may develop across the output terminals. Changing the value of that resistor will, of course, change the values of the reference voltages and the DC-offset voltage, but will have little effect on the difference between the reference voltages.

Bipolar transistors may be used rather than MOSFETs in all of the circuits shown. However, as those skilled in the art will understand, external diodes are then required to limit fly-back voltage from an inductive load such as a pump motor winding, and the circuits will be less efficient due to the approximately 0.5 V drop across the bipolar transistors when they are switched on.

All circuits 10, 12, 14, 15, 16, 17, 62 shown in Figures 1, 2, 4A, 4B, 4C, 4D, and 9 are designed to be powered by a single polarity 12 volt DC supply, but may be adapted to dual polarity supplies by eliminating the voltage follower 20 and connecting the oscillator to ground. The ground connections shown in those drawings would then be connected to the negative polarity DC supply. For example, if a dual polarity 6 V supply with a ground were available, the +12 V terminal would be connected to the +6 V supply, the ground shown would be connected to the –6 V supply, and the oscillator would be connected to the ground.

The circuits presented herein may be used with advantage in applications other than providing AC power at a fixed frequency to a pump motor. For example, the frequency of the waveform provided by the oscillator may be controlled so as to vary the frequency of the output and slope of the waveform as it crosses the reference voltages may be varied to vary the power output by varying the time during which all of the electronic switches are off. Possible applications may include control of motor speed and light intensity.

Other embodiments will be apparent to those skilled in the art and, therefore, the invention is defined in the claims.

What is claimed is:

1. An electronic circuit for driving an AC synchronous motor having a center-tapped winding from a DC supply current, comprising:

a first DC input terminal and a second DC input terminal, the first DC input terminal for connection to the DC supply current at a more positive voltage than the second DC input terminal;

three output terminals for connection to the motor winding, the first and third output terminals for connection to the respective end taps of the motor winding and the second output terminal connected to the second output terminal and for connection to the center tap of the motor winding;

a voltage reference source for providing a first reference voltage and a second reference voltage, the first reference voltage more positive that the second reference voltage when the DC input terminals are connected to the DC supply current;

a signal generator connected to the voltage reference source so as to provide a reference signal varying between a maximum voltage that is more positive that the first reference voltage and a minimum voltage that is less positive than the second reference voltage;

a first comparator/buffer connected to the signal generator and the voltage reference source so as to compare the reference signal to the first reference voltage and provide as an output a first series of positive-going output pulses each lasting during the time that the reference signal is more positive than the first reference voltage;

a second comparator/buffer connected to the signal generator and the voltage reference source so as to compare the reference signal to the second reference voltage and provide as an output a second series of positive-going output pulses each lasting during the time that the reference signal is less positive than the second reference voltage;

a first electronic switch having a control terminal connected to the output of the first comparator/buffer, a first switched terminal connected to the first output terminal, and a second switched terminal connected to the second DC input terminal, the two switched terminals connected together while an output pulse is applied to the control terminal; and

a second electronic switch having a control terminal connected to the output of the second comparator/buffer, a first switched terminal connected to the third output terminal, and a second switched terminal connected to the second DC input terminal, the two switched terminals connected together while an output pulse is applied to the control terminal.

2. The electronic circuit as defined in claim 1, wherein the waveform of the reference signal is preselected so that the reference signal crosses the voltage range between the reference voltages in a preselected time and remains more positive than the first reference voltage for approximately the same time that it remains below the second reference voltage.

3. The electronic circuit as defined in claim 2, wherein:

the first electronic switch is an N-channel MOSFET, the gate of which is connected to the output of the first comparator/buffer, the source of which is connected to the second DC input terminal, and the drain of which is connected to the first output terminal; and

the second electronic switch is an N-channel MOSFET, the gate of which is connected to the output of the second comparator/buffer, the source of which is connected to the second DC input terminal, and the drain of which is connected to the third output terminal.

4. The electronic circuit as defined in claim 3, wherein the voltage reference source comprises a voltage divider connected between the first DC input terminal and the second DC input terminal, the voltage divider providing the first reference voltage and the second reference voltage;

5. The electronic circuit as defined in claim 4, wherein the voltage divider comprises a resistive voltage ladder.

6. The electronic circuit as defined in claim 5, wherein the resistive voltage ladder further provides a DC-offset reference voltage between the first reference voltage and the second reference voltage and the electronic circuit further comprises a voltage follower connected between the resistive voltage ladder and the signal generator so as to provide the DC-offset reference voltage to the signal generator.

7. The electronic circuit as defined in claim 6, wherein:

the signal generator comprises an operational amplifier configured as a relaxation oscillator so that the time-varying signal has a generally triangular waveform;

the voltage follower comprises an operational amplifier; and

the comparator/buffers comprise operational amplifiers.

8. A DC to AC inverter for providing an AC output current from a DC supply current, comprising:

a first DC input terminal and a second DC input terminal, the first DC input terminal for connection to the DC supply current at a more positive voltage than the second DC input terminal;

first and second output terminals for connection to a device requiring the AC output current;

a voltage reference source for providing a first reference voltage and a second reference voltage, the first reference voltage more positive that the second reference voltage;

a signal generator for generating a reference signal that varies between a maximum voltage that is more positive that the first reference voltage and a minimum voltage that is less positive than the second reference voltage;

a first comparator connected to the signal generator and the voltage reference source so as to compare the reference signal to the first reference voltage and provide as an output a first series of output pulses;

a second comparator connected to the signal generator and the voltage reference source so as to compare the reference signal to the second reference voltage and provide as an output a second series of output pulses;

a third comparator connected to the signal generator and the voltage reference source so as to compare the reference signal to the second reference voltage and provide as an output a third series of output pulses;

a fourth comparator connected to the signal generator and the voltage reference source so as to compare the reference signal to the first reference voltage and provide as an output a fourth series of output pulses;

a first electronic switch having a control terminal, a first switched terminal, and a second switched terminal, the two switched terminals connected together while an output pulse is applied to the control terminal, the control terminal connected to the output of the first comparator, the first switched terminal connected to the first DC input terminal, and the second switched terminal connected to the first output terminal;

a second electronic switch having a control terminal, a first switched terminal, and a second switched terminal, the two switched terminals connected together while an output pulse is applied to the control terminal, the control terminal connected to the output of the second comparator, the first switched terminal connected to the first output terminal, and the second switched terminal connected to the second DC input terminal;

a third electronic switch having a control terminal, a first switched terminal, and a second switched terminal, the two switched terminals connected together while an output pulse is applied to the control terminal, the control terminal connected to the output of the third comparator, the first switched terminal connected to the first DC input terminal, and the second switched terminal connected to the second output terminal; and

a fourth electronic switch having a control terminal, a first switched terminal, and a second switched terminal, the two switched terminals connected together while an output pulse is applied to the control terminal, the control terminal connected to the output of the fourth comparator, the first switched terminal connected to the second output terminal, and the second switched terminal connected to the second DC input terminal.

9. The electronic circuit as defined in claim 8, wherein the waveform of the reference signal is preselected so that the reference signal crosses the voltage range between the reference voltages in a preselected time and remains more positive than the first reference voltage for approximately the same time that it remains below the second reference voltage.

10. The DC to AC inverter as defined in claim 9, wherein:

the first series of output pulses are positive-going pulses each lasting during the time that the reference signal is less positive than the first reference voltage;

the second series of output pulses are positive-going pulses each lasting during the time that the reference signal is less positive than the second reference voltage;

the third series of output pulses are positive-going pulses each lasting during the time that the reference signal is more positive than the second reference voltage;

the fourth series of output pulses are positive-going pulses each lasting during the time that the reference signal is more positive than the first reference voltage;

the first electronic switch is an P-channel MOSFET, the gate of which is connected to the output of the first comparator, the source of which is connected to the first output terminal, and the drain of which is connected to the first DC input terminal;

the second electronic switch is an N-channel MOSFET, the gate of which is connected to the output of the second comparator, the source of which is connected to the second DC input terminal, and the drain of which is connected to the first output terminal;

the third electronic switch is an P-channel MOSFET, the gate of which is connected to the output of the third comparator, the source of which is connected to second output terminal, and the drain of which is connected to the first DC input terminal; and

the fourth electronic switch is an N-channel MOSFET, the gate of which is connected to the output of the fourth comparator, the source of which is connected to the second DC input terminal, and the drain of which is connected to the second output terminal.

11. The electronic circuit as defined in claim 10, wherein the voltage reference source comprises a voltage divider connected between the first DC input terminal and the second DC input terminal, the voltage divider providing the first reference voltage and the second reference voltage;

12. The electronic circuit as defined in claim 11, wherein the voltage divider comprises a resistive voltage ladder.

13. The electronic circuit as defined in claim 12, wherein the resistive voltage ladder further provides a DC-offset reference voltage between the first reference voltage and the second reference voltage and the electronic circuit further comprises a voltage follower connected between the resistive voltage ladder and the signal generator so as to provide the DC-offset reference voltage to the signal generator.

14. The electronic circuit as defined in claim 13, wherein:

the signal generator comprises an operational amplifier configured as a relaxation oscillator so that the time-varying signal has a generally triangular waveform;

the voltage follower comprises an operational amplifier; and

the comparators comprise operational amplifiers.

15. A DC to AC inverter for providing an AC output current from a DC supply current, comprising:

a first DC input terminal and a second DC input terminal, the first DC input terminal for connection to the DC supply current at a more positive voltage than the second DC input terminal;

first and second output terminals for connection to a device requiring the AC output current;

a voltage reference source for providing a first reference voltage and a second reference voltage, the first reference voltage more positive that the second reference voltage;

a signal generator for generating a reference signal that varies between a maximum voltage that is more positive that the first reference voltage and a minimum voltage that is less positive than the second reference voltage;

a first comparator connected to the signal generator and the voltage reference source so as to compare the reference signal to the first reference voltage and provide as an output a first series of output pulses;

a second comparator connected to the signal generator and the voltage reference source so as to compare the reference signal to the second reference voltage and provide as an output a second series of output pulses;

a first electronic switch having a control terminal, a first switched terminal, and a second switched terminal, the two switched terminals connected together while an output pulse is applied to the control terminal, the control terminal connected to the output of the second comparator, the first switched terminal connected to the first DC input terminal, and the second switched terminal connected to the first output terminal;

a second electronic switch having a control terminal, a first switched terminal, and a second switched terminal, the two switched terminals connected together while an output pulse is applied to the control terminal, the control terminal connected to the output of the first comparator, the first switched terminal connected to the first output terminal, and the second switched terminal connected to the second DC input terminal;

a third electronic switch having a control terminal, a first switched terminal, and a second switched terminal, the two switched terminals connected together while an output pulse is applied to the control terminal, the control terminal connected to the output of the first comparator, the first switched terminal connected to the first DC input terminal, and the second switched terminal connected to the second output terminal; and

a fourth electronic switch having a control terminal, a first switched terminal, and a second switched terminal, the two switched terminals connected together while an output pulse is applied to the control terminal, the control terminal connected to the output of the second comparator, the first switched terminal connected to the second output terminal, and the second switched terminal connected to the second DC input terminal.

16. The DC to AC inverter as defined in claim 15, wherein the waveform of the reference signal is preselected so that the reference signal crosses the voltage range between the reference voltages in a preselected time and remains more positive than the first reference voltage for approximately the same time that it remains below the second reference voltage.

17. The DC to AC inverter as defined in claim 16, wherein:

the first comparator provides as an output a first series of positive-going output pulses each lasting during the time that the reference signal is more positive than the first reference voltage; and

the second comparator provides as an output a second series of positive-going output pulses each lasting during the time that the reference signal is less positive than the second reference voltage,

further comprising:

a first buffer connected to the output of the first comparator so as to buffer the first comparator and provide the first series of positive-going output pulses at its output;

a first buffer/inverter connected to the output of the first comparator so as to buffer the first comparator and provide a series of zero-going output pulses that are the inverse of the first series of positive-going output pulses at its output;

a second buffer connected to the output of the second comparator so as to buffer the second comparator and provide the second series of positive-going output pulses at its output;

a second buffer/inverter connected to the output of the second comparator so as to buffer the second comparator and provide a series of zero-going output pulses that are the inverse of the second series of positive-going output pulses at its output, and

wherein:

the first electronic switch is an P-channel MOSFET, the gate of which is connected to the output of the second buffer/inverter, the source of which is connected to the first output terminal, and the drain of which is connected to the DC input terminal;

the second electronic switch is an N-channel MOSFET, the gate of which is connected to the output of the first buffer, the source of which is connected to the second DC input terminal, and the drain of which is connected to the first output terminal;

the third electronic switch is an P-channel MOSFET, the gate of which is connected to the output of the first buffer/inverter, the source of which is connected to second output terminal, and the drain of which is connected to the DC input terminal; and

the fourth electronic switch is an N-channel MOSFET, the gate of which is connected to the output of the second buffer, the source of which is connected to the second DC input terminal, and the drain of which is connected to the second output terminal.

18. The electronic circuit as defined in claim 17, wherein the voltage reference source comprises a voltage divider connected between the first DC input terminal and the second DC input terminal, the voltage divider providing the first reference voltage and the second reference voltage;

19. The electronic circuit as defined in claim 18, wherein the voltage divider comprises a resistive voltage ladder.

20. The electronic circuit as defined in claim 19, wherein the resistive voltage ladder further provides a DC-offset reference voltage between the first reference voltage and the second reference voltage and the electronic circuit further comprises a voltage follower connected between the resistive voltage ladder and the signal generator so as to provide the DC-offset reference voltage to the signal generator.

21. The electronic circuit as defined in claim 20, wherein:

the signal generator comprises an operational amplifier configured as a relaxation oscillator so that the time-varying signal has a generally triangular waveform;

the voltage follower comprises an operational amplifier;

the comparators comprise operational amplifiers; and

the buffers and buffer/inverters comprise operational amplifiers.

22. The DC to AC inverter as defined in claim 16, wherein:

the first comparator provides as an output a first series of positive-going output pulses each lasting during the time that the reference signal is more positive than the first reference voltage; and

the second comparator provides as an output a second series of positive-going output pulses each lasting during the time that the reference signal is more positive than the second reference voltage,

further comprising:

a first buffer connected to the output of the first comparator so as to buffer the first comparator and provide the first series of positive-going output pulses at its output;

a first buffer/inverter connected to the output of the first comparator so as to buffer the first comparator and provide a series of zero-going output pulses that are the inverse of the first series of positive-going output pulses at its output;

a second buffer connected to the output of the second comparator so as to buffer the second comparator and provide the second series of positive-going output pulses at its output; and

a second buffer/inverter connected to the output of the second comparator so as to buffer the second comparator and provide a series of zero-going output pulses that are the inverse of the second series of positive-going output pulses at its output, and

wherein:

the first electronic switch is an P-channel MOSFET, the gate of which is connected to the output of the second buffer, the source of which is connected to the first output terminal, and the drain of which is connected to the DC input terminal;

the second electronic switch is an N-channel MOSFET, the gate of which is connected to the output of the first buffer, the source of which is connected to the second DC input terminal, and the drain of which is connected to the first output terminal;

the third electronic switch is an P-channel MOSFET, the gate of which is connected to the output of the first buffer/inverter, the source of which is connected to second output terminal, and the drain of which is connected to the DC input terminal; and

the fourth electronic switch is an N-channel MOSFET, the gate of which is connected to the output of the second buffer/inverter, the source of which is connected to the second DC input terminal, and the drain of which is connected to the second output terminal.

23. The electronic circuit as defined in claim 22, wherein the voltage reference source comprises a voltage divider connected between the first DC input terminal and the second DC input terminal, the voltage divider providing the first reference voltage and the second reference voltage;

24. The electronic circuit as defined in claim 23, wherein the voltage divider comprises a resistive voltage ladder.

25. The electronic circuit as defined in claim 24, wherein the resistive voltage ladder further provides a DC-offset reference voltage between the first reference voltage and the second reference voltage and the electronic circuit further comprises a voltage follower connected between the resistive voltage ladder and the signal generator so as to provide the DC-offset reference voltage to the signal generator.

26. The electronic circuit as defined in claim 25, wherein:

the signal generator comprises an operational amplifier configured as a relaxation oscillator so that the time-varying signal has a generally triangular waveform;

the voltage follower comprises an operational amplifier;

the comparators comprise operational amplifiers; and

the buffers and buffer/inverters comprise operational amplifiers.

27. The DC to AC inverter as defined in claim 16, wherein:

the first comparator provides as an output a first series of positive-going output pulses each lasting during the time that the reference signal is less positive than the first reference voltage; and

the second comparator provides as an output a second series of positive-going output pulses each lasting during the time that the reference signal is less positive than the second reference voltage,

further comprising:

a first buffer connected to the output of the first comparator so as to buffer the first comparator and provide the first series of positive-going output pulses at its output;

a first buffer/inverter connected to the output of the first comparator so as to buffer the first comparator and provide a series of zero-going output pulses that are the inverse of the first series of positive-going output pulses at its output;

a second buffer connected to the output of the second comparator so as to buffer the second comparator and provide the second series of positive-going output pulses at its output; and a second buffer/inverter connected to the output of the second comparator so as to buffer the second comparator and provide a series of zero-going output pulses that are the inverse of the second series of positive-going output pulses at its output, and

wherein:

the first electronic switch is an P-channel MOSFET, the gate of which is connected to the output of the second buffer/inverter, the source of which is connected to the first output terminal, and the drain of which is connected to the DC input terminal;

the second electronic switch is an N-channel MOSFET, the gate of which is connected to the output of the first buffer/inverter, the source of which is connected to the second DC input terminal, and the drain of which is connected to the first output terminal;

the third electronic switch is an P-channel MOSFET, the gate of which is connected to the output of the first buffer, the source of which is connected to second output terminal, and the drain of which is connected to the DC input terminal; and

the fourth electronic switch is an N-channel MOSFET, the gate of which is connected to the output of the second buffer, the source of which is connected to the second DC input terminal, and the drain of which is connected to the second output terminal.

28. The electronic circuit as defined in claim 27, wherein the voltage reference source comprises a voltage divider connected between the first DC input terminal and the second DC input terminal, the voltage divider providing the first reference voltage and the second reference voltage;

29. The electronic circuit as defined in claim 28, wherein the voltage divider comprises a resistive voltage ladder.

30. The electronic circuit as defined in claim 29, wherein the resistive voltage ladder further provides a DC-offset reference voltage between the first reference voltage and the second reference voltage and the electronic circuit further comprises a voltage

follower connected between the resistive voltage ladder and the signal generator so as to provide the DC-offset reference voltage to the signal generator.

31. The electronic circuit as defined in claim 30, wherein:

the signal generator comprises an operational amplifier configured as a relaxation oscillator so that the time-varying signal has a generally triangular waveform;

the voltage follower comprises an operational amplifier;

the comparators comprise operational amplifiers; and

the buffers and buffer/inverters comprise operational amplifiers.

32. The DC to AC inverter as defined in claim 16, wherein:

the first comparator provides as an output a first series of positive-going output pulses each lasting during the time that the reference signal is less positive than the first reference voltage; and

the second comparator provides as an output a second series of positive-going output pulses each lasting during the time that the reference signal is more positive than the second reference voltage,

further comprising:

a first buffer connected to the output of the first comparator so as to buffer the first comparator and provide the first series of positive-going output pulses at its output;

a first buffer/inverter connected to the output of the first comparator so as to buffer the first comparator and provide a series of zero-going output pulses that are the inverse of the first series of positive-going output pulses at its output;

a second buffer connected to the output of the second comparator so as to buffer the second comparator and provide the second series of positive-going output pulses at its output; and

a second buffer/inverter connected to the output of the second comparator so as to buffer the second comparator and provide a series of zero-going output pulses that are the inverse of the second series of positive-going output pulses at its output, and

wherein:

the first electronic switch that is an P-channel MOSFET, the gate of which is connected to the output of the second buffer, the source of which is connected to the first output terminal, and the drain of which is connected to the DC input terminal;

the second electronic switch that is an N-channel MOSFET, the gate of which is connected to the output of the first buffer/inverter, the source of which is connected to the second DC input terminal, and the drain of which is connected to the first output terminal;

the third electronic switch that is an P-channel MOSFET, the gate of which is connected to the output of the first buffer, the source of which is connected to second output terminal, and the drain of which is connected to the DC input terminal; and

the fourth electronic switch that is an N-channel MOSFET, the gate of which is connected to the output of the second buffer/inverter, the source of which is connected to the second DC input terminal, and the drain of which is connected to the second output terminal.

33. The electronic circuit as defined in claim 32, wherein the voltage reference source comprises a voltage divider connected between the first DC input terminal and the second DC input terminal, the voltage divider providing the first reference voltage and the second reference voltage;

34. The electronic circuit as defined in claim 33, wherein the voltage divider comprises a resistive voltage ladder.

35. The electronic circuit as defined in claim 34, wherein the resistive voltage ladder further provides a DC-offset reference voltage between the first reference voltage and the second reference voltage and the electronic circuit further comprises a voltage follower connected between the resistive voltage ladder and the signal generator so as to provide the DC-offset reference voltage to the signal generator.

36. The electronic circuit as defined in claim 35, wherein:

the signal generator comprises an operational amplifier configured as a relaxation oscillator so that the time-varying signal has a generally triangular waveform;

the voltage follower comprises an operational amplifier;

the comparators comprise operational amplifiers; and

the buffers and buffer/inverters comprise operational amplifiers.

37. An electronic circuit, comprising:

a voltage reference source for providing a first reference voltage and a second reference voltage, the first reference voltage more positive that the second reference voltage;

a signal generator for generating a reference signal that varies between a maximum voltage that is more positive that the first reference voltage and a minimum voltage that is less positive than the second reference voltage;

a first comparator connected to the signal generator and the voltage reference source so as to compare the reference signal to the first reference voltage and provide as an output a first series of output pulses each of which lasts during a discrete interval during which the reference signal is more positive than the first reference voltage; and a second comparator connected to the signal generator and the voltage reference source so as to compare the reference signal to the second reference voltage and provide as an output a second series of output pulses each of which lasts during a discrete interval during which the reference signal is less positive than the second reference voltage.

38. The electronic circuit as defined in claim 37, wherein the voltage reference source comprises a voltage divider connected between the first DC input terminal and the second DC input terminal, the voltage divider providing the first reference voltage and the second reference voltage;

39. The electronic circuit as defined in claim 38, wherein the voltage divider comprises a resistive voltage ladder.

40. The electronic circuit as defined in claim 39, wherein the resistive voltage ladder further provides a DC-offset reference voltage between the first reference voltage and the second reference voltage and the electronic circuit further comprises a voltage follower connected between the resistive voltage ladder and the signal generator so as to provide the DC-offset reference voltage to the signal generator..

41. The electronic circuit as defined in claim 37, wherein the output pulses are positive going pulses.

42. The electronic circuit as defined in claim 41, wherein the voltage reference source comprises a voltage divider connected between the first DC input terminal and the second DC input terminal, the voltage divider providing the first reference voltage and the second reference voltage;

43. The electronic circuit as defined in claim 42, wherein the voltage divider comprises a resistive voltage ladder.

44. The electronic circuit as defined in claim 43, wherein the resistive voltage ladder further provides a DC-offset reference voltage between the first reference voltage and

the second reference voltage and the electronic circuit further comprises a voltage follower connected between the resistive voltage ladder and the signal generator so as to provide the DC-offset reference voltage to the signal generator.

45. An electronic circuit, comprising:

a voltage reference source for providing a first reference voltage and a second reference voltage, the first reference voltage more positive that the second reference voltage;

a signal generator for generating a reference signal that varies between a maximum voltage that is more positive that the first reference voltage and a minimum voltage that is less positive than the second reference voltage;

a first comparator connected to the signal generator and the voltage reference source so as to compare the reference signal to the first reference voltage and provide as an output a first series of output pulses each of which lasts during a discrete interval during which the reference signal is more positive than the first reference voltage; and

a second comparator connected to the signal generator and the voltage reference source so as to compare the reference signal to the second reference voltage and provide as an output a second series of output pulses each of which lasts during a discrete interval during which the reference signal is more positive than the second reference voltage.

46. The electronic circuit as defined in claim 45, wherein the voltage reference source comprises a voltage divider connected between the first DC input terminal and the second DC input terminal, the voltage divider providing the first reference voltage and the second reference voltage;

47. The electronic circuit as defined in claim 46, wherein the voltage divider comprises a resistive voltage ladder.

48. The electronic circuit as defined in claim 47, wherein the resistive voltage ladder further provides a DC-offset reference voltage between the first reference voltage and the second reference voltage and the electronic circuit further comprises a voltage follower connected between the resistive voltage ladder and the signal generator so as to provide the DC-offset reference voltage to the signal generator.

49. The electronic circuit as defined in claim 45, wherein the output pulses are positive going pulses.

50. The electronic circuit as defined in claim 49, wherein the voltage reference source comprises a voltage divider connected between the first DC input terminal and the second DC input terminal, the voltage divider providing the first reference voltage and the second reference voltage;

51. The electronic circuit as defined in claim 50, wherein the voltage divider comprises a resistive voltage ladder.

52. The electronic circuit as defined in claim 51, wherein the resistive voltage ladder further provides a DC-offset reference voltage between the first reference voltage and the second reference voltage and the electronic circuit further comprises a voltage follower connected between the resistive voltage ladder and the signal generator so as to provide the DC-offset reference voltage to the signal generator.

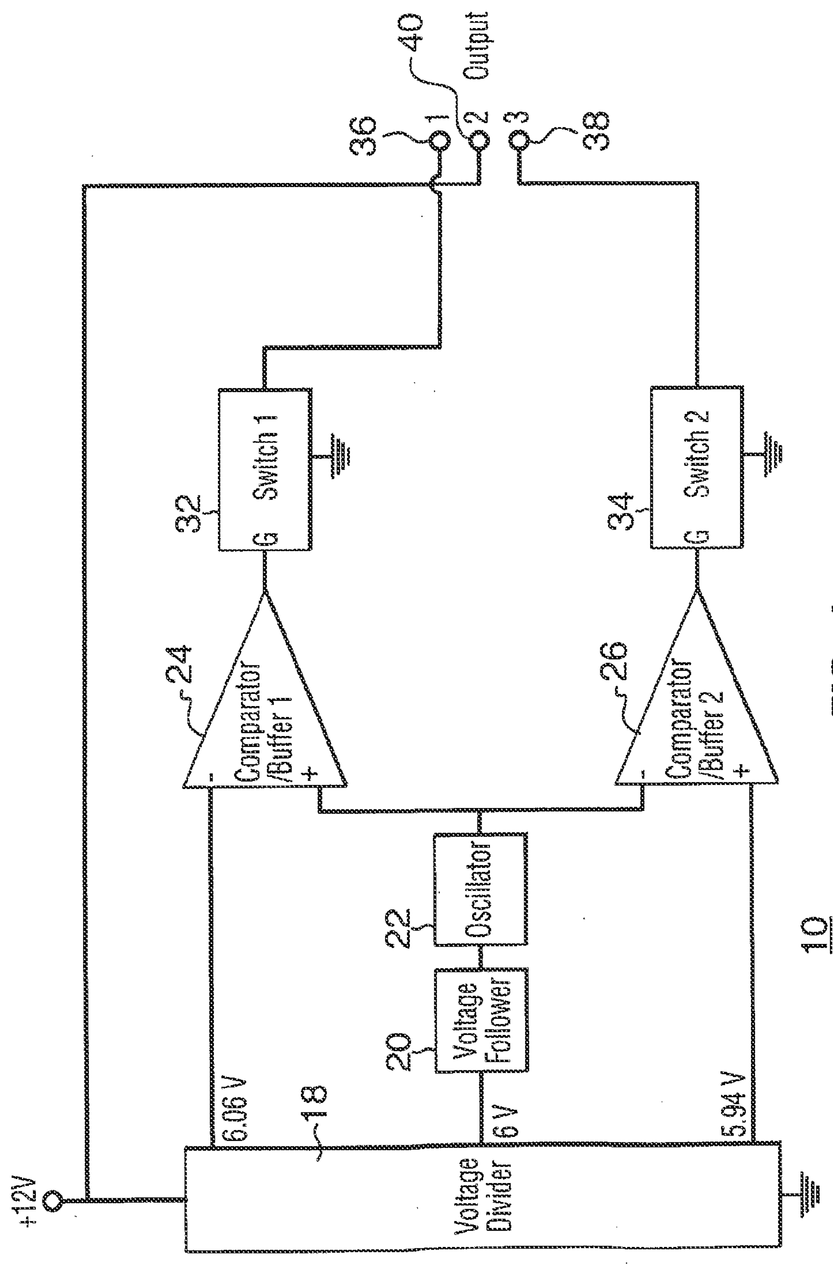


FIG. 1

SUBSTITUTE SHEET (RULE 26)

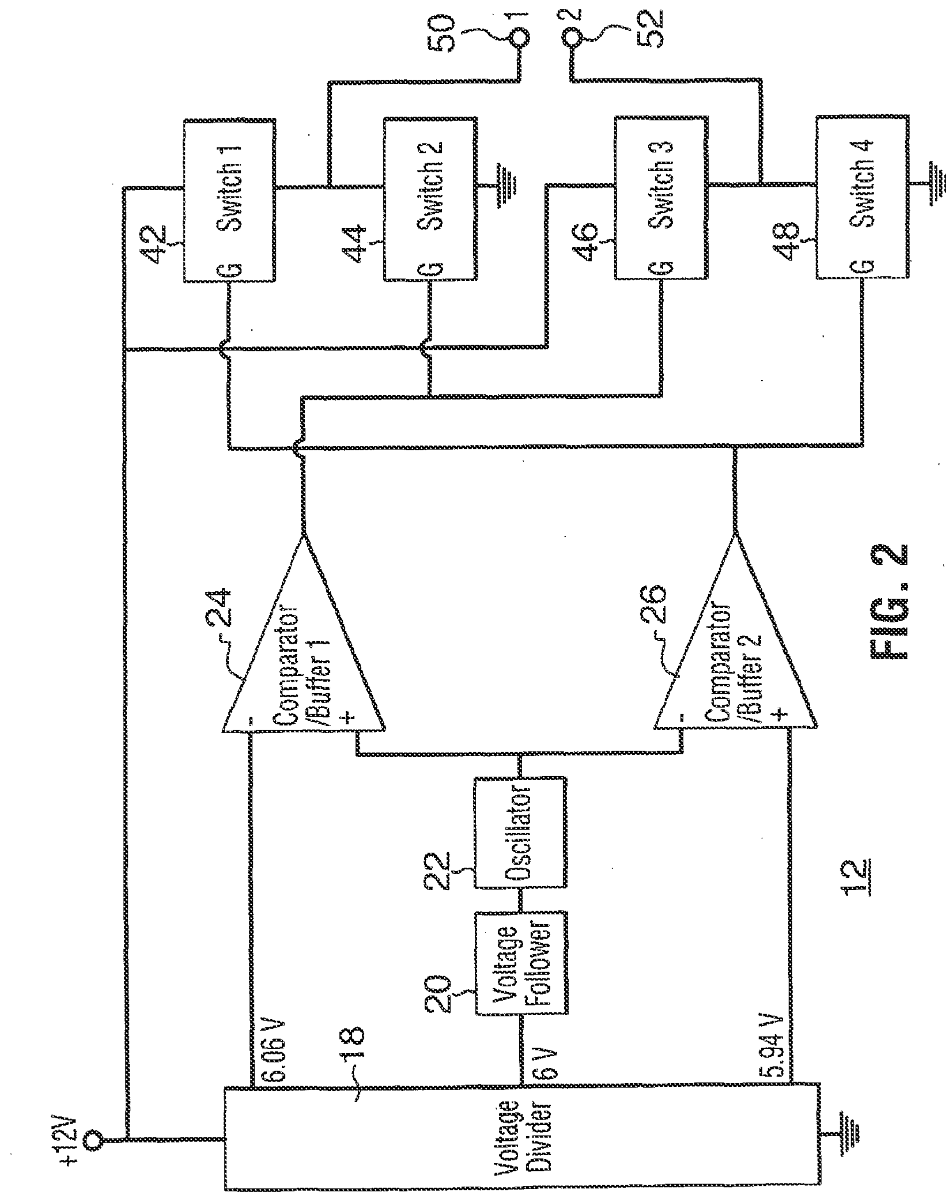
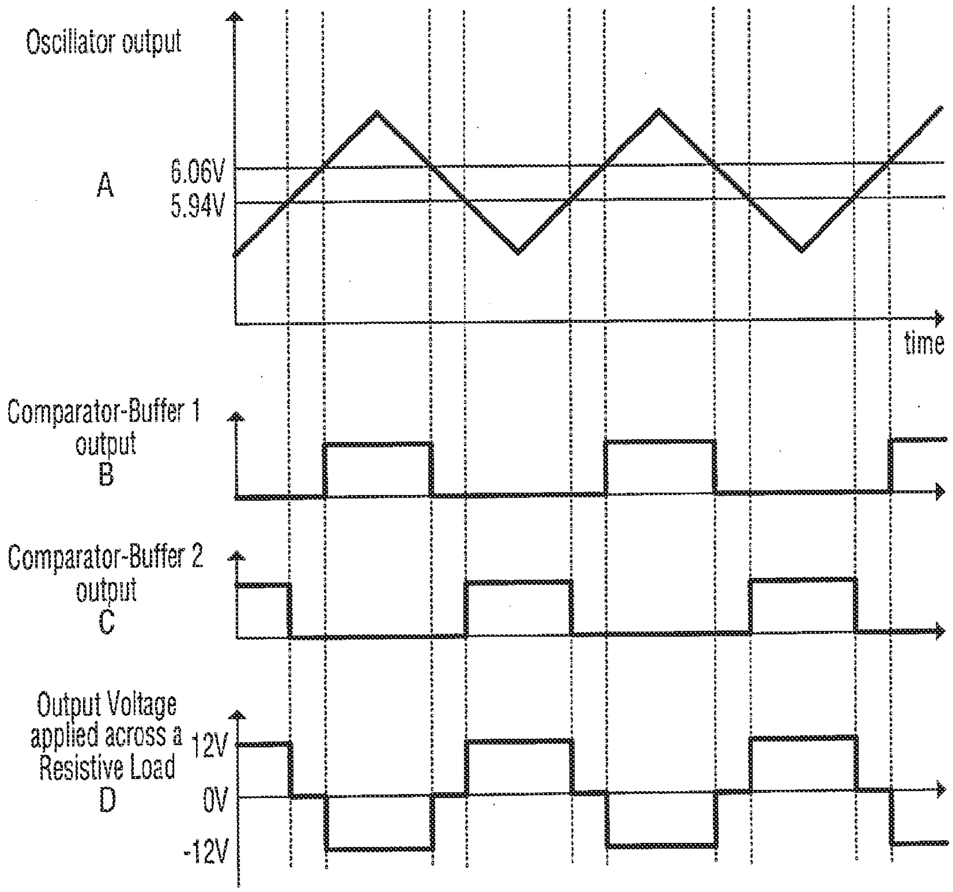

50
1
2
52
Switch 1
Switch 2
Switch 3
Switch 4
G
42
44
46
48
Comparator
/Buffer 1
Comparator
/Buffer 2
24
26
Oscillator
22
Voltage
Follower
20
6.06 V
6 V
5.94 V
18
+12V
Voltage
Divider
12

FIG. 2



Oscillator output
A
6.06V
5.94V
time
Comparator-Buffer 1 output B
Comparator-Buffer 2 output C
Output Voltage applied across a Resistive Load D
12V
0V
-12V

FIG. 3

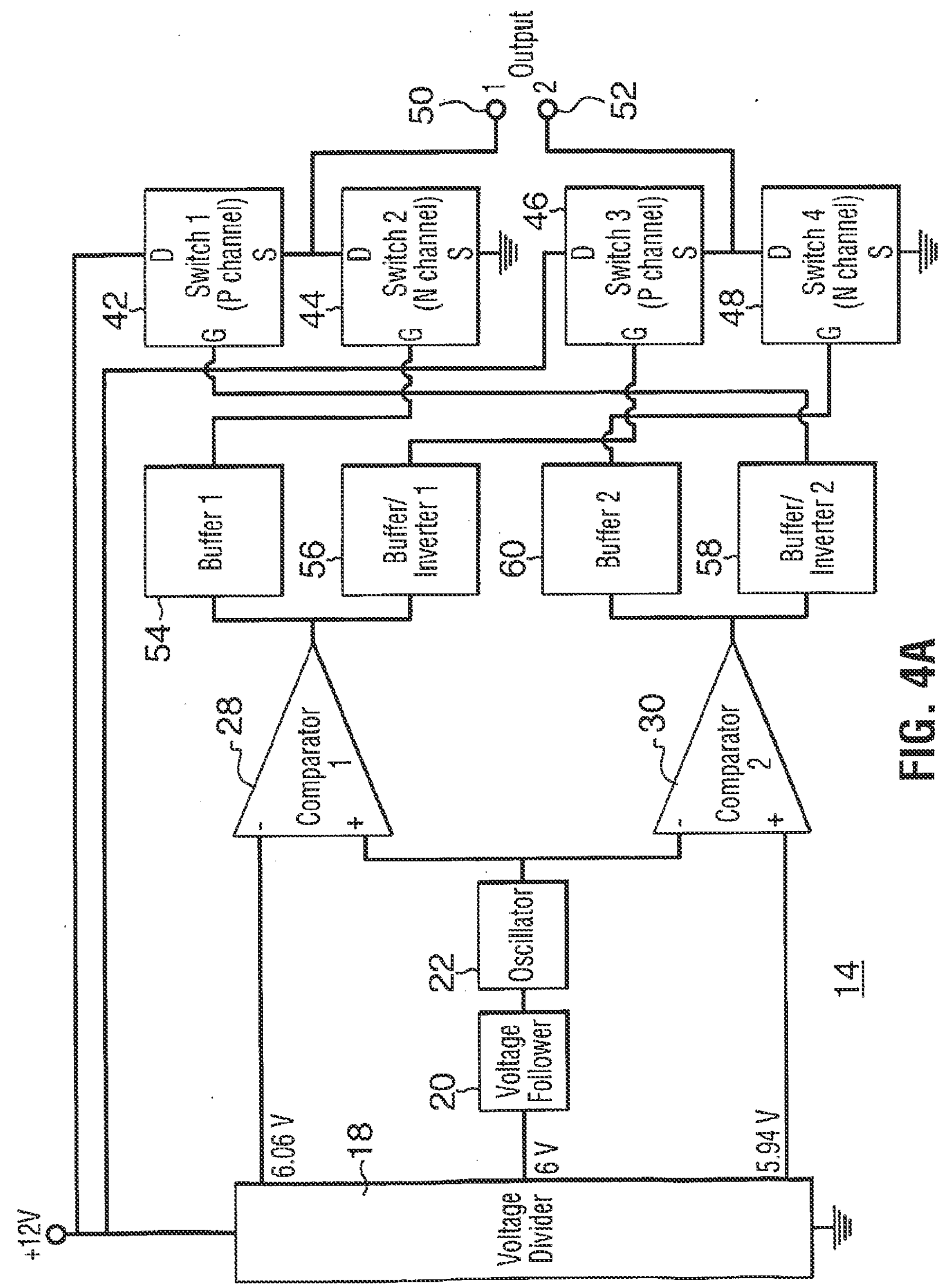


FIG. 4A

SUBSTITUTE SHEET (RULE 26)

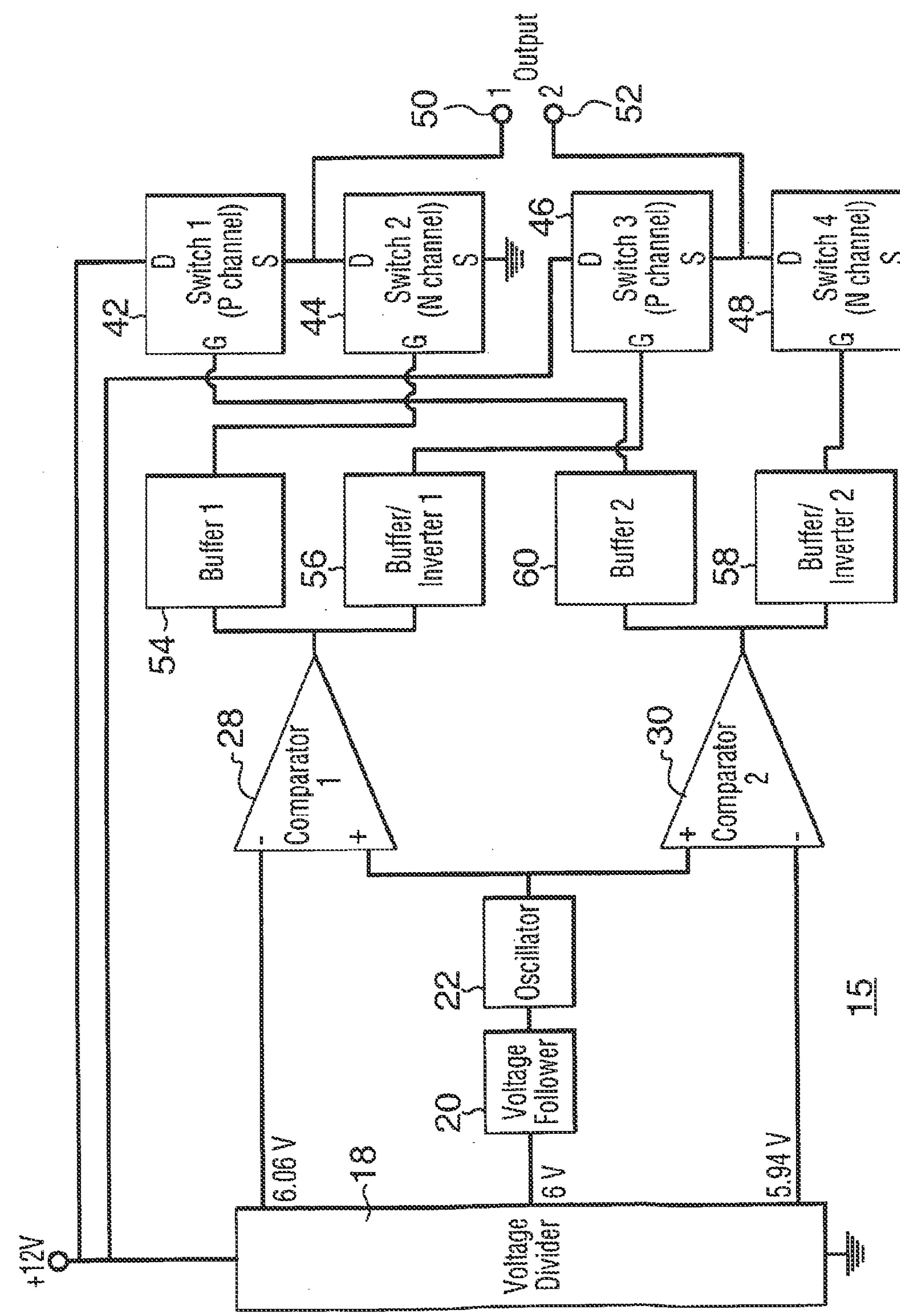
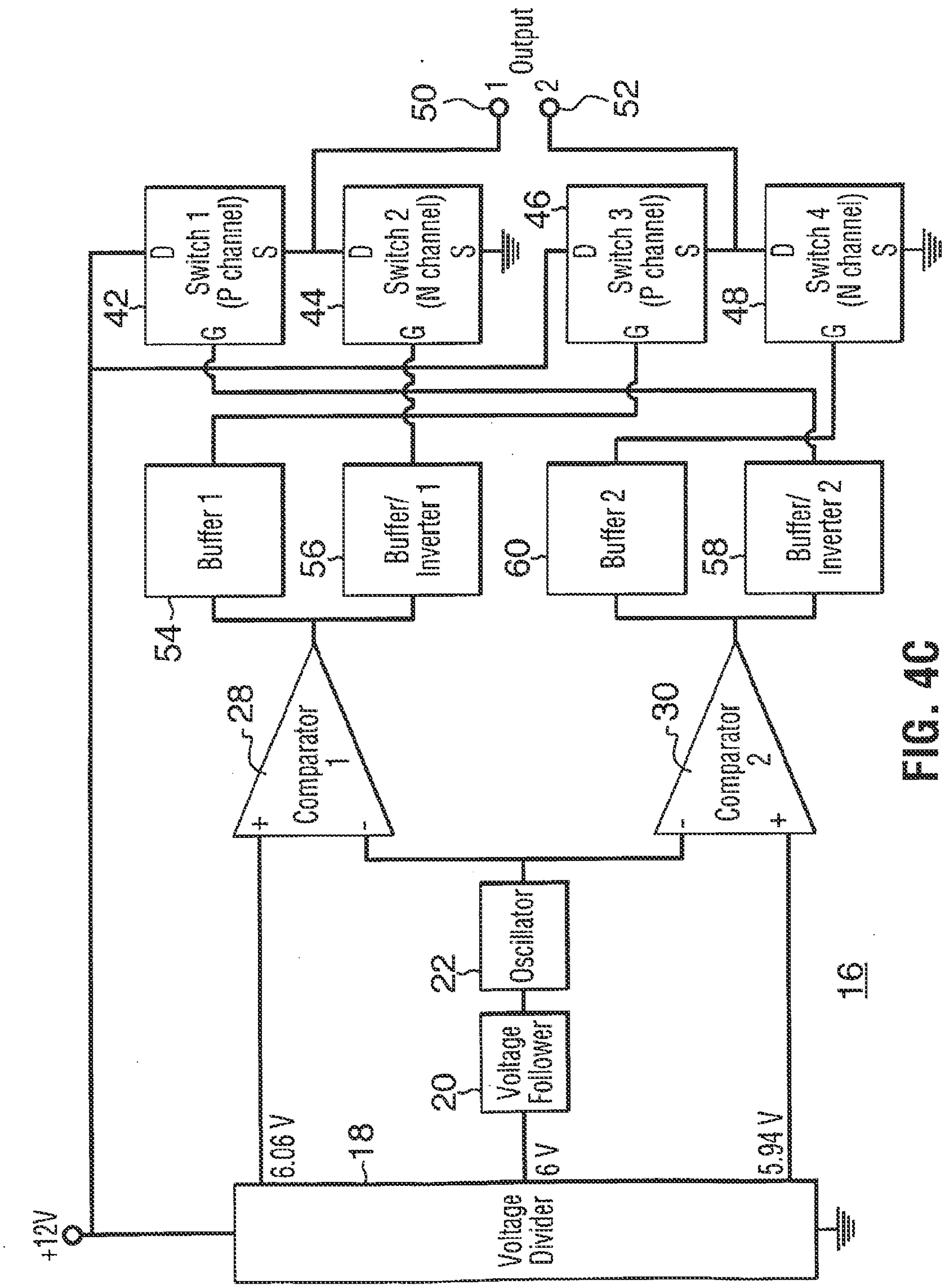

Output
1
2
50
52
Switch 1
(P channel)
Switch 2
(N channel)
Switch 3
(P channel)
Switch 4
(N channel)
D
S
G
42
44
46
48
Buffer 1
Buffer/
Inverter 1
Buffer 2
Buffer/
Inverter 2
54
56
60
58
Comparator
1
Comparator
2
28
30
Oscillator
22
Voltage
Follower
20
Voltage
Divider
18
+12V
6.06 V
6 V
5.94 V
15

FIG. 4B



Output
1
2
50
52
Switch 1 (P channel)
D
S
G
42
Switch 2 (N channel)
44
Switch 3 (P channel)
46
Switch 4 (N channel)
48
Buffer 1
54
Buffer/ Inverter 1
56
Buffer 2
60
Buffer/ Inverter 2
58
Comparator 1
28
Comparator 2
30
+
-
Oscillator
22
Voltage Follower
20
Voltage Divider
18
6.06 V
6 V
5.94 V
+12V
16

FIG. 4C

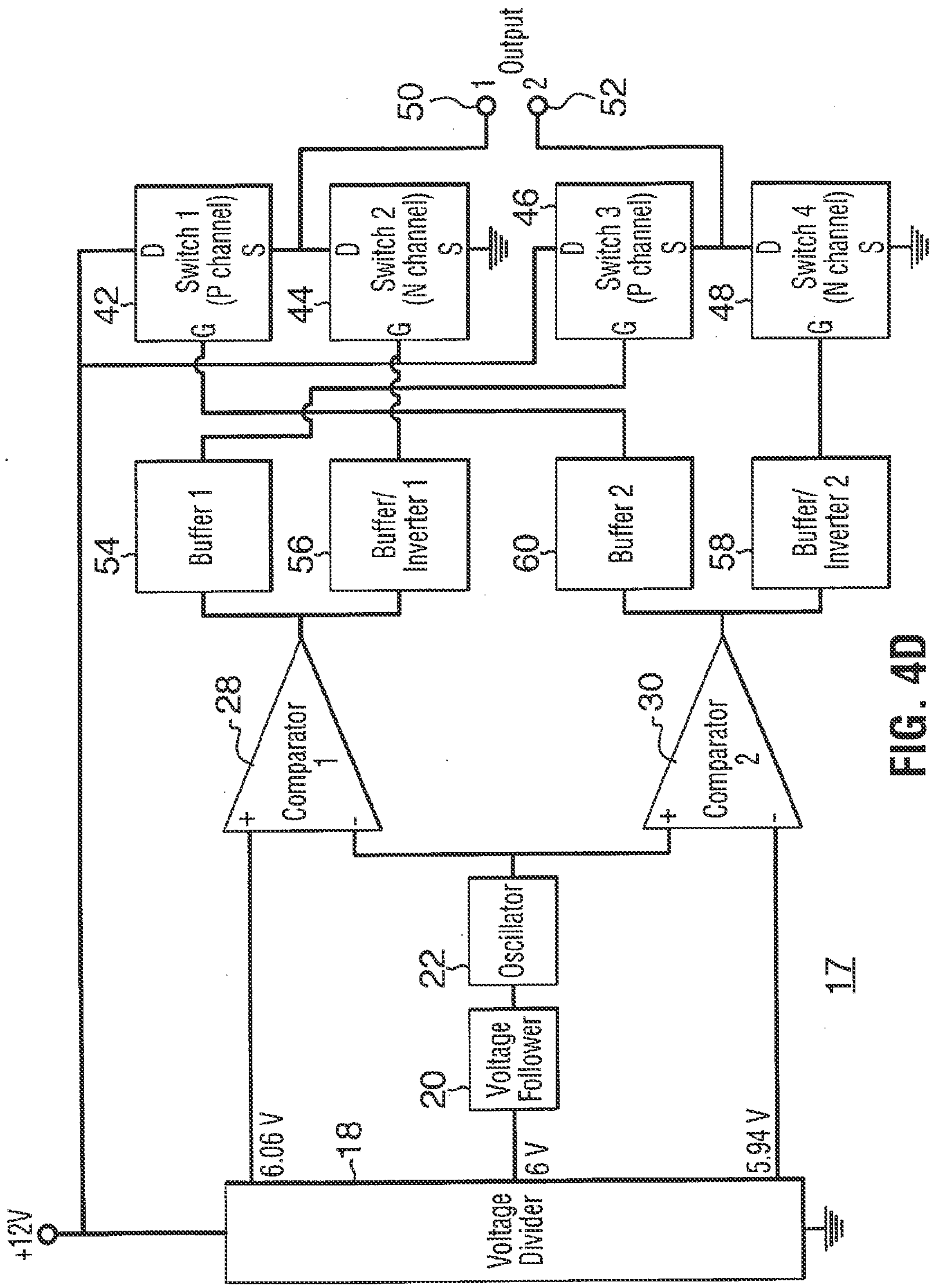

+12V
Voltage Divider
18
6.06 V
6 V
5.94 V
20
Voltage Follower
22
Oscillator
17
28
Comparator 1
30
Comparator 2
+
-
54
Buffer 1
56
Buffer/ Inverter 1
60
Buffer 2
58
Buffer/ Inverter 2
42
Switch 1 (P channel)
44
Switch 2 (N channel)
46
Switch 3 (P channel)
48
Switch 4 (N channel)
D
G
S
50
52
1
2
Output

FIG. 4D

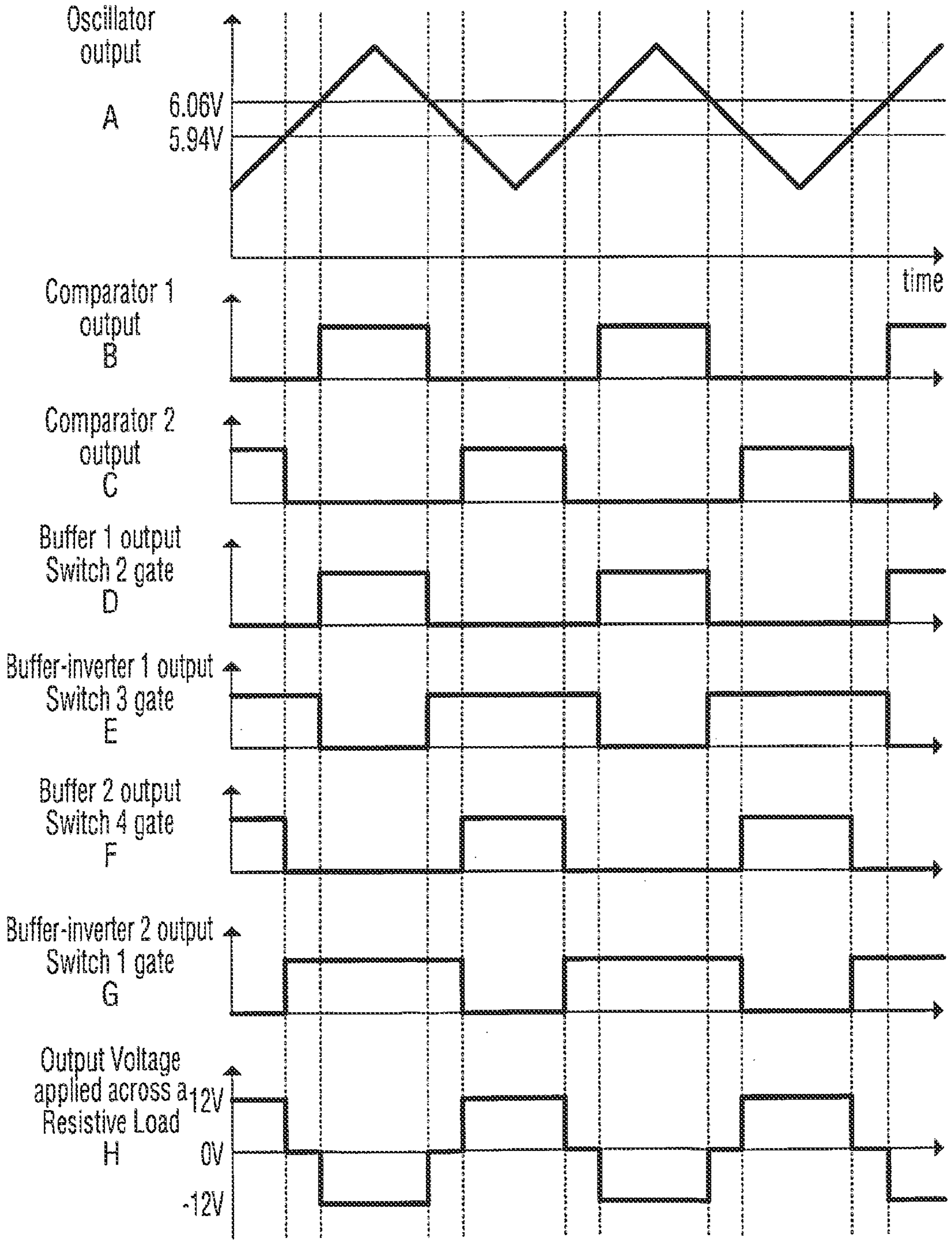

Oscillator output
A
6.06V
5.94V
time
Comparator 1 output
B
Comparator 2 output
C
Buffer 1 output
Switch 2 gate
D
Buffer-inverter 1 output
Switch 3 gate
E
Buffer 2 output
Switch 4 gate
F
Buffer-inverter 2 output
Switch 1 gate
G
Output Voltage applied across a Resistive Load
H
12V
0V
-12V

FIG. 5

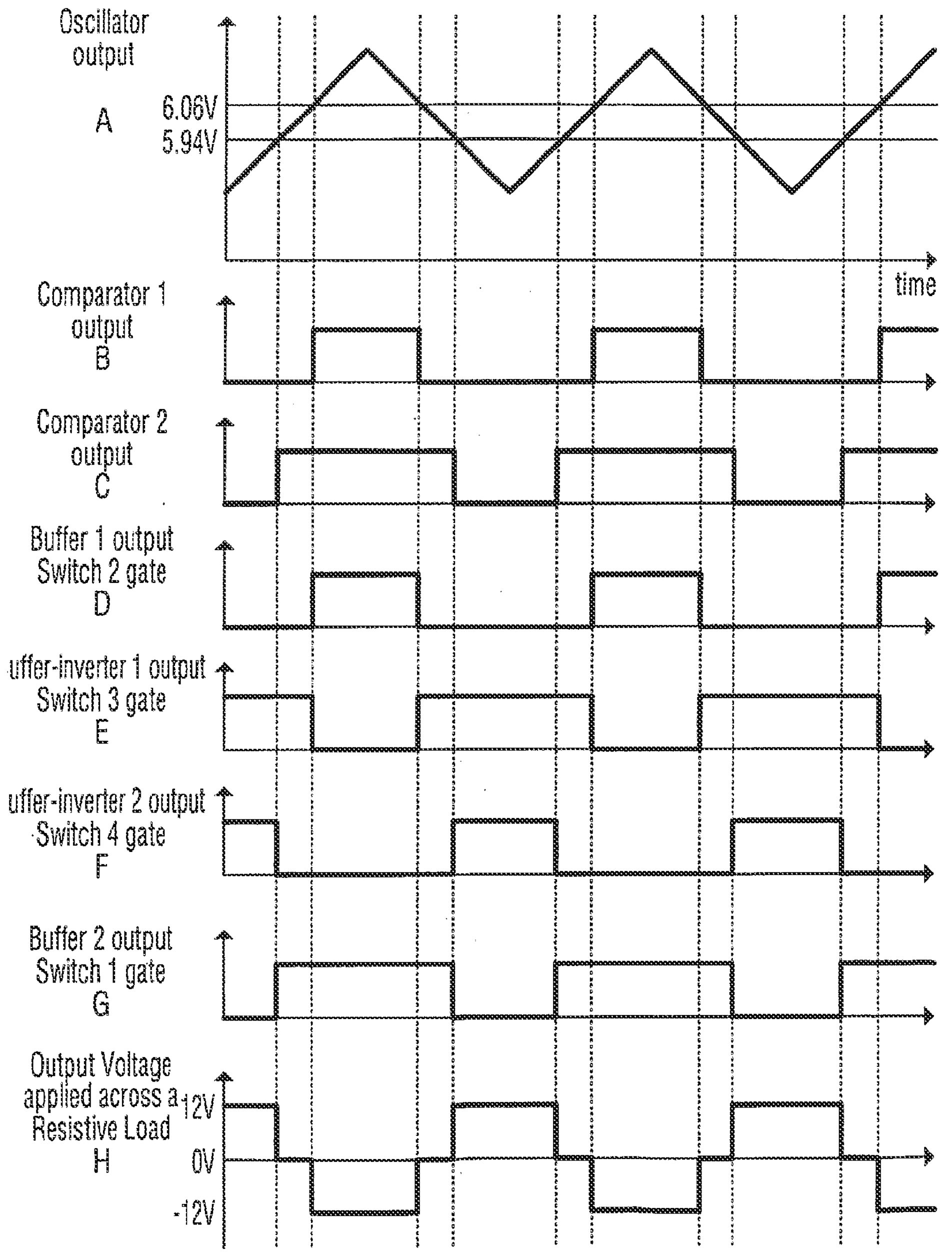

Oscillator output
A
6.06V
5.94V
time
Comparator 1 output
B
Comparator 2 output
C
Buffer 1 output
Switch 2 gate
D
uffer-inverter 1 output
Switch 3 gate
E
uffer-inverter 2 output
Switch 4 gate
F
Buffer 2 output
Switch 1 gate
G
Output Voltage applied across a Resistive Load
H
12V
0V
-12V

FIG. 6

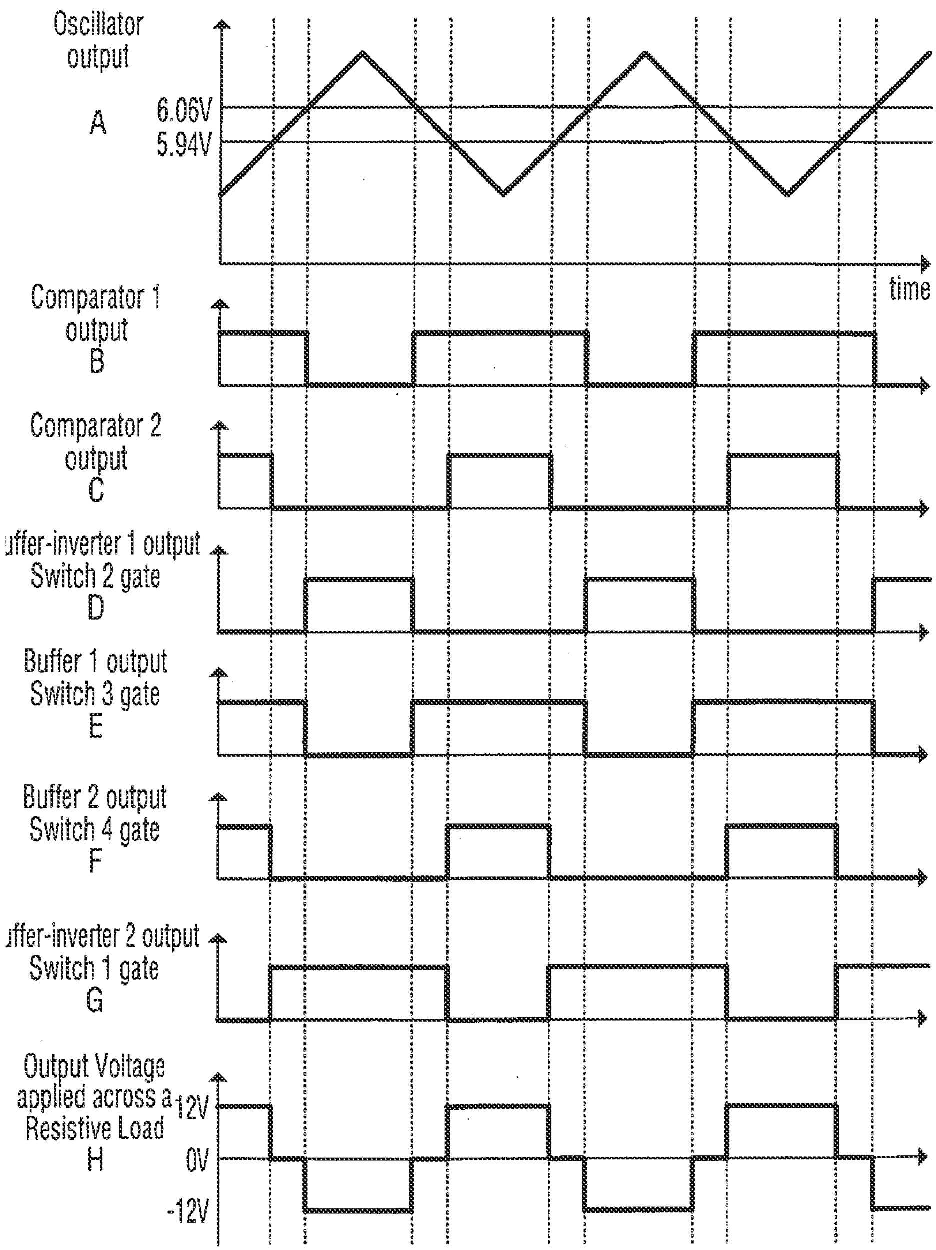
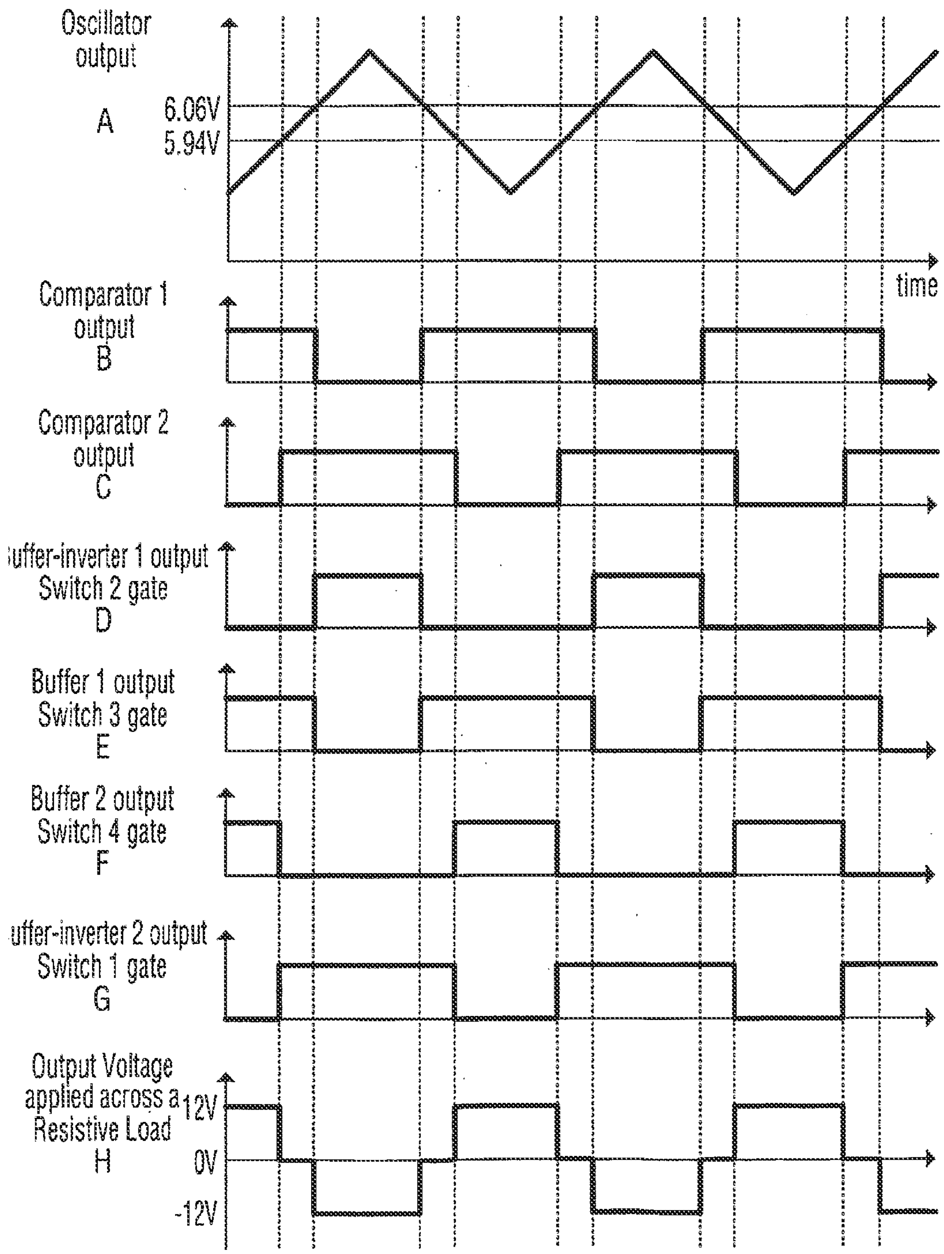

Oscillator output
A
6.06V
5.94V
time
Comparator 1 output
B
Comparator 2 output
C
uffer-inverter 1 output
Switch 2 gate
D
Buffer 1 output
Switch 3 gate
E
Buffer 2 output
Switch 4 gate
F
uffer-inverter 2 output
Switch 1 gate
G
Output Voltage applied across a Resistive Load
H
12V
0V
-12V

FIG. 7



Oscillator output
A
6.06V
5.94V
time
Comparator 1 output
B
Comparator 2 output
C
uffer-inverter 1 output
Switch 2 gate
D
Buffer 1 output
Switch 3 gate
E
Buffer 2 output
Switch 4 gate
F
uffer-inverter 2 output
Switch 1 gate
G
Output Voltage applied across a Resistive Load
H
12V
0V
-12V

FIG. 8

12/16

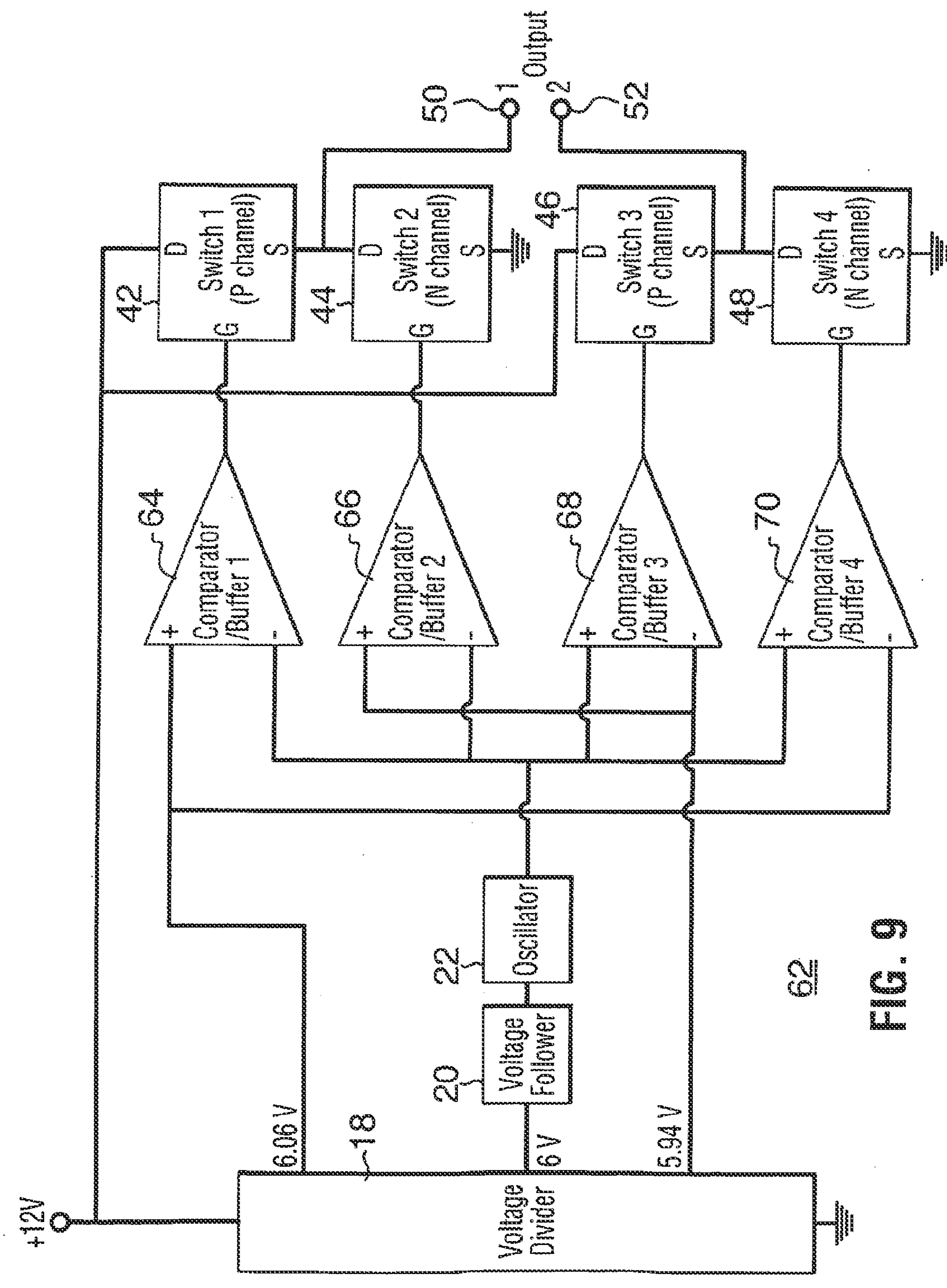


FIG. 9

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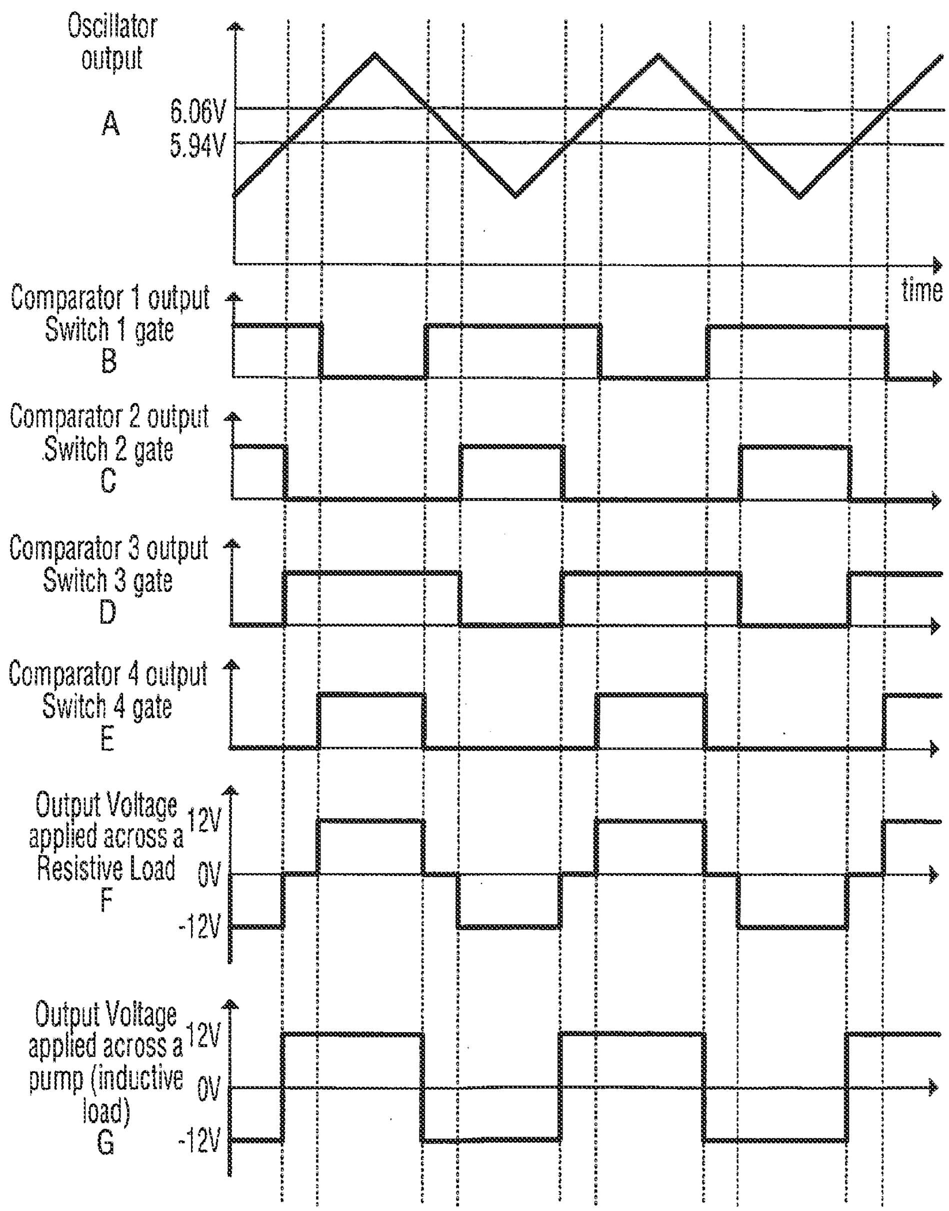

Oscillator output
A
6.06V
5.94V
time
Comparator 1 output
Switch 1 gate
B
Comparator 2 output
Switch 2 gate
C
Comparator 3 output
Switch 3 gate
D
Comparator 4 output
Switch 4 gate
E
Output Voltage applied across a Resistive Load
F
12V
0V
-12V
Output Voltage applied across a pump (inductive load)
G
12V
0V
-12V

FIG. 10

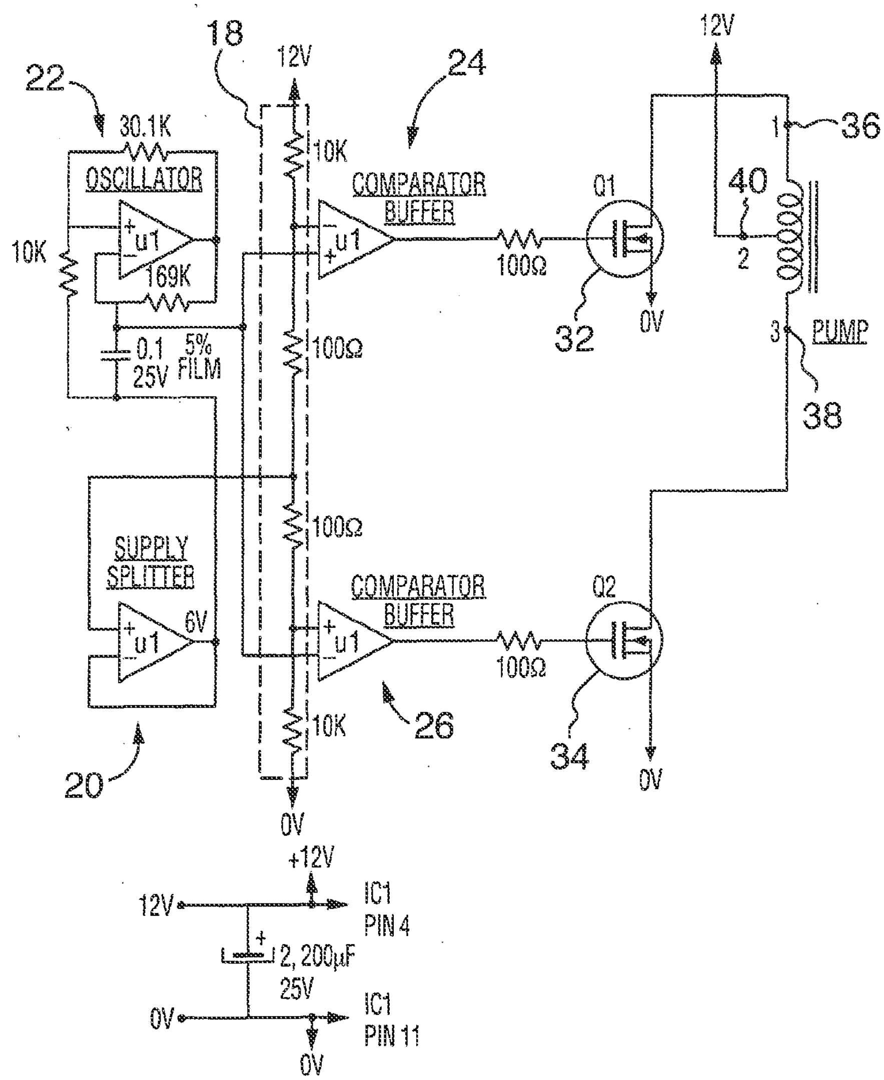
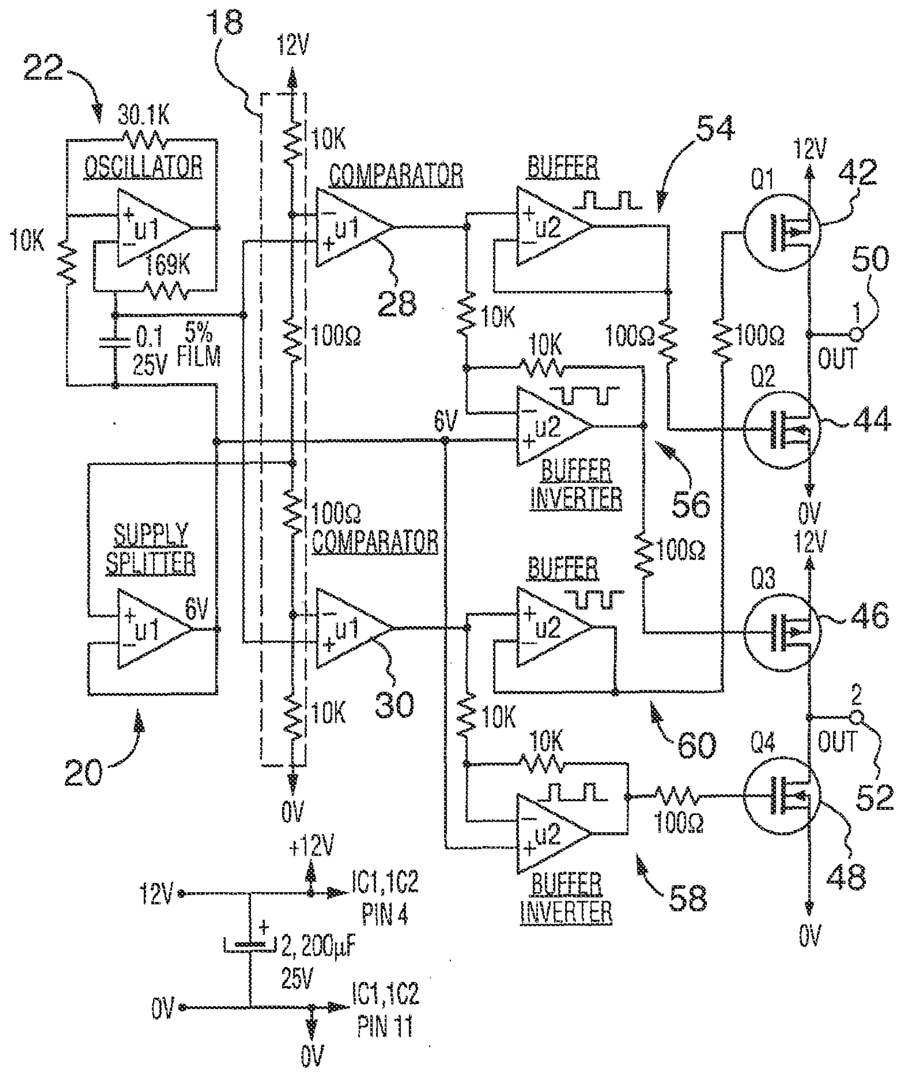

18
12V
24
22
30.1K
OSCILLATOR
u1
10K
169K
0.1
25V
5%
FILM
10K
COMPARATOR
BUFFER
u1
100Ω
100Ω
Q1
32
0V
12V
1
36
40
2
3
PUMP
38
SUPPLY
SPLITTER
u1
6V
20
100Ω
COMPARATOR
BUFFER
u1
100Ω
Q2
26
34
10K
0V
0V
+12V
12V
IC1
PIN 4
2, 200μF
25V
0V
IC1
PIN 11
0V

FIG. 11



18
12V
22
30.1K
OSCILLATOR
10K
u1
169K
0.1
25V
5%
FILM
COMPARATOR
u1
28
100Ω
BUFFER
u2
54
12V
Q1
42
50
10K
10K
100Ω
100Ω
1
OUT
Q2
44
6V
u2
BUFFER
INVERTER
56
0V
12V
SUPPLY
SPLITTER
u1
6V
100Ω
COMPARATOR
u1
30
BUFFER
u2
100Ω
Q3
46
10K
10K
60
2
OUT
Q4
10K
100Ω
52
20
0V
u2
BUFFER
INVERTER
58
48
0V
+12V
12V
IC1,1C2
PIN 4
2, 200μF
25V
0V
IC1,1C2
PIN 11
0V

FIG. 12

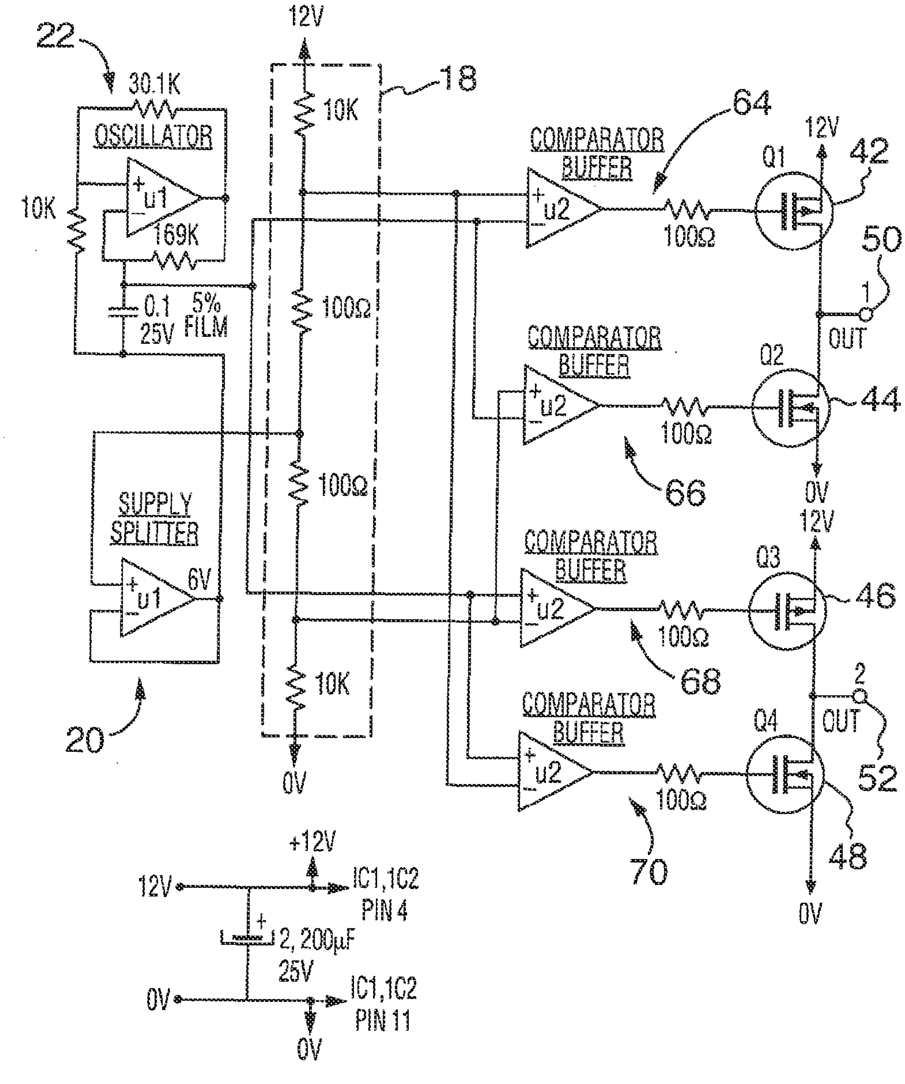

12V
22
30.1K
OSCILLATOR
u1
10K
169K
0.1
25V
5%
FILM
18
10K
100Ω
100Ω
10K
0V
SUPPLY
SPLITTER
u1
6V
20
64
COMPARATOR
BUFFER
u2
100Ω
Q1
12V
42
50
1
OUT
COMPARATOR
BUFFER
u2
100Ω
Q2
44
66
0V
12V
COMPARATOR
BUFFER
u2
100Ω
Q3
46
68
2
OUT
COMPARATOR
BUFFER
u2
100Ω
Q4
52
48
70
0V
+12V
12V
IC1,IC2
PIN 4
2, 200μF
25V
0V
IC1,IC2
PIN 11
0V

FIG. 13

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 02/01869

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H02P7/628 H02M7/538 H02M7/5387

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H02P H02M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, PAJ, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 647 905 A (HANTKE KLAUS ET AL) 3 March 1987 (1987-03-03) the whole document	1,8,15, 37,45
A	WO 93 11602 A (LIVING IMAGE TECH PTY LTD) 10 June 1993 (1993-06-10) abstract; figure 5A	1,8,15, 37,45
A	US 4 128 793 A (STICH FREDERICK A) 5 December 1978 (1978-12-05) abstract; figure 1	1
A	US 4 446 338 A (ROSCH REINHARD W) 1 May 1984 (1984-05-01) column 3, line 27 - line 40	1,8,15, 37,45

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 March 2003	12/03/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Beyer, F

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/CA 02/01869

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
US 4647905	A	03-03-1987	DE	3424052	A1	09-01-1986
			AT	390158	B	26-03-1990
			AT	74985	A	15-08-1989
			JP	1748000	C	25-03-1993
			JP	4031157	B	25-05-1992
			JP	61023300	A	31-01-1986
WO 9311602	A	10-06-1993	WO	9311602	A1	10-06-1993
US 4128793	A	05-12-1978	CA	1102869	A1	09-06-1981
US 4446338	A	01-05-1984	NONE			

Form PCT/ISA/210 (patent family annex) (July 1992)

Electronic Acknowledgement Receipt

EFS ID:	17035260
Application Number:	95002386
International Application Number:	
Confirmation Number:	7254
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Customer Number:	22852
Filer:	Eric Paul Raciti/Marlene A Richards
Filer Authorized By:	Eric Paul Raciti
Attorney Docket Number:	COOL-1.012
Receipt Date:	03-OCT-2013
Filing Date:	15-SEP-2012
Time Stamp:	17:44:59
Application Type:	inter partes reexam

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Foreign Reference	DE_203_05_281_U1.pdf	3193530 5faf72bc7ab141a41b2ee86caba0679e4a489f74	no	49

Warnings:

Information:

2	Foreign Reference	JP2002151638A_.pdf	4339785 6e7ec0a3fcdbb98273e64cb264af8d454f67fe36	no	7
Warnings:					
Information:					
3	Foreign Reference	KR-10-2003-0031027.pdf	2214410 1cde7012ddb7ed530cfee6cb688ec265ab06cedc	no	37
Warnings:					
Information:					
4	Foreign Reference	KR-20-031041_.pdf	16449513 3ea8f90f0ea5ec02a09c7edc8536ba414bcc16ae	no	31
Warnings:					
Information:					
5	Foreign Reference	TW_M244511_.pdf	12440294 31d42a95d505fca57ec5ffed2640eaa1fe0b0637	no	21
Warnings:					
Information:					
6	Foreign Reference	TW_M244513.pdf	2534939 1ff46cf1d67b7a31babe20b86f895d672d54aec0	no	53
Warnings:					
Information:					
7	Foreign Reference	TW_M251442_.pdf	751676 fc255dc98a4877fce1cc7708200ff0d0e43bc37d	no	1
Warnings:					
Information:					
8	Foreign Reference	TW_M256682_.pdf	834423 af6161d6bc31869562e902e34a9a6abb61643195	no	1
Warnings:					
Information:					
9	Foreign Reference	TW_M273032_.pdf	19258247 3fcee8f385cc9e7bc7072603dcd77c5b37acb594	no	22
Warnings:					
Information:					
10	Foreign Reference	TW_M275684_.pdf	13644143 a4a3090ab926d604cc2efe9230e7946a40ca3441	no	21
Warnings:					
Information:					

11	Foreign Reference	TW_M324810_.pdf	13989077 67886d00ce5657bb8506179ffb8d40faf6989b0c	no	21
Warnings:					
Information:					
12	Foreign Reference	TW_M578997_.pdf	2883097 44483b6243b28284187e7dbb09326c8b9d726c54	no	26
Warnings:					
Information:					
13	Foreign Reference	WO2003-055055A1_.pdf	6811924 8a67720c2dfccf0fa2be8026dd9ad1e1cd405f78	no	51
Warnings:					
Information:					
14	Non Patent Literature	Silent_Stream_Users_Manual_.pdf	2301580 60e5b3393febed39fbaff6d1fdcb6025117c9313	no	34
Warnings:					
Information:					
		Total Files Size (in bytes):	101646638		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
95/002,386	09/15/2012	8245764	COOL-1.012	7254

22852 7590 09/13/2013
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

EXAMINER	
KAUFMAN, JOSEPH A	

ART UNIT	PAPER NUMBER
3993	

MAIL DATE	DELIVERY MODE
09/13/2013	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Transmittal of Communication to Third Party Requester *Inter Partes* **Reexamination**	Control No. 95/002,386	Patent Under Reexamination 8245764	
	Examiner JOSEPH KAUFMAN	Art Unit 3993	

– The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

(THIRD PARTY REQUESTER'S CORRESPONDENCE ADDRESS)

GANZ LAW, P.C.
P.O. BOX 2200
HILLSBORO, OR 97123

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above-identified reexamination prceeding. 37 CFR 1.903.

Prior to the filing of a Notice of Appeal, each time the patent owner responds to this communication, the third party requester of the *inter partes* reexamination may once file written comments within a period of 30 days from the date of service of the patent owner's response. This 30-day time period is statutory (35 U.S.C. 314(b)(2)), and, as such, it cannot be extended. See also 37 CFR 1.947.

If an *ex parte* reexamination has been merged with the *inter partes* reexamination, no responsive submission by any *ex parte* third party requester is permitted.

All correspondence relating to this inter partes reexamination proceeding should be directed to the **Central Reexamination Unit** at the mail, FAX, or hand-carry addresses given at the end of the communication enclosed with this transmittal.

U.S. Patent and Trademark Office
PTOL-2070 (Rev. 07-04)

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FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON DC, 20001-4413 : (For Patent Owner)

MAILED
SEP 13 2013
CENTRAL REEXAMINATION UNIT

GANZ LAW P.C.
P.O. BOX 2200
HILLSBORO, OR 97123 : (For Requester)

In re Eriksen
Inter Partes Reexamination Proceeding
Control No. 95/002,386
Filed: September 15, 2012
For: U.S. Patent No. 8,245,764 B2

: **DECISION**
: **DISMISSING PETITION**
: **UNDER § 1.183**

This is a decision on the June 10, 2013 third party requester petition entitled "PETITION UNDER 37 C.F.R. § 1.183 TO SUSPEND, IN PART, 37 C.F.R. § 1.947."

The patent owner petition is before the Office of Patent Legal Administration.

The petition under 37 C.F.R. 1.182 is **dismissed**.

BACKGROUND

1. On September 15, 2012, a request for *inter partes* reexamination of U.S. Patent Number 8,245,764 ("the '764 patent") was filed by the third party requester; the resulting reexamination proceeding was assigned control number 95/002,386 ("the '2386 proceeding").
2. On October 26, 2012, an order granting reexamination in the '2386 proceeding was mailed concurrently with a non-final Office action.
3. On December 26, 2012, patent owner submitted a response to the October 26, 2012 Office action.
4. On January 25, 2013, third party requester filed comments to the patent owner's December 26, 2012 response.

5. On May 7, 2013, the Office issued a notice stating that the third party requester's January 25, 2013 comments were defective and expunged them from the record and provided a 15 day period for the requester to file compliant replacement comments.

6. On May 22, 2013, the third party requester filed replacement comments ("replacement comments") in response to the May 7, 2013 notice.

7. On June 10, 2013, the third party requester filed a third set of comments along with the instant petition requesting waiver of 37 C.F.R. § 1.947 to enter the concurrently filed comments ("substitute comments"), which are represented to be a redacted version of the January 25, 2013 requester comments.

8. On September 3, 2013, the Office issued an Action Closing Prosecution ("ACP") which stated that the requester's replacement comments of May 22, 2013, would not be entered because they propose a new rejection of unamended claims.

PERTINENT REGULATIONS

37 C.F.R. § 1.183 states:

> In an extraordinary situation, when justice requires, any requirement of the regulations in this part which is not a requirement of the statutes may be suspended or waived by the Director or the Director's designee, *sua sponte*, or on petition of the interested party, subject to such other requirements as may be imposed. Any petition under this section must be accompanied by the petition fee set forth in 1.17(f).

37 C.F.R. § 1.947 provides:

> Each time the patent owner files a response to an Office action on the merits pursuant to § 1.945, a third party requester may once file written comments within a period of 30 days from the date of service of the patent owner's response. These comments shall be limited to issues raised by the Office action or the patent owner's response. The time for submitting comments by the third party requester may not be extended. For the purpose of filing the written comments by the third party requester, the comments will be considered as having been received in the Office as of the date of deposit specified in the certificate under § 1.8.

DECISION

On January 25, 2013, the third party requester filed comments in reply to the patent owner response submitted on December 26, 2012. On May 7, 2013, the Office found the requester's comments defective and they were expunged because the comments proposed new rejections to claims 1-18 without those claims being amended.[1] On May 22, 2013, the requester filed replacement comments to the May 7, 2013 notice. On May 31, 2013, the patent owner filed a petition requesting the requester's replacement comments be expunged for violating several Office regulations.[2] In response to patent owner's petition, the third party requester filed an opposition to the petition. The patent owner's petition and requester's opposition were dismissed as premature in a decision on July 17, 2013. Subsequently, the Office did not enter the requester's replacement comments because the replacement comments propose a new rejection to claims 1-18 which were not amended by the patent owner.[3] The instant petition (filed June 10, 2013) requests that "to the extent Requester's Replacement comments currently of record are stricken, Requester respectfully petitions to suspend the provisions of 37 C.F.R. § 1.947 that might otherwise prevent entry of the accompanying Substitute Comments consisting of a redacted version of Requester's original timely filed comments."[4]

Each time patent owner files a response in an *inter partes* proceeding; the third party requester may once file comments.[5] If the requester's timely filed comments are found defective, the Office once waives 37 C.F.R. § 1.947 to permit the requester to rectify and refile the comments within 15 days.[6] If the re-filed comments submission is also found defective, the Office will not waive 37 C.F.R. § 1.947 again, and any further submission will not be accepted.[7] In this proceeding, the requester has re-filed comments in response to a notification from the Office that the originally field comments were defective. These replacement comments were found defective by the Office and the requester seeks entry of substitute comments. These substitute comments are prohibited under 37 C.F.R. § 1.947 and requester requests the applicable provisions of this rule be waived in order to consider these comments.[8] Waiver of rules may be provided under 37 C.F.R. § 1.183 when there is an "extraordinary situation" such that "justice requires" relief.

Requester argues that the substitute comments should be entered because the substitute comments comply with 35 U.S.C. § 314(b), the statute does not prohibit the filing of a substitute for replacement comments, entry would not violate the "special dispatch" requirement of 35 U.S.C. § 314(c), and the requester has a substantial interest in participating in the proceeding.[9] However, none of these factors establish an "extraordinary situation" for which justice requires that relief be granted. The requester has had two opportunities to file comments that comply with the statutory and regulatory requirements. The failure to do so does not create an extraordinary situation. In fact, such a situation is clearly addressed in M.P.E.P. § 2666.05(II) which states the Office will not automatically waive 37 C.F.R. § 1.947 again to permit a third submission of comments. Only where requester files a petition setting forth a persuasive showing under § 1.183 will § 1.947 be waived a further time.

---

[1] Notice re Defective Paper in *Inter Partes* Reexamination at 2.
[2] Patent owner petition at 1.
[3] ACP at 3.
[4] Requester petition at 1.
[5] 37 C.F.R. § 1.947.
[6] M.P.E.P. § 2666.05(II).
[7] Id.
[8] Petition at 1.
[9] Id at 2-4.

The failure of the requester to submit a compliant comments submission at an appropriate time in the proceeding is not an "extraordinary situation" such that justice would require relief. Such a failure by a party or counsel to timely act in prosecuting before the Office or a court is not a sufficient basis for waiving a rule.[10] Requester was given two opportunities to submit a compliant comments submission. Requester has provided no reason why circumstances prevented requester from filing a compliant submission in the first or second opportunity such that a third opportunity would be required. To the extent that any consequences fall upon the requester (*e.g.*, in future proceedings), those consequences are the direct result of the requester's failure to timely take appropriate action, rather than of any failure of Office procedures to provide an appropriate opportunity for the submission of a requester's comments.

The requester's additional terminological argument is also unpersuasive. The requester argues that, unlike "replacement comments", "substitute comments" are not prohibited by the M.P.E.P.[11] However, it is clear from the record that the concurrently filed comments are a second attempt at refiling the requester's defective comments which is prohibited by Office policy. The requester asks for the substitute comments to be entered on the condition that the replacement comments are stricken from the record.[12] In other words, the requester is asking the Office to consider both the replacement comments and the substitute comments, if the replacement comments are found defective. Regardless of terminology, the substitute comments are a second attempt to refile the requester's originally filed defective comments. Such a submission is explicitly prohibited by 37 C.F.R. § 1.947 and the rule will not be waived again absent a showing of an extraordinary situation for which justice requires relief. As discussed above, requester has failed to make such a showing. It is also noted, to the extent the requester argues the submission will not violate "special dispatch," the consideration by the Office of yet another comments submission would necessarily add delay to the proceeding that would not otherwise exist.

The requester's substitute comments are a third attempt by the requester to file compliant comments to the patent owner response of December 26, 2012. Such a submission is prohibited under 37 C.F.R. § 1.947, and the requester has not demonstrated any "extraordinary situation" to offset Office policy such that justice would require the waiver of the rule. Absent the existence of an "extraordinary situation", the procedural rules are designed in such a manner as to provide an orderly procedure that may be relied upon by both parties.[13]

Accordingly, the petition is **<u>dismissed</u>**.

---

[10] *See, e.g., In re Sivertz*, 227 USPQ 255 (July 23, 1985); *Potter v. Dann*, 201 USPQ 574 (D.D.C. 1978); *Nugent v. Yellow Cab Co.*, 295 F.2d 794 (7th Cir. 1961) cert denied, 369 U.S. 828 (1962).

[11] Petition at 3.

[12] Petition at 1 (stating "to the extent Requester's Replacement Comments currently of record are stricken, Requester respectfully petitions to suspend the provision of 37 C.F.R. § 1.947 that might otherwise prevent entry of the accompanying Substitute Comments.").

[13] *In re Sivertz*, 227 USPQ 255 (July 23, 1985) (citing *Myers v. Feigelman*, 455 F.2d 586, 601, 172 USPQ 580, 584 (CCPA 1972) (stating "the rules are designed to provide an orderly procedure and the parties are entitled to rely on their being followed in the absence of such circumstances as might justify waiving them under Rule 183. To hold that they may be ignored, in the absence of such circumstances, merely because no special damage has been shown would defeat the purpose of the rules")).

CONCLUSION

- The petition under § 1.183 is **dismissed**.
- Any inquiry concerning this decision should be directed to Matthew Sked, Legal Advisor, at (571) 272-7627.

Pinchus M. Laufer
Senior Legal Advisor
Office of Patent Legal Administration

September 11, 2013

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
95/002,386	09/15/2012	8245764	COOL-1.012	7254

22852 7590 09/03/2013
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

EXAMINER	
KAUFMAN, JOSEPH A	

ART UNIT	PAPER NUMBER
3993	

MAIL DATE	DELIVERY MODE
09/03/2013	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Transmittal of Communication to Third Party Requester *Inter Partes* Reexamination

Control No.	Patent Under Reexamination	
95/002,386	8245764	
Examiner	**Art Unit**	
JOSEPH KAUFMAN	3993	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

(THIRD PARTY REQUESTER'S CORRESPONDENCE ADDRESS)

GANZ LAW, P.C.
P.O. BOX 22O0
HILLSBORO, OR 97123

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above-identified reexamination prceeding. 37 CFR 1.903.

Prior to the filing of a Notice of Appeal, each time the patent owner responds to this communication, the third party requester of the *inter partes* reexamination may once file written comments within a period of 30 days from the date of service of the patent owner's response. This 30-day time period is statutory (35 U.S.C. 314(b)(2)), and, as such, it cannot be extended. See also 37 CFR 1.947.

If an *ex parte* reexamination has been merged with the *inter partes* reexamination, no responsive submission by any *ex parte* third party requester is permitted.

All correspondence relating to this inter partes reexamination proceeding should be directed to the **Central Reexamination Unit** at the mail, FAX, or hand-carry addresses given at the end of the communication enclosed with this transmittal.

ACTION CLOSING PROSECUTION (37 CFR 1.949)	Control No. 95/002,386	Patent Under Reexamination 8245764
	Examiner JOSEPH KAUFMAN	Art Unit 3993

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

Responsive to the communication(s) filed by:
Patent Owner on 26 December, 2012
Third Party(ies) on _____

Patent owner may once file a submission under 37 CFR 1.951(a) within 1 month(s) from the mailing date of this Office action. Where a submission is filed, third party requester may file responsive comments under 37 CFR 1.951(b) within 30-days (not extendable- 35 U.S.C. § 314(b)(2)) from the date of service of the initial submission on the requester. **Appeal cannot be taken from this action.** Appeal can only be taken from a Right of Appeal Notice under 37 CFR 1.953.

All correspondence relating to this inter partes reexamination proceeding should be directed to the **Central Reexamination Unit** at the mail, FAX, or hand-carry addresses given at the end of this Office action.

PART I. THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:

1. ☐ Notice of References Cited by Examiner, PTO-892
2. ☐ Information Disclosure Citation, PTO/SB/08
3. ☐ _____

PART II. SUMMARY OF ACTION:

1a. ☒ Claims 1-30 are subject to reexamination.
1b. ☐ Claims _____ are not subject to reexamination.
2. ☐ Claims _____ have been canceled.
3. ☐ Claims _____ are confirmed. [Unamended patent claims]
4. ☐ Claims _____ are patentable. [Amended or new claims]
5. ☒ Claims 1-30 are rejected.
6. ☐ Claims _____ are objected to.
7. ☐ The drawings filed on _____ ☐ are acceptable ☐ are not acceptable.
8 ☐ The drawing correction request filed on _____ is: ☐ approved. ☐ disapproved.
9 ☐ Acknowledgment is made of the claim for priority under 35 U.S.C. 119 (a)-(d). The certified copy has: ☐ been received. ☐ not been received. ☐ been filed in Application/Control No _____
10. ☐ Other _____

Extensions of Time

Extensions of time under 37 CFR 1.136(a) will **not** be permitted in these proceedings because the provisions of 37 CFR 1.136 apply only to "an applicant" and not to parties in a reexamination proceeding. Additionally, 35 U.S.C. 314(c) requires that *inter partes* reexamination proceedings "will be conducted with special dispatch" (37 CFR 1.937). Patent owner extensions of time in *inter partes* reexamination proceedings are provided for in 37 CFR 1.956. Extensions of time are not available for third party requester comments, because a comment period of 30 days from service of patent owner's response is set by statute. 35 USC 314(b)(3).

Notification of Concurrent Proceedings

The patent owner is reminded of the continuing responsibility under 37 CFR 1.985 to apprise the Office of any litigation activity, or other prior or concurrent proceeding, involving the Eriksen patent throughout the course of this reexamination proceeding. The third party requester is also reminded of the ability to similarly apprise the Office of any such activity or proceeding throughout the course of this reexamination proceeding. See MPEP § 2686 and 2686.04.

Service of Papers

Any paper filed by either the patent owner or the third party requester ***must be served*** on the other party in the reexamination proceeding in the manner provided by 37 CFR 1.248. See 37 CFR 1.903 and MPEP 2666.06.

Non-Entry of Requester's Response

Requester was notified in the office correspondence mailed 7 May 2013 that as claims 1-18 were not amended, no new rejections over claims 1-18 were permissible. On page 17 of the response by Requester dated 22 May 2013, Requester proposes a new rejection that claims 1-18 are obvious over Koga et al. Therefore, Requester's response dated 22 May 2013 is improper, will not be considered in its entirety, and be expunged from the record.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-18 are rejected under 35 U.S.C. 102(b) as being anticipated by Koga et al.

Requester has stated that Patent Owner is only eligible for the effective filing date of 7 October 2011 as the original application did not have Figure 20 or the passages in the specification to support the claimed subject matter. This material was added on 9 January 2009 and 14 July 2011. Therefore, the Examiner will use the effective filing date of 14 July 2011.

The Examiner incorporates by reference the claim charts on pages 149-164 of the Request.

New Examiner Rejections in Light of New Claims 19-30

Claims 19, 21-23, 25-27, 29 and 30 are rejected under 35 U.S.C. 102(b) as being anticipated by Koga et al.

Koga et al. has been discussed in detail as noted in the above rejection. In addition, as seen in Figure 7, a passage directs cooling liquid from the pump chamber 15 directly to the thermal exchange chamber; an entire surface of the heat exchange interface that contacts the cooling liquid forms a boundary wall of the thermal exchange chamber as seen with either surface of 19 in Figure 7; and the pump and thermal exchange chambers are connected together by one of more passages as noted above and in Figure 7, and the reservoir has and inlet and outlet at 19 and 20 as seen in Figure 8.

Claim Rejections - 35 USC § 103

The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 20, 24 and 28 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Koga et al.

Koga et al. has been discussed in detail above, but while showing at least one passage between the pump and thermal exchange chamber, is silent as to a plurality of passages between the two. It would have been obvious to one of ordinary skill in the art to provide a plurality of passages between the pump and thermal exchange chambers in order to further enhance communication between the two which would increase flow and thus be better able to cool the device.

Response to Arguments

Patent Owner: Patent Owner argues that portion 19 of Koga is not a chamber as required by the claims but a conduit. Patent Owner argues that the structure is not an "enclosed space or compartment".

Examiner: The Examiner disagrees that portion 19 does not comprise a chamber. As chambers can clearly have inlets and outlets, it is not clear how chamber 19 does not meet the conventional definition of a chamber. It is clearly an enclosed space and a compartment as would have been recognized by one of ordinary skill in the art.

Patent Owner: Patent Owner contends that the thermal chamber is not vertically spaced from the pump chamber.

Examiner: As seen in Koga et al., Figure 7, the chambers are vertically spaced apart. There is no basis for Patent Owner's contention that they are not. Chamber 19 lies below 15A.

Patent Owner: Patent Owner discusses references that did not meet the RLP standard.

Examiner: The arguments are not germane to the current proceeding.

Patent Owner: Patent Owner contends that claims 2-9, 11-14 and 16-18 are allowable for the same reasons as for the claims from which they depend. Further, Patent Owner contends that claim 4 does not show projections 24 and 24 A in the thermal exchange chamber 19.

Examiner: For the reasons noted above, the independent claims remain anticipated by Koga et al. Regarding claim 4 and by extension 5, looking at Figure 7 of Koga et al., pins 24 and 24A increase the surface area of the heat exchange unit 15B. 15B is the wall of the thermal exchange chamber. Therefore, the pins are the features that "are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber".

Patent Owner: Patent Owner contends that claims 19-30 are patentable over Koga.

Examiner: Patent Owner is directed to the new rejections proposed by the Examiner in the above section. The arguments are moot in light of these new rejections.

Patent Owner: Patent Owner contends that the priority date of the '764 patent is not relevant to the reexamination.

Examiner: The effective filing date of the Ericksen patent does determine whether or not Koga et al. is a reference under 102(e) or 102(b).

Conclusion

This is an ACTION CLOSING PROSECUTION (ACP); see MPEP § 2671.02.

(1) Pursuant to 37 CFR 1.951(a), the patent owner may once file written comments limited to the issues raised in the reexamination proceeding and/or present a proposed amendment to the claims which amendment will be subject to the criteria of 37 CFR 1.116 as to whether it shall be entered and considered. Such comments and/or proposed amendments must be filed within a time period of 30 days or one month (whichever is longer) from the mailing date of this action. Where the patent owner files such comments and/or a proposed amendment, the third party requester may once file comments under 37 CFR 1.951(b) responding to the patent owner's submission within 30 days from the date of service of the patent owner's submission on the third party requester.

(2) If the patent owner does not timely file comments and/or a proposed amendment pursuant to 37 CFR 1.951(a), then the third party requester is precluded from filing comments under 37 CFR 1.951(b).

(3) Appeal **cannot** be taken from this action, since it is not a final Office action.

All correspondence relating to this *inter partes* reexamination proceeding should be directed:

By EFS: Registered users may submit via the electronic filing system EFS-Web, at https://efs.uspto.gov/efile/myportal/efs-registered
.

By Mail to: Mail Stop *Inter Partes* Reexam
Attn: Central Reexamination Unit
Commissioner for Patents
United States Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

By Fax to: (571) 273-9900

Central Reexamination Unit

By hand: Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

For EFS-Web transmissions, 37 CFR 1.8(a)(1)(i)(C) and (ii) states that correspondence (except for a request for reexamination and a corrected or replacement request for reexamination) will be considered timely if (a) it is transmitted via the Office's electronic filing system in accordance with 37 CFR 1.6(a)(4), and (b) includes a certificate of transmission for each piece of correspondence stating the date of transmission, which is prior to the expiration of the set period of time in the Office action.

Any inquiry concerning this communication or earlier communications from the examiner, or as to the status of this proceeding, should be directed to the Central Reexamination Unit at telephone number (571) 272-7705.

Signed:

/Joseph A. Kaufman/
Joseph A. Kaufman
Primary Examiner
Art Unit 3993

Conferees:

/RMF/

/EDL/

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
95/002,386	09/15/2012	8245764	COOL-1.012	7254

22852 7590 07/17/2013
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

EXAMINER	
KAUFMAN, JOSEPH A	

ART UNIT	PAPER NUMBER
3993	

MAIL DATE	DELIVERY MODE
07/17/2013	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Transmittal of Communication to Third Party Requester ***Inter Partes* Reexamination**	Control No.	Patent Under Reexamination	
	95/002,386	8245764	
	Examiner	Art Unit	
	JOSEPH KAUFMAN	3993	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

(THIRD PARTY REQUESTER'S CORRESPONDENCE ADDRESS)

GANZ LAW, P.C.
P.O. BOX 2200
HILLSBORO, OR 97123

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above-identified reexamination prceeding. 37 CFR 1.903.

Prior to the filing of a Notice of Appeal, each time the patent owner responds to this communication, the third party requester of the *inter partes* reexamination may once file written comments within a period of 30 days from the date of service of the patent owner's response. This 30-day time period is statutory (35 U.S.C. 314(b)(2)), and, as such, it cannot be extended. See also 37 CFR 1.947.

If an *ex parte* reexamination has been merged with the *inter partes* reexamination, no responsive submission by any *ex parte* third party requester is permitted.

All correspondence relating to this inter partes reexamination proceeding should be directed to the **Central Reexamination Unit** at the mail, FAX, or hand-carry addresses given at the end of the communication enclosed with this transmittal.

U.S. Patent and Trademark Office
PTOL-2070 (Rev. 07-04)

Paper No. 20121017

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(For Patent Owner)

MAILED

JUL 17 2013

CENTRAL REEXAMINATION U

GANZ LAW, P.C.
P.O. BOX 2200
HILLSBORO, OR 97123

(For Third-Party Requester)

In re Eriksen
Reexamination Proceeding
Control No. 95/002,386
Request Deposited: September 15, 2012
For: U.S. Patent No. 8,245,764 B2

: DECISION
: DISMISSING
: PETITIONS

This is a decision on the patent owner's petition entitled "PATENT OWNER'S PETITION UNDER 37 C.F.R. § 1.182 – REQUEST TO EXPUNGE THIRD PARTY REQUESTER'S REPLACEMENT COMMENTS FILED ON MAY 22, 2013 FROM THE RECORD" filed on May 31, 2013. The petition is treated as a request under § 1.181 to invoke supervisory authority to not enter the May 22, 2013 requester's comments. This decision also addresses the requester's opposition petition, filed June 10, 2013, which is also treated as a petition under 37 CFR 1.181. These petitions are before the Director of the Central Reexamination Unit for decision.

The patent owner's petition is **DISMISSED** as premature.

The requester's opposition petition is **DISMISSED** as premature.

REVIEW OF RELEVANT FACTS

1. On September 15, 2012, a request for *inter partes* reexamination of all of the claims (claims 1-18) of U.S. Patent No 8,245,764 B2 to Eriksen was filed by a third party requester. The request was assigned Control no. 95/002,386 ("the '2386 proceeding").
2. On October 26, 2012, the Office issued an order granting the '2386 request for *inter partes* reexamination of all claims and a first Office action rejecting these claims.
3. On December 26, 2012, patent owner timely submitted a response to the first Office action. The response included new proposed claims 19-30.
4. On January 25, 2013, requester submitted comments to patent owner's response.
5. On May 7, 2013, the Office issued a notice of defective paper stating that the requester's comments were not compliant with 37 CFR 1.947 because they improperly raised new issues by proposing new rejections for unamended, original claims 1-18. The comments were expunged and "closed" to the public in accordance with MPEP 2667.
6. On May 22, 2013, the requester timely submitted replacement comments.
7. On May 31, 2013, patent owner submitted the instant petition.
8. On June 10, 2013, third party requester filed an opposition to the instant petition.
9. Concurrent with the opposition petition, requester submitted on June 10, 2013 a petition under 37 C.F.R. § 1.183 to suspend, in part, 37 C.F.R. § 1.947, and, to the extent the replacement comments are expunged, enter and consider the comments in the interest of justice. This petition will be addressed in a separate decision.

DECISION

The May 31, 2013 petition, treated solely under 37 CFR 1.181, to invoke supervisory authority asserts that the requester's replacement comments of May 22, 2013 should not be entered in the proceeding record because they are not in compliance with Office regulations and policies. However, there has been no decision by the examiner if the third party requester's comments of May 22, 2013 are in compliance with Office rules and procedures. Accordingly, it is premature to invoke supervisory authority regarding entry or refusal to enter the May 22, 2013 comments because the examiner has not made a decision on entry. Thus, the patent owner's May 31, 2013 petition and the requester's June 10, 2013 opposition are premature and are accordingly dismissed.

CONCLUSION

1. The May 31, 2013, patent owner's petition, which is treated as a petition under 37 CFR 1.181, is **dismissed** as premature.

2. The June 10, 2013, requester's opposition petition, which is treated as a petition under 37 CFR 1.181, is **dismissed** as premature.

3. Telephone inquiries related to this decision should be directed Andy Kashnikow, Supervisory Patent Reexamination Specialist, at (571) 272-4361, or Eileen Lillis, Supervisory Patent Reexamination Specialist, at (571) 272-6928.

Irem Yucel
Director, Central Reexamination Unit

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent No.: 8,245,764 **Currently in Litigation Styled:** *Asetek Holdings, Inc et al v. Coolit Systems Inc*, Case No. 3:12-cv-04498-EMC (N.D. Cal.) **Issued:** August 21, 2012 **Filed:** October 7, 2011 **Applicant:** Andre Sloth Eriksen **Title:** COOLING SYSTEM FOR A COMPUTER SYSTEM	**R.C.N.:** 95/002,386 **Confirmation No.:** 7254 **Examiner:** Joseph A. Kaufman **Art Unit:** 3993

SUBMITTED VIA ELECTRONIC FILING SYSTEM ON JUNE 10, 2013
UNITED STATES PATENT AND TRADEMARK OFFICE

PETITION IN OPPOSITION TO PATENT OWNER'S PETITION TO STRIKE THIRD-PARTY REQUESTER'S COMMENTS

Third-party requester, CoolIT Systems, Inc., petitions under 37 C.F.R. § 1.182 to present views in opposition to the petition served by Patent Owner on May 31, 2013. If the Office determines that a petition under Rule 1.182 is not the proper basis for presenting this opposition, Requester petitions under 37 C.F.R. § 1.83 to waive the provisions of 37 C.F.R. § 1.939 to permit Requester to present the following opposition to Patent Owner's May 31, 2013, petition.

A fee of $400 pursuant to 37 C.F.R. § 1.17(f) is being paid concurrently with the filing of this Petition. If the fee paid is insufficient, or if additional or alternative fees are due in connection with the filing of this Petition in Opposition, please charge such fees to Deposit Account No. 50-1001.

BACKGROUND

1. On September 15, 2012, Requester filed a Request for *Inter Partes* Reexamination (Request) of all claims (i.e., claims 1-18) of U.S. Patent No. 8,245,764 (the '764 Patent).
2. On October 26, 2012, the Office issued an Order instituting the present reexamination as to all challenged claims. The same day, an Office Action issued rejecting each of the challenged claims as being anticipated by Koga.
3. On December 26, 2012, Patent Owner amended the listing of claims by adding new claims 19-30 and contested the anticipation rejections in a "Response Under 37 C.F.R. § 1.111" (Amendment).
4. On January 25, 2013, Requester filed "Comments by Third-Party Requester under 37 C.F.R. § 1.947 Subsequent to Patentee's Response to Office Action Dated October 26, 2012" (Original Comments).

5. On May 7, 2013, the Office issued a "Notice Re Defective Paper in *Inter Partes* Reexamination" (Notice).
6. On May 22, Requester filed "Comments by Third-Party Requester Under 37 C.F.R. § 1.947 Subsequent to Patentee's Response to Office Action Dated October 26, 2012, and Notice Dated May 7, 2013" (Replacement Comments).
7. On May 31, 2013, Patent Owner, Asetek A/S, filed the Petition at issue here.

I. <u>Asetek's Petition Lacks Merit and Should be Dismissed</u>

Although the Replacement Comments included several editorial revisions to comply with the Notice dated May 7, 2013 (e.g., deletion of headings and rearrangement of text), the Replacement Comments are limited to issues raised in the Office Action dated October 26, 2012, and Asetek's Amendment dated December 26, 2012, and do not go beyond the Original Comments. Therefore, the Replacement Comments fully comply with 37 C.F.R. § 1.947.

Accordingly, as explained more fully below, Asetek's Petition should be dismissed in its entirety and the Replacement Comments should remain of record and be fully considered on the merits.

A. <u>Asetek's Amendment Dated December 22, 2012, Inherently Raised the Issue of Obviousness from Koga</u>

In the outstanding Office Action, all challenged claims stand rejected under 35 U.S.C. § 102(b) as being anticipated by Koga. Office Action, p. 3. However, Asetek's remarks in its Amendment raised the issue of obviousness.

For example, Asetek's remarks inherently assert that the rejected and effectively amended claims overcome Section 103's prohibition on patenting subject matter not identically disclosed or described in a pior art reference if differences between the claimed subject matter as a whole and the prior art (e.g., Koga) would have been obvious to one of ordinary skill in the art. For example, Asetek theorized on the understanding one of ordinary skill in the art would have given Koga, concluded that the claims "are allowable over <u>*Koga*</u>" and "patentably distinguish over [Koga]", and on that basis urged the Office to "reconsider[] and confirm[] the patentability of the reexamined claims, as well as new claims 19-30 …." *See*, Amendment, pp. 19-20 (stating "a person of ordinary skill in the art would have interperpreted, a 'chamber' …" and "[t]herefore, … a person of ordinary skill in the art would not have interpreted a conduit …."), 22-24 (stating "Therefore, these claims are allowable over <u>*Koga*</u> at least for the same reason independent claims 1, 10, and 15 are allowable over <u>*Koga*</u>. "), and 31 (stating "reexamined claims 1-18, as well as new claims 19-30, patentably distinguish over the cited art. Thus, reconsideration and confirmation of the patentability of reexamined claims, as well as new claims 19-30 ….").

Also, Asetek expressly acknowledged difference between asserting that a reference does not anticipate a claim (implicates § 102 only) and asserting that the claim is patentable over the reference (implicates, *inter alia*, §§ 102-103). For example, Asetek asserted that certain dependent "claims are allowable over ***Koga***" and in the immediately following sentence asserted that "these dependent claims are not anticipated by ***Koga***." Amendment, p. 22. The former statement inherently implicated the anticipation inquiry under § 102 and the obviousness inquiry under § 103, while the latter statement implicated only the § 102 inquiry. In purporting that the challenged claims are allegedly "allowable" over Koga, Asetek discussed its view of the understanding one of ordinary skill in the art would have had following a review of Koga. Amendment, pp. 19-20.

Thus, Asetek's remarks inherently implicate 35 U.S.C. § 103, at least with regard to Koga taken alone. To conclude otherwise would vitiate the 35 U.S.C § 103 prohibition on patenting subject matter that only trivially differs from (i.e., might not be anticipated by but is obvious from) the applied reference. Accordingly, the Replacement Comments properly responded to Asetek's assertion that the claims "patentably distinguish over" Koga and Asetek's request to "confirm[] patentability" of the reexamined claims by merely pointing out that patentability cannot be confirmed on the basis of potential trivial differences. The entire subject of obviousness with regard to challenged claims 1-18 is reproduced, as follows:

> L. IN THE ALTERNATIVE, KOGA RENDERS CLAIMS 1-18 OBVIOUS
>
> As explained above, Koga expressly disclosed each and every combination of features arranged in the manner recited in claims 1-18. However, to the extent that Koga might be considered as not disclosing some trivial claim limitation recited in one or more claims, the basic knowledge or "common sense" possessed by one of ordinary skill in the art would have resolved such difference. Accordingly, Requester respectfully urges the Office, in the alternative, to reject each such claim under 35 U.S.C. § 103(a) as claiming an obvious variant of Koga.

[Replacement Comments, p. 17.]

Requester's limited remarks regarding obviousness directly contest Asetek's assertions regarding patentability without going beyond the issues raised in Asetek's Amendment. The Replacement Comments do not look to any other reference in connection with challenged claims 1-18 to provide for or overcome any purported deficiency of Koga alleged by Asetek. Instead, the Replacement Comments merely contest Asetek's assertion found on Page 31 of its Amendment that the challenged claims somehow might "patentably distinguish over" Koga based Asetek's allegations regarding purported differences from Koga and the level of ordinary skill in the art.

The Replacement Comments do not go beyond the issues raised by Asetek's Amendment, and thus are proper. Asetek's Petition should be dismissed and the Replacement Comments should remain of record.

B. Asetek's Reliance on *Inter Partes* Reexamination No. 95/000115 is Misplaced

Asetek asserts that the Office should strike Requester's Replacement Comments because the Office expunged comments in *Inter Partes* Reexamination No. 95/000115 ('115 Reexamination). However, the procedural posture of the '115 Reexamination substantively differed from the current situation and thus actions by the Office in the '115 Reexamination are of no consequence here.

Specifically, the Office refused in the '115 Reexamination to adopt an anticipation rejection and the requester set forth an obviousness rejection in response to the Office's refusal to adopt the proposed rejection. There, the patent owner did not assert that the claims were patentable or raise any issues relating to the level of ordinary skill in the art. Accordingly, the requester's comments in the '115 Reexamination were limited under 37 C.F.R. § 1.947 to issues raised in the Office action, which did not include any basis for raising an obviousness rejection.

In stark contrast, the Office here adopted Requester's proposed anticipation rejections based on Koga ***and*** Asetek responded by alleging trivial differences from Koga and affirmatively asserting Asetek's theories regarding the level of ordinary skill in the art, and purporting based on those asserted theories that the challenged claims are "allowable" and "patentably distinguish" over Koga. Those specific allegations by Asetek and the content of Asetek's Amendment as a whole inherently raised the issue of whether the subject matter claimed in claims 1-18, though purportedly not identically disclosed or described in Koga, might be patentable (e.g., non-obvious).

Thus, the Replacement Comments appropriately asserted that any purported differences from Koga are trivial and would have been obvious to one of ordinary skill in the art under 37 C.F.R. § 1.947 because those comments addressed issues raised by the patent owner's response and do not raise any issues not already before the Office for consideration.[1]

Asetek's Petition should be dismissed and the Replacement Comments should remain of record.

---

[1] Under 37 C.F.R. § 1.947, Requester's comments shall be limited to issues raised by the Office action ***<u>or</u>*** the patent owner's response. (Emphasis added.)

C. The Replacement Comments do not Add to (or "Go Beyond") the Original Comments

Although Applicant agrees that MPEP 2666.05 II describes the permissible scope of replacement comments, MPEP 2666.05 II imposes no *in haec verba* requirement on replacement comments as Asetek's Petition seems to suggest. Naturally, the text of the Replacement Comments differs from the text in the Original Comments, as it must in order to respond properly to the Notice. However, the Replacement Comments do not add to the subject matter found in the original comments. Substantive differences between the Original Comments and the Replacement Comments are the result of narrowing amendments made in an attempt to comply with the Notice.

1. Claims 1-18

For example, as described above, the Replacement Comments assert that claims 1-18 would have been obvious from Koga. However, that assertion fits squarely within the scope of and does not add to the Original Comments. In particular, the Original Comments explained that each combination of features claimed in claims 1-18 would have been obvious from Koga, especially in view of the subject matter disclosed by Wei and in view of the subject matter disclosed by Takayuki. Original Comments, pp. 15, lines 4-16, 22-23, 28-36, and 38-48.

The Replacement Comments properly maintain that, contrary to allegations in Asetek's Amendment, claims 1-18 are not patentable over Koga to the extent Koga might not identically disclose the subject matter claims in claims 1-18. As in the Original Comments, the Replacement Comments explain that any purported differences from Koga would have been resolved by the basic knowledge or "common sense" possessed by one of ordinary skill in the art. For example, Requester invites a comparison of the discussion appearing in the Original Comments at p. 15, lines 4-16 and pp. 22-23 to the discussion appearing in the Replacement Comments, p. 17, lines 22-27.

The Replacement Comments replace approximately 22 pages in the Original Comments explaining claims 1-18 would have been obvious from Koga in view of Wei or Takayuki with one brief paragraph in Section L. pointing out that any alleged difference from Koga would be an obvious variant of Koga firmly within the grasp of an ordinary artisan. The objected-to remarks in Section L. of the Replacement Comments do not add to (i.e., do not "go beyond") the Original Comments.

2. Claims 19-30

Asetek's remarks pertaining to the proposed rejections of claims 19-30 are inaccurate and misleading. In particular, Asetek asserts that merely 1 ½ pages (i.e., pages 36-38) in the Original Comments were devoted to the proposed rejections of claims 19-30 based on Koga and Wei, utterly ignoring the remarks spanning pages 21-23 in the Original Comments explaining the relevance of Koga and Wei to claims 19-30 (e.g., "Reasonable Likelihood #1"). Petition, p. 5. Similarly, Asetek's assertion that merely 1 ½ pages (i.e., pages 48-49) in the Original Comments were devoted to the proposed rejections of claims 19-30 based on Koga and Takayuki ignores the remarks appearing on pages 23-24 (e.g., "Reasonable Likelihood #2). Asetek's Petition, p. 5.

As presented in the Replacement Comments, the claim charts and text in the Original Comments were slightly rearranged for convenience and readability, and several headings and some introductory text were deleted. For example, several headings appearing in the Original Comments to demarcate each respective Reasonable Likelihood arising from Wei, Takayuki and Cheon were omitted from the Replacement Comments, though the corresponding text setting forth the respective Reasonable Likelihoods was reproduced in substantially identical form (except omitting references to claims 1-18). In particular, each of Headings VII.B. (p. 21, "Summary of the Reasonable Likelihood that Requester will Prevail"), VII.C. (p. 22, "Reasonable Likelihood #1 …"), VII.D. (p. 23, "Reasonable Likelihood #2 …") and VII.E (p. 25, "Reasonable Likelihood #3 …") as presented in the Original Comments were omitted from the Replacement Comments.

As noted above, the substantive text from the Original Comments setting forth the Reasonable Likelihood in relation to Wei, Takayuki, and Cheon is substantially identically reproduced in the Replacement Comments. *Cf.* Original Comments pp. 21-25 and Replacement Comments pp. 22-23, 27-28, and 32-36. In the Original Comments, Requester explained the relevance of Cheon to, *inter alia*, new claims 19-30 in setting forth a Reasonable Likelihood as to those claims. *See, e.g.*, Original Comments, p. 25-27. The remarks from the Original Comments setting forth the Reasonable Likelihood based on Cheon as to claims 19-30 are substantially identically reproduced in the Replacement Comments. *See*, Replacement Comments, p. 32-36.

Therefore, the Replacement Comments raise a reasonable likelihood as to each of proposed claims 19-30.

In the Original Comments, Cheon was used to challenge issued claims 1-18, as well as proposed dependent claims 19-30. In the Replacement Comments, Cheon is used only to challenge proposed dependent claims 19-30. Thus, since each of proposed dependent claims 19-30 is narrower than the base claim from which it depends, the remarks regarding Cheon in the Replacement Comments must also be narrower than in the Original Comments.

Although the undersigned regrets any confusion editorial revisions between the Original Comments and the Replacement Comments might have caused, the Replacement Comments do not "go beyond" the Original Comments for the reasons stated above.

Asetek's Petition should be dismissed.

D. Citation of KOGA '355 under 37 CFR 1.948(a)(2) is proper

Pursuant to 37 C.F.R. § 1.948(a)(2), the Replacement Comments properly cite to Koga '355 to rebut Asetek's response as to the disclosure of Koga. Specifically, Koga '355 is presented to demonstrate that the applied Koga reference inherently discloses a feature said by PO to be lacking from Koga, and thus that Koga anticipates the challenged claims. *See, e.g.,* Replacement Comments, pp. 12-13; 37 C.F.R. § 1.948(a)(2); MPEP § 2666.05 II.

The Federal Circuit has approved of such use of an explanatory reference in an anticipation rejection. "To serve as an anticipation when the reference is silent about the asserted inherent characteristic, such gap in the reference may be filled with recourse to extrinsic evidence. Such evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." Continental Can Co. USA v. Monsanto Co., 948 F.2d 1264, 1268, 20 USPQ2d 1746, 1749 (Fed. Cir. 1991).

Importantly, Koga '355 is not presented in Requester's Comments as substitute new art to provide for a purported deficiency of Koga, for that would be improper under 37 C.F.R. § 1.948(a)(2). Instead, Requester properly cites to Koga '355 to rebut Asetek's interpretation of Koga. Although Koga '355 and Koga do not share a common priority claim, the references name the same first inventor and disclose substantially similar devices. *Cf.* Koga, FIG. 7 and Koga '355, FIG. 51. However, Koga '355 expressly describes the feature said by Asetek to be lacking from Koga, whereas Koga merely illustrates the feature. *See*, Replacement Comments, pp. 12-13.

Requester notes that the Replacement Comments also cite to the learned treatise Munson as well as to the Shorter Oxford English Dictionary to rebut responses by Asetek without objection from Asetek. That Koga '355 happens to be a patent reference does not preclude its citation in a similar fashion.

For the foregoing reasons, citation of KOGA '355 under 37 CFR 1.948(a)(2) is proper, and Asetek's Petition should be dismissed.

The Replacements Comments should remain of record.

II. Conclusion

For at least the reasons stated herein, the Replacement Comments comport with 37 C.F.R. §§ 1.947 and 1.948, as well as M.P.E.P. § 2666.05 II. Accordingly, Requester respectfully requests that Asetek's Petition be dismissed in its entirety and the Replacement Comments remain of record.

Date: June 10, 2013

Respectfully submitted,
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Certificate of Service

The undersigned hereby certifies that a complete copy of this THIRD-PARTY REQUESTER'S PETITION UNDER 37 C.F.R. § 1.182 IN OPPOSITION TO PATENT OWNER'S PETITION FILED MAY 31, 2013 was served on counsel for Asetek:

Finnegan, Henderson, Farabow, Garrett & Dunner LLP
901 New York Avenue, NW
Washington, D.C. 20001-4413

via first class mail, on June 10, 2013.

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Electronic Patent Application Fee Transmittal

Application Number:	95002386
Filing Date:	15-Sep-2012
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Filer:	Lloyd L. Pollard II/Tracie Semenchalam
Attorney Docket Number:	COOL-1.012

Filed as Large Entity

inter partes reexam Filing Fees

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Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Petition fee- 37 CFR 1.17(f) (Group I)	1462	1	400	400
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
		Total in USD ($)		**400**

Electronic Acknowledgement Receipt

EFS ID:	15998181
Application Number:	95002386
International Application Number:	
Confirmation Number:	7254
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Customer Number:	22852
Filer:	Lloyd L. Pollard II/Tracie Semenchalam
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1		37CFR1182PtoDismissPOsPFINAL.pdf	247317 41ca6e5dcddf0979d6f9ecff57d158cef7f75504	yes	9

Multipart Description/PDF files in .zip description

Document Description	Start	End
Receipt of Petition in a Reexam	1	8
Reexam Certificate of Service	9	9

Warnings:

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2	Fee Worksheet (SB06)	fee-info.pdf	29995 031ff2624166fb90530b097b9060b73fd3046805	no	2

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

ATTORNEY DOCKET NO. COOL-1.012
FILED VIA EFS ON JUNE 10, 2013

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent No.: 8,245,764 **Currently in Litigation Styled:** *Asetek Holdings, Inc et al v. Coolit Systems Inc*, Case No. 3:12-cv-04498-EMC (N.D. Cal.) **Issued:** August 21, 2012 **Filed:** October 7, 2011 **Applicant:** Andre Sloth Eriksen **Title:** COOLING SYSTEM FOR A COMPUTER SYSTEM	**R.C.N.:** 95/002,386 **Confirmation No.:** 7254 **Examiner:** Joseph A. Kaufman **Art Unit:** 3993

SUBMITTED VIA ELECTRONIC FILING SYSTEM ON JUNE 10, 2013
UNITED STATES PATENT AND TRADEMARK OFFICE

PETITION UNDER 37 C.F.R. § 1.183 TO SUSPEND, IN PART, 37 C.F.R. § 1.947

In the interests of justice and pursuant to 37 C.F.R. § 1.183, and to the extent Requester's Replacement Comments currently of record are stricken, Requester respectfully petitions to suspend the provisions of 37 C.F.R. § 1.947 that might otherwise prevent entry of the accompanying Substitute Comments[1] consisting of a redacted version of Requester's original timely filed comments. As explained more fully below, the relief requested under this Petition comports with the entirety of 35 U.S.C. § 314.

A fee of $400 pursuant to 37 C.F.R. § 1.17(f) is being paid concurrently with the filing of this Petition. If the fee paid is insufficient, or if additional or alternative fees are due in connection with the filing of this Petition in Opposition, please charge such fees to Deposit Account No. 50-1001.

BACKGROUND

1. On August 27, 2013, Patent Owner, Asetek A/S, filed a Complaint in the Disctrict Court for the Northern District of California alleging infringement of U.S. Patent No. 8,245,764 (the '764 Patent) by Third-Party Requester, CoolIT Systems, Inc.
2. On September 15, 2012, Requester filed a Request for *Inter Partes* Reexamination (Request) of all claims (i.e., claims 1-18) in the '764 Patent.

[1] The proposed Substitute Comments accompany this Petition as Exhibit A and, except for redactions and the date of submission, correspond word-for-word to the timely filed Original Comments.

3. On October 26, 2012, the Office issued an Order instituting the present reexamination as to all challenged claims. The same day, an Office Action issued rejecting each of the challenged claims as being anticipated by Koga.
4. On December 26, 2012, Patent Owner amended the listing of claims by adding new claims 19-30 and contested the anticipation rejections in a "Response Under 37 C.F.R. § 1.111" (Amendment).
5. On January 25, 2013, Requester filed "Comments by Third-Party Requester under 37 C.F.R. § 1.947 Subsequent to Patentee's Response to Office Action Dated October 26, 2012" (Original Comments).
6. On May 7, 2013, the Office issued a "Notice Re Defective Paper in *Inter Partes* Reexamination" (Notice) and expunged the Original Comments from the Record.
7. On May 22, Requester filed "Comments by Third-Party Requester Under 37 C.F.R. § 1.947 Subsequent to Patentee's Response to Office Action Dated October 26, 2012, and Notice Dated May 7, 2013" (Replacement Comments).
8. On May 31, 2013, Patent Owner petitioned under 37 C.F.R. § 1.182 to expunge the Replacement Comments.
9. Concurrently with filing this Petition under 37 C.F.R. § 1.183, Requester filed a Petition Under 37 C.F.R. § 1.182 to Dismiss Patent Owner's Petition Filed May 31, 2013.

ARGUMENTS

To the extent the Replacement Comments presently of record might be expunged, entry and consideration of the accompanying Substitute Comments would comport with the entirety of 35 U.S.C. § 314 and would serve the interests of justice.

Since the accompanying Substitute Comments consist entirely of a redacted version of the timely filed Original Comments, and omit each portion of the Original Comments objected-to in the Notice, § 314(b) does not prohibit entry and consideration of the Substitute Comments.

Pursuant to 35 U.S.C. § 314(b), each time Patent Owner responds to an action on the merits from the Patent and Trademark Office, Requester shall have one opportunity to file written comments addressing issues raised by the Office action or the Patent Owner's response, provided Requester's comments are received by the Office within 30 days after the date of service of the Patent Owner's response. As M.P.E.P. § 2666.05 II, and numerous decisions by the Office indicate, including in this *Inter Partes* Reexamination, neither the statutory limitation in § 314(b) of "one opportunity to file written comments" nor 37 C.F.R. § 1.947 prohibits a requester from substituting replacement comments for timely filed written comments, provided such replacement comments meet certain requirements (e.g., do not "go beyond" the timely filed original comments).

Indeed, the Office automatically suspends 37 C.F.R. § 1.947 at least once to allow a requester the opportunity to bring timely filed but non-compliant written comments into compliance. M.P.E.P § 2666.05 II. However, nothing in § 314(b) prohibits filing a substitute for the replacement comments. For example, as long as all subject matter contained in such a substitution formed part of the original, timely filed written comments and addresses only issues raised by the Office or the patent owner, that subject matter can properly be considered under § 314(b) as having been timely filed. *See*, M.P.E.P. § 2666.05 II (allowing substitution of replacement comments for improper original comments).

Entry of the proposed Substitute Comments comports with Section 314(b).

As M.P.E.P. § 2666.05 II makes clear, however, the Office does not automatically suspend 37 C.F.R. § 1.947 a second time out of concern for violating the "special dispatch" requirement of § 314(c). Under the current extraordinary circumstances, however, entering the accompanying Substitute Comments, which consist entirely of a redacted version of the timely filed Original Comments striking those portions objected-to in the Notice, would cause no delay in the instant proceeding. Thus, suspending 37 C.F.R. § 1.947 to the extent necessary to enter and to consider the proposed Substitute Comments would not violate the "special dispatch" requirement under § 314(c), as explained more fully below.

For example, the accompanying Substitute Comments consist entirely of a redacted version of the timely filed Original Comments. Thus, the Substitute Comments necessarily address fewer issues than the Original Comments and address no greater number of issues than the Replacement Comments address.[2] Accordingly, consideration of the Substitute Comments would take no longer than consideration of the Replacement Comments.

And, the Office must take time to consider Patent Owner's and Requester's competing Petitions relating to the propriety of the Replacement Comments. Thus, any delay arises by virtue of the competing petitions. Moreover, even assuming, *arguendo*, that the Replacement Comments might ultimately be deemed as improper and stricken from the record, the proposed Substitute Comments would address fewer issues than Replacement Comments and thus would take less time to consider than

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[2] For reasons stated in Requester's concurrently filed Petition under 37 C.F.R. § 1.182, the Replacement Comments are believed to address no greater number of issues than those addressed in the Original Comments and raised by the Office and Patent Owner. (A copy of Requester's Petition Under 37 C.F.R. § 1.182 accompanies this Petition as Exhibit B, for convenience.)

consideration of the Substitute Comments already of record. And, even if the Replacement Comments might be stricken after the Examiner has already considered them, all issues addressed in the proposed Substitute Comments already would have been considered by the Examiner.

Accordingly, under the current extraordinary circumstances, entry and consideration of the Substitute Comments would cause no delay to the instant proceedings and would not run afoul of the "special dispatch" requirement of § 314(c).

Moreover, justice requires suspension of 37 C.F.R. § 1.947 to the extent that rule might otherwise prevent entry of the proposed Substitute Comments.

Requester's right to participate in the *Inter Partes* Reexamination of the '764 Patent is substantial. *See, e.g.*, 35 U.S.C. § 314. The parties are actively involved in a co-pending litigation involving questions of invalidity, unenforceability, and non-infringement of the '764 Patent. If the Office declines the opportunity to fully consider all substantive issues before it, including those in the proposed Substitute Comments, the Office risks possibly confirming overly broad claims subject to concurrent litigation. Confirmation of overly broad claims would unduly prejudice Requester, as well as the Public. Moreoever, it would lead to a waste of party and Court resources, since the issues addressed in the proposed Substitute Comments would be contested and decided in a forum potentially much less efficient than the instant proceeding before the Office.

The Office is well-equipped to efficiently resolve the issues of invalidity before it here and should resolve them. Considering the proposed Substitute Comments would not waste Office resources and would comport with the "Special Dispatch" requirement of Section 314, as the Substitute Comments address only issues raised by the Office and the Patent Owner.

Moreover, Requester has made *bona fide* attempts to respond properly to issues raised in the Office action and in Asetek's Amendment, as well to fully comply with the Notice. *See*, Exhibit B (setting myriad reasons the Replacement Comments are proper). Accordingly, the equities of the situation weigh in favor of entering the proposed Substitute Comments should the Comments currently of record be stricken.

CONCLUSION

Thus, under the current extraordinary circumstances, and in the interests of justice, Requester respectfully urges the Office to enter and fully consider the accompanying Substitute Comments to the extent that the Replacement Comments currently of record might be deemed to be improper and ultimately expunged from the Record.

Date: June 10, 2013

Respectfully submitted,
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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a complete copy of this PETITION UNDER 37 C.F.R. § 1.183 TO SUSPEND, IN PART, 37 C.F.R. § 1.947, together with EXHIBITS A and B thereto, was served on counsel for patent owner at the following address:

Biju I. Chandran
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via first class mail, on June 10, 2013.

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EXHIBIT A TO REQUESTER'S PETITION UNDER 37 C.F.R. § 1.183

Proposed Substitute Comments

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent No.: 8,245,764	**R.C.N.:** 95/002,386
Currently in Litigation Styled: *Asetek Holdings, Inc et al v. Coolit Systems Inc*, Case No. 3:12-cv-04498-EMC (N.D. Cal.)	**Confirmation No.:** 7254 **Examiner:** Joseph A. Kaufman
Issued: August 21, 2012	**Art Unit:** 3993
Filed: October 7, 2011	
Applicant: Andre Sloth Eriksen	
Title: COOLING SYSTEM FOR A COMPUTER SYSTEM	

SUBMITTED VIA ELECTRONIC FILING SYSTEM ON JUNE 10, 2013
UNITED STATES PATENT AND TRADEMARK OFFICE

COMMENTS BY THIRD-PARTY REQUESTER UNDER 37 C.F.R. § 1.947 SUBSEQUENT TO PATENTEE'S RESPONSE TO OFFICE ACTION DATED OCTOBER 26, 2012

Pusuant to 37 C.F.R. § 1.947, Requester submits its comments in reponse to Asetek's "Response Under 37 C.F.R. § 1.111," filed with the Office on December 26, 2012 (referred to hereafter as the "Amendment").

TABLE OF CONTENTS

I. CLAIM CONSTRUCTION

During *inter partes* reexamination, claims are interpreted according to the "broadest reasonable interpretation" standard. *See* MPEP § 2658; 2258(I)(G) (citing In re Yamamoto, 740 F.2d 1569 (Fed. Cir. 1984)). The analysis in these Comments is intended to comport with this standard.

Because the standards of claim interpretation applied by the Federal Courts during patent litigation proceedings differ from the claim interpretation standard that must be used in the Patent Office during claim reexamination proceedings, any interpretations of terms in the claims discussed herein for the purpose of reexamination are not binding on Requester in any litigation related to the '764 Patent (or other patents) and do not necessarily correspond to the construction of claims under the legal standards that must be applied by the Federal Courts in litigation. *See*, In re Zletz, 893 F.2d 319, 321-322 (Fed. Cir. 1989). In applying the particular prior art references identified herein, Requester neither admits nor acquiesces as to any interpretation of any claim of the '764 Patent asserted now or in the future in litigation before the Federal Courts, or in any other proceeding before any other tribunal. Requester reserves all rights to challenge in any proceeding, before any forum, any claim interpretations proferred by the Patent Owner in putting forth allegations of infringement against Requester.

II. ISSUES RAISED BY PATENT OWNER'S AMENDMENT MAKE CITATION OF ADDITIONAL PRIOR ART PROPER

In accordance with 37 C.F.R. § 1.948(a)(1)-(2), several additional prior art references cited in these Comments are necessary to rebut a response of the Patent Owner and/or a finding by the Examiner. In particular, but not exclusively, reliance on art not presently a basis of the reexamination proceeding is proper where, as here, Patent Owner amends the claims. 37 C.F.R. § 1.948(a)(2). Available art includes references previously considered by the Office, as well as references not previously considered by the Office.[1] Moreover, the Office can adopt new prior art rejections anytime during the reexamination proceeding.[2] Each reference not already of record in this reexamination accompanies these Comments and is listed on the accompanying Information Disclosure Statement. In particular, these Comments refer to each of the following additional prior art references:

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[1] *See*, MPEP §§ 2258-2258.01.

[2] *See, e.g.,* Belkin Int'l, Inc. v. Kappos, Slip Op. 2012-1090 (Fed. Cir., 2012). Although the Belkin decision concerned an *inter partes* reexamination under the pre-AIA "substantial new question" standard, the Court's statement regarding the Office's ability to raise new grounds of rejection does not appear to be so limited. *Also see*, MPEP § 2258.01 (stating that "in the examining stage of a reexamination proceeding, the examiner will consider whether the claims are subject to rejection based on art," without limitation on the scope of the body of art).

1. Shinya Koga, *et al.*, U.S. Patent No. 7,209,355, issued April 24, 2007, from an application filed on October 29, 2004, and claiming priority from an application filed on October 4, 2002 (hereinafter "**Koga '355**");
2. Bruce Munson, *et al.*, Fundamentals of Fluid Mechanics, 3rd Ed., pp. 45-48, 1998 (hereinafter, "**Munson**");
3. Shorter Oxford English Dictionary, 5th Ed (2002), p. 3526;
4. Qiang-Fei Duan, *et al.*, U.S. Patent No. 7,325,591, issued on February 5, 2008, from an application filed February 18, 2005 (hereinafter "**Duan**");
5. Oliver Laing, *et al.*, U.S. Publication No. 2004/0052663, published March 18, 2004, from an application filed on May 7, 2003 (hereinafter "**Laing**");
6. Jie Wei, *et al.*, U.S. Patent No. 7,222,661, issued May 29, 2007, from an application filed on November 18, 2004 (hereinafter "**Wei**");
7. Shin Takayuki, Japanese Publication No. 2002-151638, published on May 24, 2002 (hereinafter "**Takayuki**") (accompanied by English-language translation generated by the Japanese Patent Office website);
8. Brian A. Hamman, U.S. Patent No. 6,529,376, issued March 4, 2003, from an application filed August 3, 2001 (hereinafter "**Hamman**"); and
9. Kioan Cheon, U.S. Patent No. 5,731,954, issued on March 24, 1998, from an application filed August 22, 1996 (hereinafter "**Cheon**").

Each prior art patent and publication cited herein constitutes effective prior art as to the challenged claims of the '764 Patent under 35 U.S.C. § 102 and/or 35 U.S.C. § 103.[3] Requester relies on the entirety of these Comments to support the propriety of citing to additional prior art under 37 C.F.R. § 1.948(a).

III. THE NEW CLAIMS DO NOT SATISFY 35 U.S.C. § 112

Pursuant to 37 C.F.R. § 1.906, the new claims shall be examined, in part, on the basis of the requirements of 35 U.S.C. § 112. (Consistent with 37 CFR 1.906(a), Requester does not herein explain the many ways in which the **issued** claims are invalid under Section 112.)

At the outset, Requester notes that admissions by the Patent Owners as to matters affecting patentability may be used to reject claims in a reexamination proceeding. 37 C.F.R. § 103(c)(3).

A. Proposed New Claims 20, 21, 24, 25, 28 and 29 Are Indefinite

During examination, after applying the broadest reasonable interpretation to the claim, if the metes and bounds of the claimed invention are not clear, the claim is indefinite and should be rejected. *Zletz*, 893 F.2d at 322. For example, if the language of a claim, given its broadest reasonable

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[3] *See* Patent Owner's admissions in its Amendment dated December 26, 2012, for example but not exclusively on pages 26-27, and as discussed herein, below.

interpretation, is such that a person of ordinary skill in the relevant art would read it with more than one reasonable interpretation, then a rejection under 35 U.S.C. 112, second paragraph is appropriate. MPEP § 2173.02(I). In reviewing a claim for compliance with 35 U.S.C. 112, second paragraph, the examiner must consider the claim as a whole to determine whether the claim apprises one of ordinary skill in the art of its scope and, therefore, serves the notice function required by 35 U.S.C. 112, second paragraph, by providing clear warning to others as to what constitutes infringement of the patent. MPEP § 2173.02(II) (citing *Solomon v. Kimberly-Clark Corp.*, 216 F.3d 1372, 1379 (Fed. Cir. 2000)).

Proposed claims 20, 21, 24, 25, 28 and 29 are indefinite on account of their use of at least the following terms and phrases, all of which is new claim language not found in the issued claims (or anywhere else in the specification).

"*the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber*" (recited in each of claims 20, 24 and 28): From this phrase, it is unclear whether the claimed thing "that opens into the thermal exchange chamber" is the "reservoir," the "plurality of passages positioned within the reservoir" or "the one or more passages." A review of the portions of the '764 Patent cited by Asetek (e.g., FIG. 17; 22:26-43) does nothing to resolve the ambiguous claiming. The exploded assembly view in FIG. 17 does not even identify the claimed "thermal exchange chamber," leaving one to wonder about the path a fluid would take into the claimed thermal exchange chamber. For example, it is unclear from FIG. 17 and its associated description whether the intermediate member 47 seats against the housing 14 and thus whether "reservoir" opens into the thermal exchange chamber, whether the outlet 34 opens into the thermal exchange chamber and whether either or both of the first passage 48 and second passage 49 opens into the thermal exchange chamber. Each of claims 20, 24 and 28 should be cancelled or amended to resolve the indefinite formulation currently proposed.

"*wherein an entire surface of the heat-exchanging[4] interface in contact with the cooling liquid in the reservoir forms the boundary wall of the thermal exchange chamber*" (expressly recited in claims 21 and 29, and similarly claimed in claim 25): This new claim language is indefinite on several fronts. First, it is unclear how a "surface," which by definition is two-dimensional, could form the claimed "boundary wall," a three-dimensional structure configured, according to the claims, to be placed into contact with a heat generating component. Second, the recitation "the heat-exchanging interface" in claims 21 and 29, and "the heat-exchange" interface in claim 25, lacks an antecedent basis. For example, independent claim

[4] Claim 25 recites "heat-exchange interface," but suffers similar deficiencies with regard to this recitation as discussed in connection with "heat-exchanging interface."

1 from which claim 21 depends merely recites "a heat-exchanging interface forming a boundary wall of the thermal exchange chamber, and configured to be placed in thermal contact with a surface of the heat-generating component." Neither claim 21 nor claim 1 claims a "heat-exchanging interface in contact with the cooling liquid in the reservoir." Accordingly, it is unclear which surface could constitute the newly claimed "entire surface" in proposed claim 21. Claim 25 suffers a similar deficiency in relation to the base claims from which it depends (i.e., claims 10 and 12). Moreover, independent claim 15 recites a "heat-exchange interface," yet proposed claim 29 recites "the heat-exchanging interface." Accordingly, each of claims 21, 25 and 29 should be cancelled or amended to resolve the indefinite proposed claiming.

B. NEW CLAIMS 19-30 LACK WRITTEN DESCRIPTION-ENABLEMENT SUPPORT

Much of the new claim language added to the proposed claims, and not found in the issued claims, is unsupported under Section 112, ¶ 1.

Asetek points to no drawing or description in the patent of a complete cooling system practiced as a single embodiment having the following features, which appear for the first time in the proposed claims. Instead, Asetek attempts to cherry pick elements from different portions of the specification and drawings and assemble them into new, and in some instances inoperative, combinations. Even with this improper attempt to assemble disparate elements of different embodiments, some of which result in inoperative combinations, collectively they still do not describe the recited cooling systems.

"wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber" (required by claims 19, 23 and 27): Claims 19, 23 and 27 depend from issued independent claims 1, 10 and 15, respectively. Issued claim 1 requires "an impeller cover having one or more passages." As Asetek admits on Page 15 of its Amendment, independent claims 1, 10 and 15 recite common features and should be read together, including the claimed "one or more passages." Thus, the impeller cover must define the claimed "passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber."

The written description does not use the phrase "direct cooling liquid from the pump chamber directly into the thermal exchange chamber." Apart from Asetek's vague statement in the Amendment that FIG. 17 somehow provides "support" for this new element, the patent has no drawing purporting to describe or otherwise define what is meant by this phrase. In particular, the patent does not expressly or necessarily disclose any embodiment showing any passage in the impeller cover configured to direct cooling liquid from the pump chamber **directly** into the thermal exchange chamber identified by Asetek in its latest response. In particular, FIG. 17 (reproduced below from Asetek's Amendment with additional annotations for convenience) and FIG. 20 (also reproduced below for additional clarity) show that neither the outlet 34 nor the unnumbered opening in the impeller cover 46A is configured to direct cooling liquid from the pump chamber **directly** into the purported themal exchange chamber as required by the new recitation.

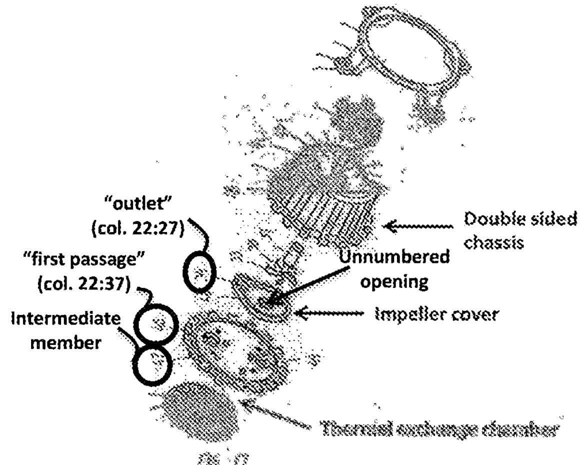

FIG. 17 AS PRESENTED IN ASETEK'S AMENDMENT ON PAGE 28 (WITH ADDITIONAL ANNOTATIONS FOR CONVENIENCE)

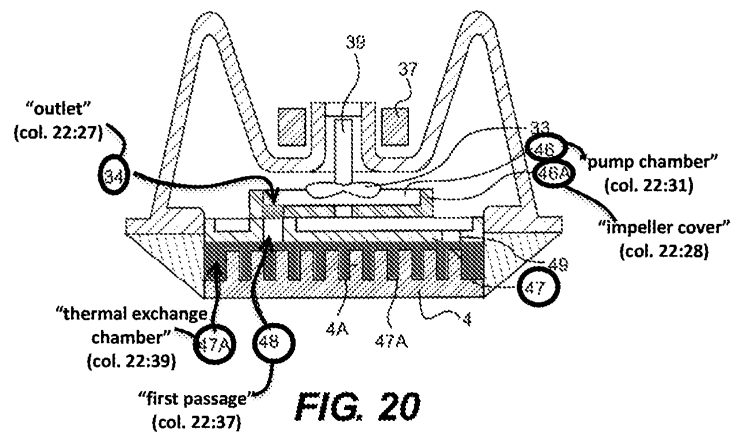

FIG. 20 FROM THE '764 PATENT, ANNOTATED[5]

Instead, any cooling liquid passing from the pump chamber must pass through (or at least by) the intermediate member 47 before entering the purported thermal exchange chamber 47A. Indeed, the text relied on by Asetek expressly states as much: "The intermediate member 47 is provided with a first passage 48 for leading cooling liquid from the pump chamber 46 to a thermal exchange chamber 47A provided at the opposite of the intermediate member 47." '764 Patent, col. 22:36-39. Thus, what Asetek cites as "support" for this claim element (Amendment, pp. 13 and 28) does not support the element.

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[5] Requestor notes the unresolved issue of whether the subject matter shown in FIG. 20 was adequately described in the original International Application.

"wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber" (required by claims 20, 24 and 28): Claims 20, 24 and 28 depend from independent claims 1, 10 and 15, respectively. Issued independent claim 1 requires "an impeller cover having one or more passages." As Asetek admits on Page 15 of its Amendment, independent claims 1, 10 and 15 recite common features and should be read together, including the claimed "one or more passages." Thus, the impeller cover must define the claimed "plurality of passages positioned within the reservoir that opens into the thermal exchange chamber."

However, the written description does not use the phrase "a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber." Apart from Asetek's vague statement in the Amendment that FIG. 17 somehow provides "support" for this new element, the patent has no drawing purporting to describe or otherwise define what is meant by this phrase. In particular, the patent does not expressly or necessarily disclose any embodiment showing any passage in the impeller cover (let alone a plurality of passages) that opens into the thermal exchange chamber. To the contrary, FIG. 17 (reproduced above) shows that neither the outlet 34 nor the unnumbered opening in the impeller cover 46A opens into the thermal exchange chamber.

Instead, any cooling liquid passing from the pump chamber must pass through (or at least by) the intermediate member 47 before entering the purported thermal exchange chamber. Indeed, the text relied on by Asetek expressly states as much: "The intermediate member 47 is provided with a first passage 48 for leading cooling liquid from the pump chamber 46 to a thermal exchange chamber 47A provided at the opposite of the intermediate member 47." '764 Patent, col. 22:36-39. Thus, what Asetek cites as "support" for this claim element (Amendment, pp. 13 and 28) does not support the element.

"an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms the boundary wall of the thermal exchange chamber" (required by claims 21, 25 and 29):

As noted above, this new claim element is indefinite, and Requester cannot ascertain what is intended to be claimed by this new requirement. Regardless, the written description does not use the newly coined phrasing. In particular, the patent does not expressly or necessarily disclose any embodiment that would put one of ordinary skill in the art on notice as to what is intended to be claimed.

Whatever surface this new element refers to, Asetek's citation to "FIG. 17, '34', '48'; Col. 22: 26-43" does nothing to clarify the matter. The patent has no drawing or description purporting to describe or otherwise define what is meant by this new claiming. Asetek's citation is irrelevant to the claimed surface. For example, reference numeral "34" is referred to as an "outlet" and reference numeral "48" is referred to as a "first passage" in the cited text. *See* '764 Patent, col. 22:26-43.

Asetek's Amendment lacks any indication of where support for any surface, let alone "an entire surface" that forms the claimed "boundary wall of the thermal exchange chamber," can be found in the patent. Indeed, one cannot even ascertain what constitutes a "thermal exchange chamber" from the cited text. For example, the specification non-sensically states "An intermediate member 47 is provided between the pump chamber 46 together with the interior of the reservoir and a heat exchanging interface 4." Id. at 22:33-36. Thus, what Asetek cites as "support" for this claim element does not support the element.

"the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir" (required by claims 22, 26 and 30): Although Asetek cites to FIG. 4 in the '764 Patent as allegedly providing support for these new features, Asetek points to no drawing or any description in the patent of a complete cooling system practiced as a single embodiment having the features required by these new dependent claims and the base claims from which they depend. For example, claims 22, 26 and 30 depend from independent claims 1, 10 and 15, respectively. Issued independent claim 1 requires, *inter alia*, an "a pump chamber including the impeller and … a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber, the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages." Asetek admits on Page 15 of its Amendment that independent claims 1, 10 and 15 recite common features and should be read together, including the claimed vertical spacing.

However, the embodiment shown in FIG. 4 in the '764 Patent (identical to the the embodiment shown in FIGS. 6 and 8 (*see* '764 Patent, 9:43-45, 48-49)) lacks any combination of features that apparently can be construed as a pump chamber vertically spaced from a thermal exchange chamber, contrary to the requirements of each of claims 1, 10 and 15.[6] That said, the '764 Patent explains that the embodiment shown in FIG. 17 has such a combination of features. However, the embodiment illustrated in FIG. 17, and later purportedly illustrated in FIG. 20, lacks any indication of an inlet or an outlet as required by the newly proposed claims.

Admittedly, the specification mentions in passing that "the reservoir housing 14 may be provided with an inlet (not shown) and an outlet (not shown) for the cooling liquid." '764 Patent, 21:62-64.

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[6] This is particularly evident based on Asetek's assertion that two chambers cannot be considered as vertically spaced apart from each other if even a minor portion of one chamber overlaps with a portion of another chamber (i.e., if the portions are "at the same level" as each other). *See* Amendment, p. 20 (alleging that Koga does not disclose vertically spaced chambers).

However, simply adding an inlet 15 and an outlet 16 of the type shown in FIG. 4 to the reservoir housing 14 shown in FIGS. 17 and 20 would not allow the cooling system to operate as required by the proposed claims – i.e., to direct cooling liquid into the reservoir and to discharge the cooling liquid from the reservoir. Instead, the cooling liquid within the reservoir housing 14 would simply continue to recirculate within the reservoir housing. The '764 Patent lacks any description of how to prevent such recirculation in order for the cooling liquid to flow along the path required by the proposed claims.

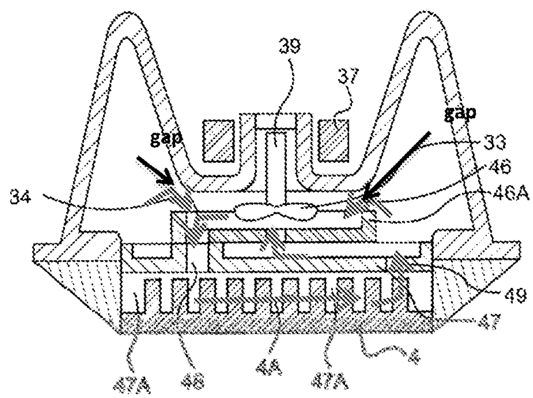


FIG. 20

FIG. 20 FROM THE '764 PATENT, ANNOTATED TO SHOW A GAP THAT PERMITS THE COOLING LIQUID TO RECIRCULATE, AS WELL AS THE PATH OF RECIRCULATION

Accordingly, even with the improper attempt to assemble disparate elements of different embodiments, the result is an inoperative combination of elements, providing evidence that Asetek did not fully appreciate, let alone enable or describe, such a combination. Taken collectively, the cherry-picked elements inadequately describe the cooling systems recited in the proposed claims. Accordingly, what Asetek cites as "support" does not support proposed claims 22, 26 and 30.

IV. THE OFFICE SHOULD DECLINE ASETEK'S EXTREME REWRITING OF THE ISSUED CLAIMS IN THE GUISE OF "CONSTRUCTION" AND MAINTAIN THE REJECTIONS BASED ON KOGA

In an attempt to distinguish the issued claims from the prior art, Asetek proposes new constructions that are contrary to the language of the claims, contrary to examples of "the invention" shown in the '764 Patent, and contrary to the plain meaning one of ordinary skill in the art would have understood from reading the existing claims. In the guise of construing the claims, Asetek in effect replaces them with a rewriting that adds supposed limitations not recited in the claims or even expressly described in the specification (to try to avoid invalidating prior art). Asetek's lack of confidence in its extreme "construction" positions is shown by its submission of a dozen new claims reciting new limitations.

Moreover, no basis exists in the file history of the '764 Patent for one of ordinary skill in the art to independently arrive at the Patent Owner's strained and unduly narrow interpretation of "chamber" and "vertical" set forth in its December 26, 2012, Amendment, particularly in versions of the specification and drawings pre-dating the application's expansion to include FIG. 20 and its corresponding description. Accordingly, Patent Owner's proffered interpretation of these terms should be rejected as failing to comport with the "broadest reasonable interpretation" required in the reexamination context.

Asetek's proposed "constructions" have no support in the claim language, in any definitions in the patent, in any description of the "invention" in the patent, or in the prosecution history. Moreover, Asetek points to no art-accepted definition for the terms "chamber" and "vertical" in a technical treatise or a dictionary that refutes the construction already adopted by the Office.

A. Asetek's Proposed Definition Of The Term "Chamber" Subsumes Asetek's Description Of Koga's "Sucking Channel 19"

Asetek agrees with the Examiner's construction of the term "chamber" as meaning "any enclosed space; compartment …." Amendment, p. 18 (citing to the Order, pp. 4 and 7). However, Asetek does not explain any basis for its conclusion that Koga's "sucking channel 19" is somehow not an enclosed space or a compartment. Indeed, Asetek even presents a definition of the term "channel" as being "a tubular passage for liquids; a conduit." Amendment, p. 18, FN 5.

These definitions of "chamber" and "channel" are not mutually exclusive. In contrast to Asetek's apparent position, the definition of "chamber" adopted by Asetek subsumes its propounded definition of "channel". A "tubular passage for liquids" necessarily constitutes an "enclosed space." Accordingly, the definition of the term "channel" proposed by Asetek fits squarely within the definition of the term "chamber" adopted by Asetek. Thus, Koga's "sucking channel 19" is properly considered a "chamber."

B. Asetek Does Not Refute That Koga's Sucking Channel Is An Enclosed Space

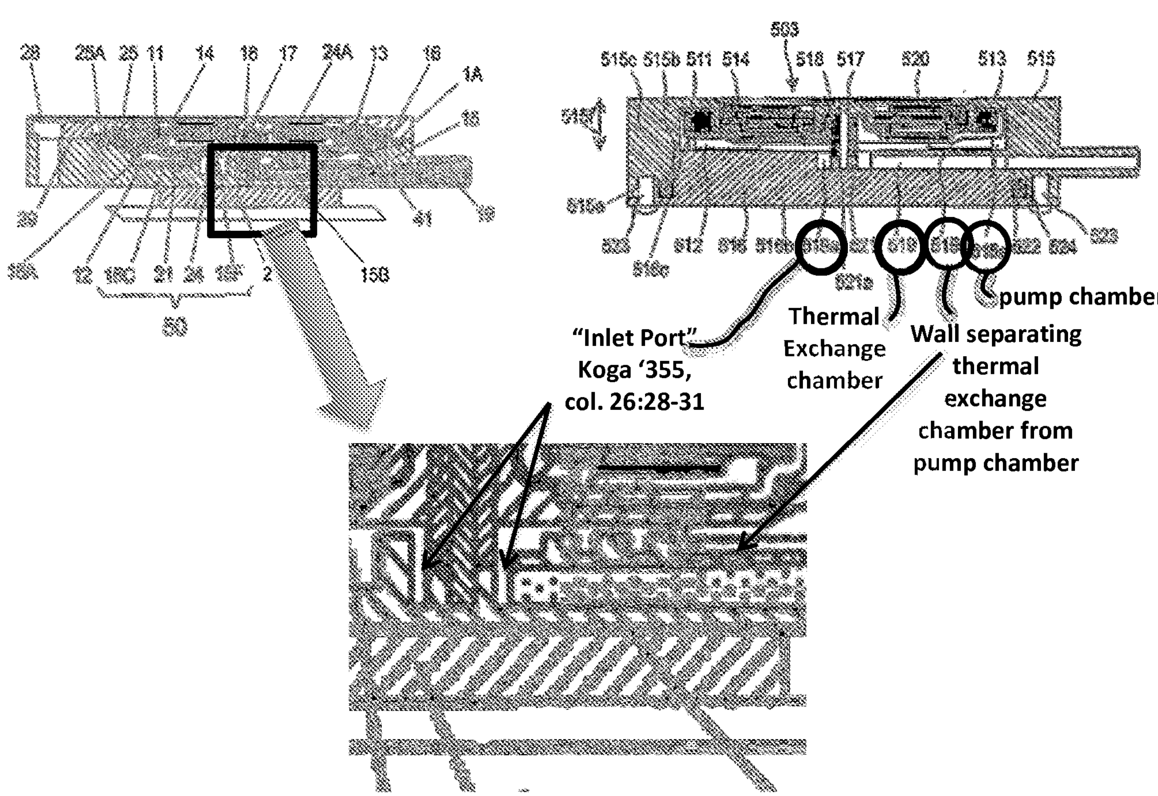
Moreover, Asetek does not refute that Koga's "sucking channel 19" is an enclosed space or a compartment. Rather, Asetek makes qualified allegations that Koga's "sucking channel" does not constitute a portion of Koga's "pump room 15A." Amendment, p. 18. Although this admission by Asetek squarely confirms that Koga's sucking channel 19 is separate from Koga's pump chamber 15A, it does nothing to distinguish Koga's "sucking channel 19" from a claimed "chamber." Thus, despite the verbosity of Asetek's argument, Asetek does not seriously challenge that Koga's "sucking channel 19" constitutes a "chamber," as claimed.

Asetek's conclusory and unfounded attorney argument on pages 18-20 concerning the alleged understanding one of ordinary skill in the art would have given Koga cannot supplant evidence as to what one of ordinary skill in the art would have understood. The specification does not clearly and unquestionably define the term "chamber" to mean anything that would distinguish over Koga's channel 19. Instead, the evidence merely confirms the Examiner's interpretation that Koga discloses a claimed.

C. Contrary To Asetek's Mere Argument, Evidence Confirms That Koga's "Sucking Channel 19" Is Properly Construed As A Claimed "Thermal Exchange Chamber"

A substantially similar device to the one shown in Koga's FIG. 7 is shown and described in FIG. 51 of Koga '355. For convenience, these drawings are reproduced below.

FIG.7 Fig. 51



ANNOTATED COMPARISION OF FIG. 7 IN KOGA AND FIG. 51 IN KOGA '355 SHOWING THAT BOTH DEVICES INCLUDE AN "INLET PORT" TO THE PUMP CHAMBER

Koga's so-called "sucking channel 19" is relabeled in Koga '355 as a "passage 519". *Cf.* Koga, FIG. 7, col 8:4-24; and Koga '355, FIG. 51, col. 28:32-34, 42-46. Moreover, Koga '355 explains that the passage 519 is formed by overlaying a "sealing portion 515d of the upper case 515" on a groove 519b in the lower case 516 "for sealing between the pump chamber 515a and the inlet passage 519 to allow no leakage of the coolant." Koga '355 28:34-58. Clearly, the passage 519 constitutes an enclosed space, and thus is a "chamber," as claimed.

Koga's "sucking channel 19" must also be considered an enclosed space in at least the same way that the passage 519a in Koga '355 constitues an enclosed space. Thus, Koga's "sucking channel 19" is properly construed in the outstanding Office action as being a claimed "chamber." The Office should continue to consider Koga's channel 19 as being a "chamber," which it clearly is.

The specification and file history impart no special or different meaning to the phrase "thermal exchange." Accordingly, its plain and ordinary meaning controls. For example, during operation, energy in the form of heat is absorbed by the cooling liquid in the chamber 19 from the casing wall 15. *See, e.g.*, Request, p. 37 (citing Koga FIG. 7, col. 9:10-47).

As explained in the Request and confirmed in the Office Action, Koga's sucking channel 19 consitutes a "thermal exchange chamber". Id.

D. ASETEK'S COMMENTS REGARDING LAING AND DUAN ARE INAPPOSITE

The inlet and outlet ports shown in each of Laing and Duan are irrelevant to whether Koga discloses a pump chamber vertically spaced apart from a thermal exchange chamber. *See*, Amendment, p. 21. First, neither of Laing's ports 20, 26 and neither of Duan's ports 11, 12 houses a pump. Second, neither of Laing's ports and neither of Duan's ports is placed in thermal contact with a heat generating component. Accordingly, Requester never alleged and the Office has not determined whether either of Laing's ports and/or either of Duan's ports should be considered as a pump chamber or as a thermal exchange chamber. Asetek's remarks are misplaced and irrelevant.

E. KOGA DISCLOSES A PUMP CHAMBER

Moreover, Koga's so-called "pump room 15A" is relabeled in Koga '355 as a "pump chamber 515a" in accordance with idiomatic English. *Cf.* Koga, FIG. 7, col 8:4-24; and Koga '355, FIG. 51, col. 28:32-34, 42-46. Thus, Koga's pump room 15A clearly constitutes a "pump chamber."

F. KOGA DISCLOSES A VERTICAL SEPARATION BETWEEN THE PUMP CHAMBER AND THE THERMAL EXCHANGE CHAMBER

The sole remaining question, then, is whether Koga's pump chamber 15A is vertically spaced from the thermal exchange chamber 19. The answer is a resounding "yes," particularly considering that Asetek has admitted in this reexamination that Koga's thermal exchange chamber 19 does not constitute a portion of the pump chamber. *See*, Amendment p. 18 (stating "sucking channel 19 is not a 'chamber' of Koga's pump room 15A").

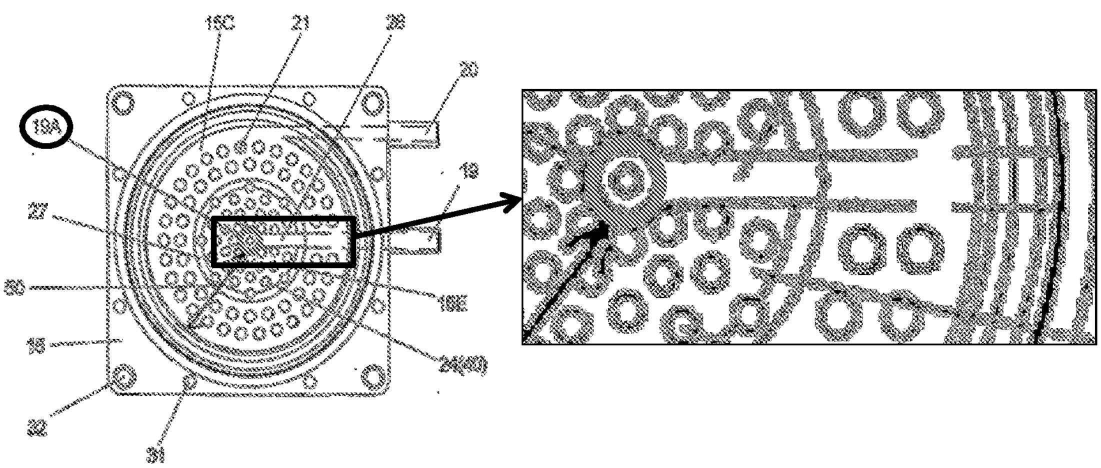
As shown in Koga's FIG. 7, above, a horizontal wall extends between Koga's thermal exchange chamber 19 and the pump chamber 15A. (A similar wall 515d extends between the thermal exchange chamber 519 and the pump chamber 515A in Koga '355). The Shorter Oxford English Dictionary, 5th Ed.

even defines "vertical" to mean "placed, extending, moving or operating at right angles to a horizontal plane …."[7] The horizontal wall of Koga has a finite thickness extending vertically, and thus separates the thermal exchange chamber 19 from the pump chamber 15A, as admitted by Asetek, in a vertical direction. Moreover, Koga's summary describes an aspect of its disclosure as "a sucking channel [Koga's thermal exchange chamber] prepared between the heat receiving plane and an inner wall of the pump room [Koga's pump chamber]." Koga, col. 3:24-25; 4:58-60.

G. Asetek Misconstrues Koga In An Attempt To Distinguish It

Asetek urges, incorrectly, on page 20 of its Amendment that a portion of Koga's pump chamber is positioned at the same level as the thermal exchange chamber 19. Instead, as Koga explains with regard to FIG. 5 (reproduced below), the feature Asetek regards as a portion of the pump chamber 15A is actually an inlet port to the pump chamber. *See*, Koga, FIGS. 5 and 7, col. 6:6, 8, 19; *also see,* Koga '355, col. 26:27-30 (describing a similar inlet port 519a). Thus, contrary to Asetek's allegations, no portion of Koga's pump chamber 15A is "at the same level as" Koga's thermal exchange chamber 19. Koga's chambers are vertically spaced apart, as claimed.

FIG.5



KOGA FIG. 5 (ANNOTATED AND ENLARGED TO SHOW DETAIL OF INLET PORT 19A, SHADED)

H. Asetek's Proposed Construction Of "Vertical" Flies In The Face Of Common Sense And Does Not Comport With The Concept Of "Vertical" Understood In The Art

Even assuming, *arguendo*, that Koga's inlet port to the pump chamber 15A could be construed as being a portion of the pump chamber, the mere fact that such a port might be "at the same level as" the

[7] An excerpt of the Shorter Oxford English Dictionary (OED) accompanies these Comments.

thermal exchange chamber 19 does not prevent the pump chamber 15A and the thermal exchange chamber 19 from being vertically separated under the "broadest reasonable interpretation" standard governing reexamination.

First, practical experience reveals that liquids flow under gravity from higher elevations to lower elevations. Common sense dictates that a liquid could flow under gravity from Koga's pump chamber 15A into Koga's thermal exchange chamber 19 when the device is disconnected from a fluid circuit. Thus, based simply on common sense, Koga's thermal exchange chamber should be considered as being below Koga's pump chamber. Asetek's assertion to the contrary based on the position of an inlet is farcical.

Second, the Munson reference, an introductory textbook concerning fluid mechanics, confirms that pressure in a static body of liquid of the type used in claimed cooling systems is "not influenced by the size or shape of the tank or container in which the fluid is held." Munson, p. 46. Rather, Munson explains, the depth of the fluid is what controls. Id. Accordingly, one of ordinary skill in the art would readily understand from this single passage, as well as from the totality of Munson (as well as common sense), that Koga's pump chamber 15 is positioned above Koga's thermal exchange chamber 19, even if Koga's inlet port could be considered as being a portion of the pump chamber chamber.

Moreover, Asetek's illogical assertions regarding Koga's inlet port 19A do nothing to address that Koga discloses a wall overlying the thermal exchange chamber and vertically separating the pump chamber from the thermal exchange chamber. *See, e.g.*, Koga, FIG. 7 (reproduced above). Asetek even admits that Koga's thermal exchange chamber 19 constitutes no portion of Koga's pump chamber 15. *See*, Amendment, p. 18.

I. ASETEK'S PROPOSED CONSTRUCTION OF "VERTICAL" DOES NOT EVEN COMPORT WITH THE '764 PATENT'S CONCEPT OF THE PURPORTED "INVENTION"

According to the '764 Patent, FIG. 4 shows "an exploded view of the invention and the surrounding elements." '764 Patent, col. 9, 38-39. FIG. 6 shows an exploded view of the purported "invention". Id. at 9:43-45. FIGS. 4 and 6 from the '764 Patent are reproduced below and annotated for convenience.

From even a cursory review of FIGS. 4 and 6, the purported "invention" appears to be no more than a pump 21 positioned within a box 14. From a study of FIGS. 4 and 6, it is difficult to understand Asetek's allegations that Koga somehow does not disclose vertically spaced apart chambers given that the purported "invention" shown in FIGS. 4 and 6 seems to completely immerse all features associated with the pump 21 in the box 14.

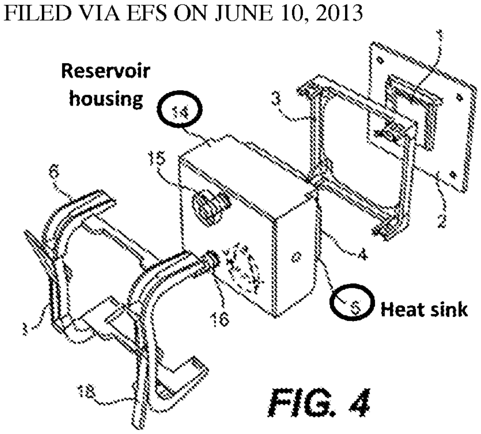


FIG. 4

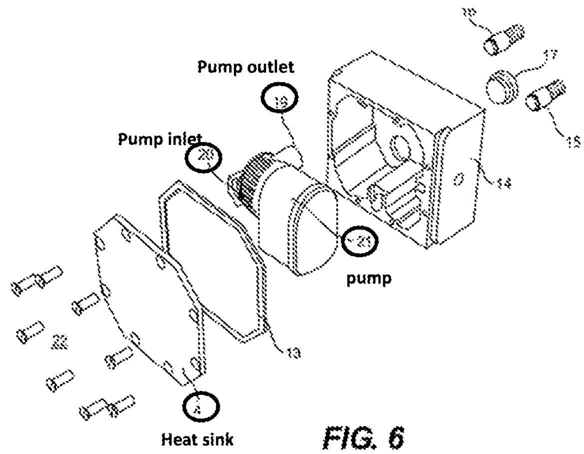


FIG. 6

FIGS. 4 AND 6 FROM THE '764 PATENT SHOWING THE PURPORTED "INVENTION"

J. THE REJECTION OF EACH OF EXISTING INDEPENDENT CLAIMS 1, 10 AND 15 AS BEING ANTICIPATED BY KOGA SHOULD BE MAINTAINED

Asetek's attempts to distinguish issued claims 1, 10 and 15 from the prior art are contrary to the language of the claims, contrary to examples of "the invention" shown in the '764 Patent, and contrary to the plain meaning one of ordinary skill in the art would have understood from reading the claims. In the guise of construing the claims, Asetek in effect attempts to replace them with a rewriting that adds supposed limitations not recited in the claims or even expressly described in the specification (to try to avoid invalidating prior art). However, Asetek has the option of amending the claims in an attempt to overcome the properly set forth prior art rejections based on Koga. Requester respectfully urges the Office to reject Patent Owner's proffered constructions and instead require Patent Owner to amend the claims if it wishes to overcome the outstanding rejections of claims 1, 10 and 15 based on Koga.

K. THE REJECTION OF EACH OF DEPENDENT CLAIMS 2-9, 11-14 AND 16-18 AS BEING ANTICIPATED BY KOGA SHOULD BE MAINTAINED

Asetek merely alleges that each of existing dependent claims 2, 3, 5-9, 11-14 and 16-18 should be determined to be patentable by virtue of its respective dependency from an existing base claim, without alleging any other basis of patentability. Requester respectfully urges that the Office should maintain the outstanding rejection of each of existing claims 2, 3, 5-9, 11-14 and 16-18, at least because the base claims should remain rejected and Asetek has set forth no other basis for withdrawing the outstanding rejections of existing dependent claims 2, 3, 5-9, 11-14 and 16-18.

Dependent claim 4 recites "The cooling system of claim 3, wherein the first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber." Although it is unclear what is meant by "adapted to increase heat transfer" (e.g., "increase" relative to what?), Requester submits that Koga discloses each and every element arranged as claimed in dependent claim 4 (as well as the base claims from which it depends).

As a first example, Koga explains that the casing 15 and thus the heat exchanging interface 15B is made of "highly conductive material," which "adapts" the first side of the heat exchanging interface (e.g., the side in contact with cooling liquid in the thermal exchange chamber 19) to increase heat transfer to the cooling liquid in the thermal exchange chamber 19 (e.g., relative to a material with low thermal conductivity). *See, e.g.*, Koga, col. 10:22-23.

As a second example, the "first side" of the heat exchanging interface 15B is adapted to direct coolant through the thermal exchange chamber 19 toward the center of the impeller 11, increasing cooling efficiency. *See, e.g.*, Koga, col. 8:4-9, 31-33 (stating "as a result, much more heat transferred to casing 15 can be collected by coolant 41").

As a third example, Koga explaines that the "backside of heat receiving plane 15B," a portion of which consititutes the claimed "first side" in contact with coolant in the thermal exchange chamber 19, can be dimpled. Koga, col. 6:52-53. Koga explains further that such features on the "backside" facilitates heat transfer by distrupting a boundary layer. Koga, col. 6:56-62.

Thus, Koga discloses that a first side of the heat-exchanging interface 15B includes features (e.g., conductive material, configuration to direct coolant, and dimples) that are adapted to increase heat transfer from the heat-exchanging interface 15B to the cooling liquid in the thermal exchange chamber 19, as claimed in dependent claim 4. The rejection of claim 4 as being anticipated by Koga should be maintained.

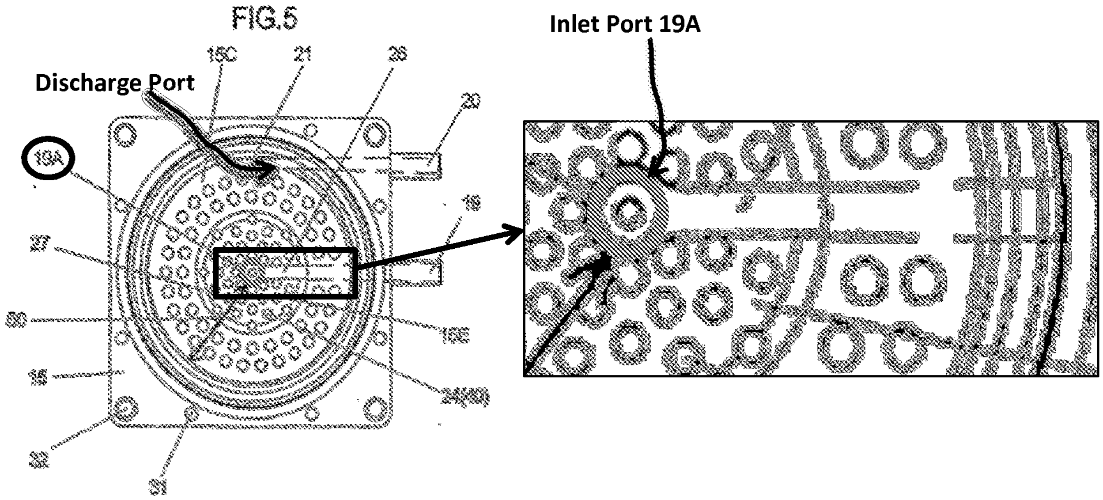
V. THE NEW CLAIMS ARE UNPATENTABLE OVER KOGA

As explained below, Koga discloses each and every feature arranged as claimed in each of proposed claims 19-30. Thus, Koga anticipates each proposed claim.

A. KOGA ANTICIPATES NEW CLAIMS 19, 23 AND 27

Each of proposed claims 19, 23 and 27 requires that the "one or more passages include[s] a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber." As stated in the Request, Koga's pump chamber 15A is defined by Koga's casings 15 and 16, which form an impeller cover. *See*, Request, pp. 152, 158, 161. As described above and shown in Koga's FIG. 5 (reproduced below for convenience), the casings 15 and 16 also define an inlet port 19A extending between Koga's thermal exchange chamber 19 and pump chamber 15A. The inlet port 19A constitutes a "passage".

Moreover, claims 19, 23 and 27 merely require that the claimed "passage" be configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber. Koga's inlet port 19A is not encumbered by any valve or otherwise impeded by any device that would prevent a coolant from flowing from the the pump chamber 15A directly into the thermal exchange chamber 19 as required by claims 19, 23 and 27. Thus, Koga's inlet port 19A, a passage, is configured to direct cooling liquid from the pump chamber 15A directly into the thermal exchange chamber 19, as claimed.



KOGA FIG. 5 (ANNOTATED AND ENLARGED TO SHOW DETAIL OF INLET PORT 19A, SHADED)

Koga anticipates each of claims 19, 23 and 27. Accordingly, Requester respectfully urges the Office to reject each of claims 19, 23 and 27 for anticipation by Koga.

B. Koga Anticipates New Claims 20, 24 and 28

Each of proposed claims 20 and 24 requires that the "one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber." Claim 28 requires that the thermal exchange chamber and the pump chamber are fluidly coupled together by a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber."

Koga's pump chamber 15A and thermal exchange chamber 19 are fluidly coupled to each other, in part, by the discharge port (shown in annotated FIG. 5, above) from the pump chamber 15A opening into the discharge channel 20. *See*, Request, pp. 153, 158 and 161. For example, coolant passes from the pump chamber 15A, through the discharge port, through the discharge channel 20, through the radiator 3 (FIG. 1) and returns to the thermal exchange chamber 19. Id. As well, the thermal exchange chamber 19 and the pump chamber 15A are fluidly coupled to each other by the inlet port 19A, also shown in annotated FIG. 5, above.

The inlet port 19A constitutes a "passage" positioned within Koga's reservoir. As well, the discharge port from Koga's pump chamber 15A into the discharge channel 20 consititutes a "passage" positioned within the reservoir.

Thus, Koga discloses a "plurality of passages positioned within the reservoir," as claimed in each of claims 20, 24 and 28. Moreover, Koga's reservoir opens into the thermal exchange chamber 19, precisely as claimed in each of these claims.

Because Koga discloses each and every feature arranged as claims 20, 24 and 28 require, Koga anticipates each of proposed claims 20, 24 and 28.

Accordingly, Requester respectfully urges the Office to reject proposed claims 20, 24 and 28 for anticipation by Koga.

C. Koga Anticipates New Claims 21, 25 and 29

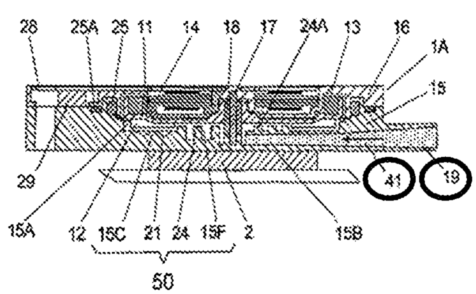
Each of proposed claims 21, 25 and 29 requires "an entire surface of the heat-exchanging/e interface in contact with the cooling liquid in the reservoir forms [a] boundary wall of the thermal exchange chamber."

Koga's FIG. 7 (reproduced below) shows that an inner surface of the thermal exchange chamber 19 is in contact with the cooling liquid 41 in the reservoir. To the extent that a "surface" can form a "wall", as required by each of claims 21, 25 and 29, the entire inner surface of the thermal exchange chamber forms a boundary wall of the thermal exchange chamber, as required by each of proposed claims 21, 25 and 29.

Koga discloses each and every feature arranged as claimed in each of proposed claims 21, 25 and 29. Thus, Koga anticipates proposed claims 21, 25 and 29.

Accordingly, Requester respectfully urges the Office to reject proposed claims 21, 25 and 29 for anticipation by Koga.

FIG.7



KOGA FIG. 7 (ANNOTATED)

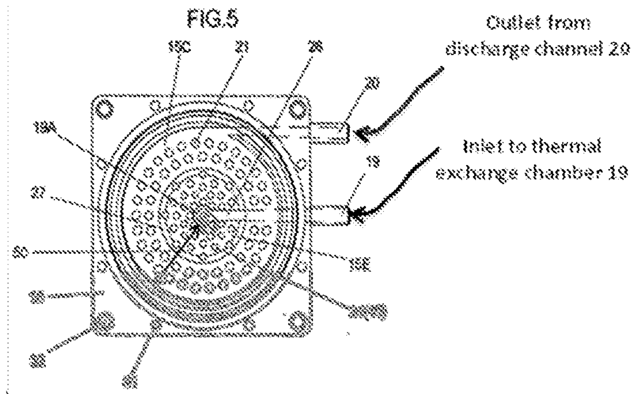
A. Koga Anticipates New Claims 22, 26 and 30

Each of proposed claims 22, 26 and 30 requires that the "reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir."

As shown in the annoted FIG. 7, below, an aperture positioned near the terminal end (e.g., distally from the pump chamber 15A) of Koga's discharge channel 20 consitutes an outlet configured to discharge the cooling liquid from the reservoir. *See,* Koga, col. 8:4-5. As well, Koga's thermal exchange chamber has an aperture constituting an inlet configured to direct the cooling liquid into the reservoir. Id.

Therefore, Koga discloses each and every feature arranged as claimed in each of proposed claims 22, 26 and 30. Thus, Koga anticipates proposed claims 22, 26 and 30.

Accordingly, Requester respectfully urges the Office to reject proposed claims 22, 26 and 30 for anticipation by Koga.



KOGA FIG. 5 (ANNOTATED)

VI. THE EXAMINER'S DECISION NOT TO ORDER REEXAMINATION BASED ON A GROUND PROPOSED IN THE ORIGINAL REQUEST DOES NOT CONSTITUTE A DETERMINATION FAVORABLE TO PATENTABILITY AS TO THAT PROPOSED GROUND

Asetek mischarachterizations of the Order dated October 26, 2012, and allegations that the Office made in the Order a determination upholding patentability runs contrary to existing law, reaffirmed in at least one Federal Circuit opinion[8] since this Reexamination was Requested. Specifically, the Belkin opinion clarifies that an examiner's refusal to institute a reexamination on a proposed ground does not act as a decision favorable to patentability. Id. at 8-9. Moreover, the Belkin court confirmed that the Patent Office may, at any time, make any new rejection, as long as the rejection meets the requirement for

[8] *See,* e.g., Belkin Int'l, Inc. v. Kappos, Slip Op. 2012-1090 (Fed. Cir., 2012)., cited in FN 2.

instituting reexamination. Id. at 7. On this basis, Requester proposes rejections below based on art presented in the Request that apparently was not fully considered.

VII. CLAIMS ARE INVALID OVER ADDITIONAL PRIOR ART

A. ASETEK ADMITS THAT REFERENCES FILED EARLIER THAN MAY 6, 2005 CONSTITUTE VALID PRIOR ART

Asetek admits in its Amendment that all referenences relied upon in the Request constitute valid prior art to the claims in the '764 Patent. Amendment, pp. 26-27. In particular, Asetek states that "the priority date of the '764 claims is not an issue relevant to this reexamination proceeding. … [A]ll prior art references relied upon in the Request predate the filing date of the International Application." Id. at 26. On this basis, Asetek admits that "the availability of the references relied upon in the proposed rejections is not dependent on the priority date of the '764 Patent." Id. at 27. From these and other statements in Asetek's Amendment, Requester understands that Asetek admits any reference predating the filing date of the International Application (i.e., May 6, 2006) constitutes valid prior art to the '764 Patent. In any event, Duan was the latest-filed reference cited in the Request and was filed on February 18, 2005.

Requester maintains the assertions set forth in the Request that no claim in the '764 Patent is entitled to priority predating the '764 Patent's filing date of July 14, 2011. However, in view of Asetek's admission that all references relied on in the Request constitute valid prior art to the '764 Patent, the issue of priority is presently moot for purposes of this reexamination. Accordingly, to comport with 37 CFR 1.906(a), to save on costs and/or to expedite reexamination, Requester presently declines to rebut Asetek's remarks regarding whether any issued claim might somehow be entitled to priority from the International Application's filing date (or any other date earlier than July 14, 2011). That is to say, Requester expressly reserves the right to contest, in any relevant forum, including this reexamination proceeding and the co-pending litigation, each and every allegation in Asetek's Amendment (e.g., including but not limited to allegations on pages 27 through 31 therein).[9]

B. SUMMARY OF THE REASONABLE LIKELIHOOD THAT REQUESTER WILL PREVAIL

In accordance with 37 C.F.R. § 1.915(b)(3), Requester herein demonstrates a reasonable likelihood of prevailing with respect to at least one of the challenged claims, and more, by demonstrating

[9] As but one example, Requester reserves the right to contest the availability of priority from any previously filed application, including the International Application, if Asetek in the future challenges the availability of any references cited herein (or in future filings) as prior art. At this time, however, the alleged priority is not at issue given the understanding that Asetek admits any reference predating May 6, 2005, constitutes valid prior art to the claims in the '764 Patent.

that each of proposed claims 19 through 30 is fully anticipated by or obvious from one or more additional prior art references. Requester relies upon the entirety of the Request and these Comments to satisfy the required "reasonable likelihood" showing. This section summarizes each reasonable likelihood of prevailing raised by the additional prior art references. The following sections present a detailed explanation of the pertinency and manner of applying the additional prior art to proposed claims 19 through 30.

The additional prior art references were either not cited or not fully considered during the original prosecution of the '764 Patent. Each reference, alone or in a specific combination with another reference set forth below, raises a Reasonable Likelihood for the challenged claims, as follows:

No.	Reasonable Likelihood Requester Will Prevail
1	Newly found Wei combined with Koga raises a Reasonable Likelihood under § 103 as to proposed claims 19 through 30.
2	Newly found Takayuki combined with Koga raises a Reasonable Likelihood under § 103 as to proposed claims 19 through 30.

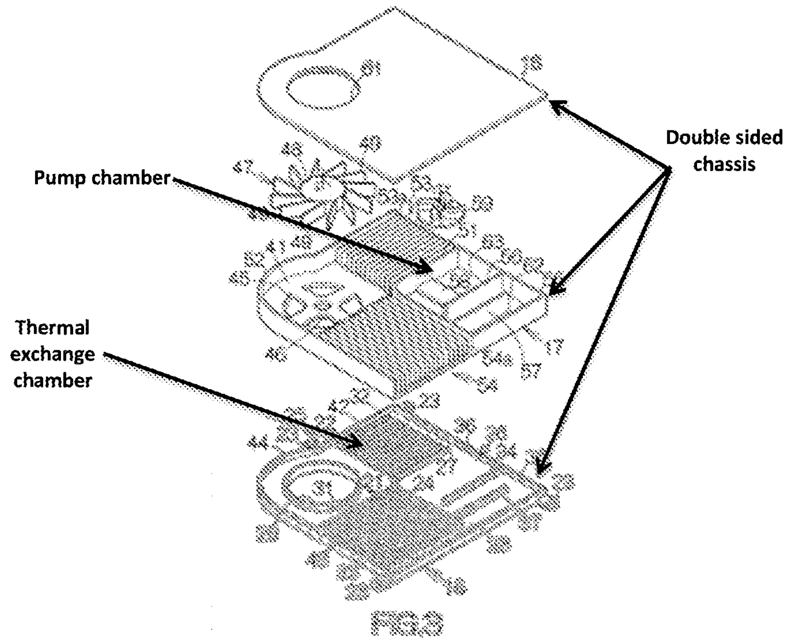
In accordance with 37 C.F.R. § 1.915(b)(4), a copy of every additional prior art reference relied on to present a Reasonable Likelihood accompanies these Comments, together with an Information Disclosure Statement pursuant to 37 C.F.R. § 1.915(b)(2).

As explained in the Request, the original examiner in the '764 Patent allowed existing claims 1-18 on the basis of the claimed "thermal exchange chamber formed below the pump chamber and vertically space [*sic*: spaced] apart from the pump chamber". Request, p. 12. Each of the additional prior art references cited herein supply some or all of the very features the Patent Owner alleged were lacking from the references applied during prosecution of the application leading to the '764 Patent. Thus, these references would have been important to a reasonable Examiner in deciding patentability.

C. Reasonable Likelihood #1: Proposed Claims 19-30 Would Have Been Obvious From Wei and Koga

The newly found Wei reference having been filed on November 18, 2004, presumptively qualifies as prior art to the '764 Patent under 35 U.S.C. § 102(a) and (e), as well as under 35 U.S.C. § 103. In any event, Wei constitutes valid prior art to the '764 Patent based on Asetek's admissions discussed above. Amendment, pp. 26-27. Koga also constitutes valid prior art to the '764 Patent. Id.

For convenience, an exploded view of Wei's device is reproduced and annotated below. As shown and explained more fully below in connection with the proposed rejections based on Wei and Koga, Wei discloses each of the above-identified features Patent Owner said were lacking from the references applied during prosecution of the ‘764 Patent, namely vertically separated pump and thermal exchange chambers.



WEI FIG. 3 (ANNOTATED)

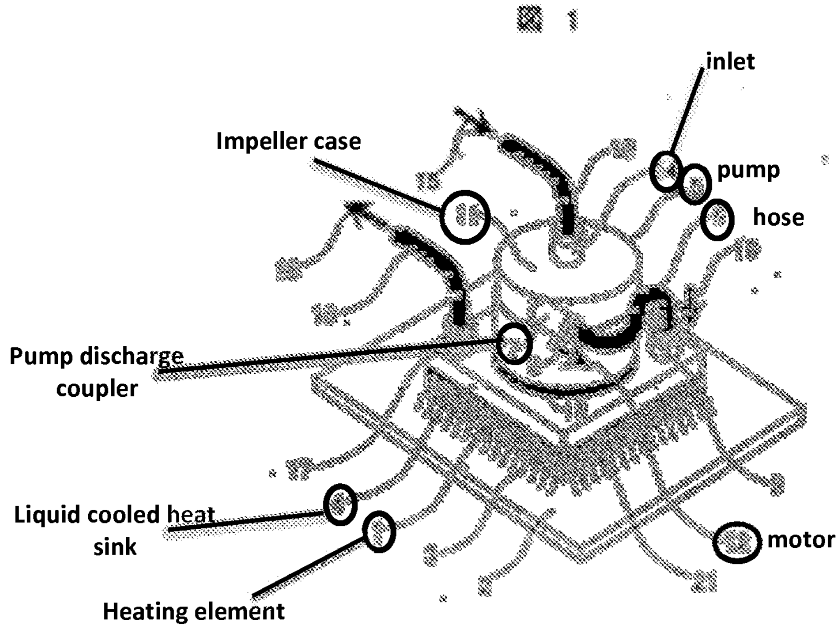
Indeed, Wei expressly disclosed virtually every feature arranged in the manner recited in proposed claims 19 through 30. To the extent that Wei might be considered as not disclosing some trivial claim limitation, the basic knowledge or “common sense” possessed by one of ordinary skill in the art would have resolved such difference, particularly following a review of Koga’s disclosure.

Accordingly, the combination of limitations proposed in claims 19 through 30 would have been obvious to one of ordinary skill in the art from a review of Wei and Koga. Thus, Wei and Koga raise a Reasonable Likelihood under 35 U.S.C. § 103 as to each of proposed claims 19 through 30.

D. Reasonable Likelihood #2: Proposed Claims 19-30 Would Have Been Obvious From Takayuki and Koga

The newly found Takayuki reference having been publishd on May 24, 2002, qualifies as prior art to the ‘764 Patent under 35 U.S.C. § 102(b), as well as under 35 U.S.C. § 103. In any event, Takayuki constitutes valid prior art to the ‘764 Patent based on Asetek’s admissions discussed above. Amendment, pp. 26-27. Koga also constitutes valid prior art to the ‘764 Patent. Id.

For convenience, an exploded view of Takayuki’s device is reproduced and annotated below.



TAKAYUKI FIG. 1 (ANNOTATED)

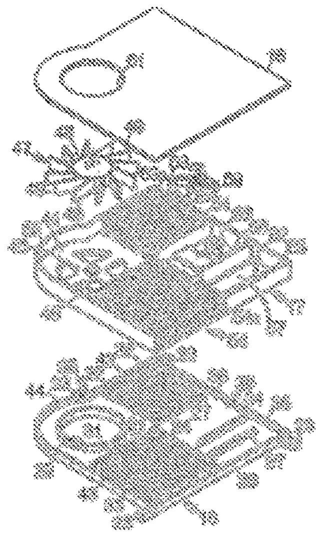
As shown above and explained more fully below in connection with the proposed rejections based on Takayuki and Koga, Takayuki discloses each of the above-identified features Patent Owner said were lacking from the references applied during prosecution of the '764 Patent, namely vertically separated pump and thermal exchange chambers. *See*, Takayuki, FIG. 1 (impeller case 11 and pump 5; liquid-cooled heat sink 4).

Indeed, Takayuki expressly disclosed virtually every feature arranged in the manner recited in proposed claims 19 through 30. To the extent that Takayuki might be considered as not disclosing some trivial claim limitation, the basic knowledge or "common sense" possessed by one of ordinary skill in the art would have resolved such difference, particularly following a review of Koga's disclosure.

Accordingly, the combination of limitations proposed in claims 19 through 30 would have been obvious to one of ordinary skill in the art from a review of Wei and Koga. Thus, Takayuki and Koga raise a Reasonable Likelihood under 35 U.S.C. § 103 as to each of proposed claims 19 through 30.

E. PROPOSED REJECTION #1: PROPOSED CLAIMS 19-30 ARE UNPATENTABLE OVER WEI AND KOGA

Each combination of features claimed in proposed claims 19-30 in the '764 Patent would have been obvious to one of ordinary skill in the art from a review of Wei and Koga at the time of the purported invention claimed in the '764 Patent, as set forth in the following claim chart:

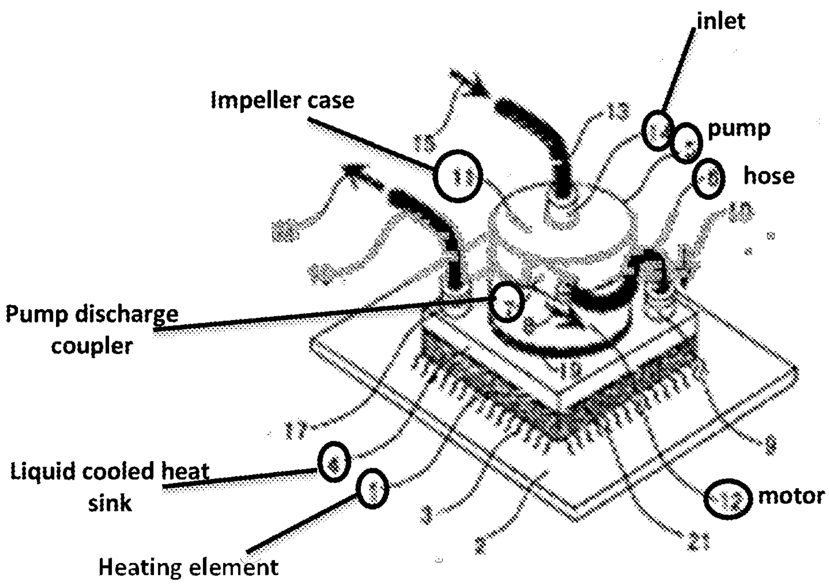
U.S. Patent No. 8,245,764 Claim Language	Correspondence to Wei and Koga
WEI, FIG. 3: 	Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" - choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or motivation to combine. All of these rationale apply here as detailed below. First, combining Wei with Koga yields predictable results. Second, simply substituting Koga's stator/impeller for Wei's pump achieves predictable results. Third, at least based on Koga's disclosed concept of a stator separated from a cooling liquid and an impeller in contact with the liquid, it would have been obvious to at least try to incorporate such a configuration into Wei's device to drive Wei's impeller. Fourth, both Wei and Koga at least suggest providing cooling systems as claimed (e.g., having, *inter alia*, vertically spaced apart thermal exchange and pump chambers). Each of Wei and Koga discloses cooling systems for heat-generating components, exactly as claimed in the '764 Patent.
19. (New) The cooling system of claim 1, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	Wei, FIG. 3. The chambers are fluidly coupled together as claimed. *See*, Wei col. 7:14-32; 7:64-8:22.
20. (New) The cooling system of claim 1, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber.	Wei, FIG. 3 – openings from pump chamber 63 are positioned on opposed sides of support member 58 and open into the thermal exchange chamber 42 ("endoergic chamber 42"). *See*, Wei col. 7:14-32; 7:64-8:22.
21. (New) The cooling system of claim 1, wherein an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms the boundary wall	Wei, FIG. 3. Inner surface of thermal exchange chamber 42.

of the thermal exchange chamber.	
22. (New) The cooling system of claim 1, wherein the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	Wei, FIG. 3. E.g., opening 28 and opening by wall 56 into pump chamber 63. Koga also discloses exactly this combination of features. For example, an aperture positioned near the terminal end (e.g., distally from the pump chamber 15A) of Koga's discharge channel 20 consitutes an outlet configured to discharge the cooling liquid from the reservoir. *See,* Koga, col. 8:4-5. As well, Koga's thermal exchange chamber has an aperture constituting an inlet configured to direct the cooling liquid into the reservoir. Id.
23. (New) The cooling system of claim 10, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	Wei, FIG. 3. The chambers are fluidly coupled together as claimed. *See*, Wei col. 7:14-32; 7:64-8:22.
24. (New) The cooling system of claim 10, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber.	Wei, FIG. 3 – openings from pump chamber 63 are positioned on opposed sides of support member 58 and open into the thermal exchange chamber 42 ("endoergic chamber 42"). *See*, Wei col. 7:14-32; 7:64-8:22.
25. (New) The cooling system of claim 12, wherein an entire surface of the heat-exchange interface in contact with the cooling liquid in the reservoir forms a boundary wall of the thermal exchange chamber.	Wei, FIG. 3. Inner surface of thermal exchange chamber 42.
26. (New) The cooling system of claim 10, wherein the reservoir further includes an inlet configure~ to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	Wei, FIG. 3. E.g., opening 28 and opening by wall 56 into pump chamber 63. Koga also discloses exactly this combination of features. For example, an aperture positioned near the terminal end (e.g., distally from the pump chamber 15A) of Koga's discharge channel 20 consitutes an outlet configured to discharge the cooling liquid from the reservoir. *See,* Koga, col. 8:4-5. As well, Koga's thermal exchange chamber has an aperture constituting an inlet configured to direct the cooling liquid into the reservoir. Id.
27. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, the one or more passages including a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	Wei, FIG. 3. The chambers are fluidly coupled together as claimed. *See*, Wei col. 7:14-32; 7:64-8:22.

28. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by a plurality of passages positioned within the reservoir that open into the thermal exchange chamber.	Wei, FIG. 3 – openings from pump chamber 63 are positioned on opposed sides of support member 58 and open into the thermal exchange chamber 42 ("endoergic chamber 42"). *See*, Wei col. 7:14-32; 7:64-8:22.
29. (New) The cooling system of claim 15, wherein an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms a boundary wall of the thermal exchange chamber.	Wei, FIG. 3. Inner surface of thermal exchange chamber 42.
30. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, and the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	Wei, FIG. 3. E.g., opening 28 and opening by wall 56 into pump chamber 63. Koga also discloses exactly this combination of features. For example, an aperture positioned near the terminal end (e.g., distally from the pump chamber 15A) of Koga's discharge channel 20 consitutes an outlet configured to discharge the cooling liquid from the reservoir. *See,* Koga, col. 8:4-5. As well, Koga's thermal exchange chamber has an aperture constituting an inlet configured to direct the cooling liquid into the reservoir. Id.

F. PROPOSED REJECTION #2: PROPOSED CLAIMS 19-30 ARE UPATENTABLE OVER TAKAYUKI AND KOGA

Each combination of features claimed in proposed claims 19-30 would have been obvious to one of ordinary skill in the art from a review of Takayuki and Koga at the time of the purported invention claimed in the '764 Patent, as set forth in the claim chart below:



TAKAYUKI, FIG. 1 (ANNOTATED)

U.S. Patent No. 8,245,764 Claim Language	Correspondence to Takayuki[10] and Koga
	Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" - choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or motivation to combine. All of these rationale apply here as detailed below. First, combining Takayuki with Koga yields predictable results. Second, simply substituting Koga's stator/impeller for Takayuki's pump achieves predictable results. Third, at least based on Koga's disclosed concept of a stator separated from a cooling liquid and an impeller in contact with the liquid, it would have been obvious to at least try to incorporate such a configuration into Takayuki's device. Fourth, both Takayuki and Koga at least suggest providing cooling systems as claimed (e.g., having, *inter alia*, vertically spaced apart thermal exchange and pump chambers). Each of Takayuki and Koga discloses cooling systems for heat-generating components, exactly as claimed in the '764 Patent.
19. (New) The cooling system of claim 1, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	Takayuki FIG. 1 shows that the passage formed by the outlet 7, hose 6 and inlet 9 is configured to direct cooling liquid from the pump chamber (inside cover 11) directly into the thermal exchange chamber inside heat sink 4.

[10] All references herein to paragraphs in Takayuki's specification refer to the paragraph numbers in the English-language translation accompanying the submission of the Japanese-language Takayuki publication.

20. (New) The cooling system of claim 1, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber.	Takayuki FIG. 1 shows an inlet 9 and an outlet 17. Both of these passages open into the thermal exchange chamber as claimed. *See*, Takayuki, ¶¶ 13 and 18.
21. (New) The cooling system of claim 1, wherein an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms the boundary wall of the thermal exchange chamber.	Takayuki describes exactly this combination of features. *See*, Takayuki, ¶¶ 13 and 18.
22. (New) The cooling system of claim 1, wherein the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	Takayuki discloses exactly this combination of features. For example, FIG. 1 shows an inlet 14 and a wastewater coupler 17, constituting the claimed inlet and outlet, respectively. *See*, Takayuki, ¶¶ 13 and 18.
23. (New) The cooling system of claim 10, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	Takayuki FIG. 1 shows that the passage formed by the outlet 7, hose 6 and inlet 9 is configured to direct cooling liquid from the pump chamber (inside cover 11) directly into the thermal exchange chamber inside heat sink 4.
24. (New) The cooling system of claim 10, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber.	Takayuki FIG. 1 shows an inlet 9 and an outlet 17. Both of these passages open into the thermal exchange chamber as claimed. *See*, Takayuki, ¶¶ 13 and 18.
25. (New) The cooling system of claim 12, wherein an entire surface of the heat-exchange interface in contact with the cooling liquid in the reservoir forms a boundary wall of the thermal exchange chamber.	Takayuki describes exactly this combination of features. *See*, Takayuki, ¶¶ 13 and 18.
26. (New) The cooling system of claim 10, wherein the reservoir further includes an inlet configure~ to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	Takayuki discloses exactly this combination of features. For example, FIG. 1 shows an inlet 14 and a wastewater coupler 17, constituting the claimed inlet and outlet, respectively. *See*, Takayuki, ¶¶ 13 and 18.
27. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, the one or more passages including a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	Takayuki FIG. 1 shows that the passage formed by the outlet 7, hose 6 and inlet 9 is configured to direct cooling liquid from the pump chamber (inside cover 11) directly into the thermal exchange chamber inside heat sink 4.
28. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by a plurality of passages positioned within the reservoir that open into the thermal exchange chamber.	Takayuki FIG. 1 shows an inlet 9 and an outlet 17. Both of these passages open into the thermal exchange chamber as claimed. *See*, Takayuki, ¶¶ 13 and 18. The inlet 9 and the outlet 17 also fluidly couple the pump chamber and the thermal exchange chamber to each other (e.g., by way of the radiator).

29. (New) The cooling system of claim 15, wherein an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms a boundary wall of the thermal exchange chamber.	Takayuki describes exactly this combination of features. *See*, Takayuki, ¶¶ 13 and 18.
30. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, and the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	Takayuki discloses exactly this combination of features. Takayuki FIG. 1 shows that the passage formed by the outlet 7, hose 6 and inlet 9 is configured to direct cooling liquid from the pump chamber (inside cover 11) directly into the thermal exchange chamber inside heat sink 4. FIG. 1 also shows an inlet 14 and a wastewater coupler 17, constituting the claimed inlet and outlet, respectively. *See*, Takayuki, ¶¶ 13 and 18.

VIII. CONCLUSION

An Action Closing Prosecution (ACP) is proper where, as here, issues of patentability have been considered a second or subsequent time and any new grounds of rejection are necessitated by an amendment. The Office previously determined that each of the existing claims is invalid over prior art, as set forth in the Office action dated October 26, 2012. In response to that Office action, Asetek amended the claims (literally and through its extreme rewriting of the claims in the guise of "construction.") In response to those amendments, Requester respectfully urges the Office to reject the existing and proposed claims on grounds set forth above and in the Request. Each new ground of rejection is necessitated by Asetek's amendments to the claims, making an Action Closing Prosecution proper.

Accordingly, Requester respectfully asks the Office to promptly reject all claims in an Action Closing Prosecution

Date: June 10, 2013

Respectfully submitted,
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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a complete copy of these COMMENTS BY THIRD-PARTY REQUESTER UNDER 37 C.F.R. § 1.947 SUBSEQUENT TO PATENTEE'S RESPONSE TO OFFICE ACTION DATED OCTOBER 26, 2012 was served on the official correspondence address for the '764 Patent shown in PAIR:

Finnegan, Henderson, Farabow, Garrett & Dunner LLP
901 New York Avenue, NW
Washington, D.C. 20001-4413

via first class mail, on JUNE 10, 2013.

By: */Lloyd L. Pollard II/*

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EXHIBIT B TO REQUESTER'S PETITION UNDER 37 C.F.R. § 1.183

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent No.: 8,245,764	**R.C.N.:** 95/002,386
Currently in Litigation Styled: *Asetek Holdings, Inc et al v. Coolit Systems Inc*, Case No. 3:12-cv-04498-EMC (N.D. Cal.)	**Confirmation No.:** 7254 **Examiner:** Joseph A. Kaufman
Issued: August 21, 2012	**Art Unit:** 3993
Filed: October 7, 2011	
Applicant: Andre Sloth Eriksen	
Title: COOLING SYSTEM FOR A COMPUTER SYSTEM	

SUBMITTED VIA ELECTRONIC FILING SYSTEM ON JUNE 10, 2013
UNITED STATES PATENT AND TRADEMARK OFFICE

PETITION IN OPPOSITION TO PATENT OWNER'S PETITION TO STRIKE THIRD-PARTY REQUESTER'S COMMENTS

Third-party requester, CoolIT Systems, Inc., petitions under 37 C.F.R. § 1.182 to present views in opposition to the petition served by Patent Owner on May 31, 2013. If the Office determines that a petition under Rule 1.182 is not the proper basis for presenting this opposition, Requester petitions under 37 C.F.R. § 1.83 to waive the provisions of 37 C.F.R. § 1.939 to permit Requester to present the following opposition to Patent Owner's May 31, 2013, petition.

A fee of $400 pursuant to 37 C.F.R. § 1.17(f) is being paid concurrently with the filing of this Petition. If the fee paid is insufficient, or if additional or alternative fees are due in connection with the filing of this Petition in Opposition, please charge such fees to Deposit Account No. 50-1001.

BACKGROUND

1. On September 15, 2012, Requester filed a Request for *Inter Partes* Reexamination (Request) of all claims (i.e., claims 1-18) of U.S. Patent No. 8,245,764 (the '764 Patent).
2. On October 26, 2012, the Office issued an Order instituting the present reexamination as to all challenged claims. The same day, an Office Action issued rejecting each of the challenged claims as being anticipated by Koga.
3. On December 26, 2012, Patent Owner amended the listing of claims by adding new claims 19-30 and contested the anticipation rejections in a "Response Under 37 C.F.R. § 1.111" (Amendment).
4. On January 25, 2013, Requester filed "Comments by Third-Party Requester under 37 C.F.R. § 1.947 Subsequent to Patentee's Response to Office Action Dated October 26, 2012" (Original Comments).

5. On May 7, 2013, the Office issued a "Notice Re Defective Paper in *Inter Partes* Reexamination" (Notice).
6. On May 22, Requester filed "Comments by Third-Party Requester Under 37 C.F.R. § 1.947 Subsequent to Patentee's Response to Office Action Dated October 26, 2012, and Notice Dated May 7, 2013" (Replacement Comments).
7. On May 31, 2013, Patent Owner, Asetek A/S, filed the Petition at issue here.

I. Asetek's Petition Lacks Merit and Should be Dismissed

Although the Replacement Comments included several editorial revisions to comply with the Notice dated May 7, 2013 (e.g., deletion of headings and rearrangement of text), the Replacement Comments are limited to issues raised in the Office Action dated October 26, 2012, and Asetek's Amendment dated December 26, 2012, and do not go beyond the Original Comments. Therefore, the Replacement Comments fully comply with 37 C.F.R. § 1.947.

Accordingly, as explained more fully below, Asetek's Petition should be dismissed in its entirety and the Replacement Comments should remain of record and be fully considered on the merits.

A. Asetek's Amendment Dated December 22, 2012, Inherently Raised the Issue of Obviousness from Koga

In the outstanding Office Action, all challenged claims stand rejected under 35 U.S.C. § 102(b) as being anticipated by Koga. Office Action, p. 3. However, Asetek's remarks in its Amendment raised the issue of obviousness.

For example, Asetek's remarks inherently assert that the rejected and effectively amended claims overcome Section 103's prohibition on patenting subject matter not identically disclosed or described in a pior art reference if differences between the claimed subject matter as a whole and the prior art (e.g., Koga) would have been obvious to one of ordinary skill in the art. For example, Asetek theorized on the understanding one of ordinary skill in the art would have given Koga, concluded that the claims "are allowable over *Koga*" and "patentably distinguish over [Koga]", and on that basis urged the Office to "reconsider[] and confirm[] the patentability of the reexamined claims, as well as new claims 19-30 …." *See*, Amendment, pp. 19-20 (stating "a person of ordinary skill in the art would have interperpreted, a 'chamber' …" and "[t]herefore, … a person of ordinary skill in the art would not have interpreted a conduit …."), 22-24 (stating "Therefore, these claims are allowable over *Koga* at least for the same reason independent claims 1, 10, and 15 are allowable over *Koga*. "), and 31 (stating "reexamined claims 1-18, as well as new claims 19-30, patentably distinguish over the cited art. Thus, reconsideration and confirmation of the patentability of reexamined claims, as well as new claims 19-30 ….").

Also, Asetek expressly acknowledged difference between asserting that a reference does not anticipate a claim (implicates § 102 only) and asserting that the claim is patentable over the reference (implicates, *inter alia*, §§ 102-103). For example, Asetek asserted that certain dependent "claims are allowable over ***Koga***" and in the immediately following sentence asserted that "these dependent claims are not anticipated by ***Koga***." Amendment, p. 22. The former statement inherently implicated the anticipation inquiry under § 102 and the obviousness inquiry under § 103, while the latter statement implicated only the § 102 inquiry. In purporting that the challenged claims are allegedly "allowable" over Koga, Asetek discussed its view of the understanding one of ordinary skill in the art would have had following a review of Koga. Amendment, pp. 19-20.

Thus, Asetek's remarks inherently implicate 35 U.S.C. § 103, at least with regard to Koga taken alone. To conclude otherwise would vitiate the 35 U.S.C § 103 prohibition on patenting subject matter that only trivially differs from (i.e., might not be anticipated by but is obvious from) the applied reference. Accordingly, the Replacement Comments properly responded to Asetek's assertion that the claims "patentably distinguish over" Koga and Asetek's request to "confirm[] patentability" of the reexamined claims by merely pointing out that patentability cannot be confirmed on the basis of potential trivial differences. The entire subject of obviousness with regard to challenged claims 1-18 is reproduced, as follows:

> L. IN THE ALTERNATIVE, KOGA RENDERS CLAIMS 1-18 OBVIOUS
>
> As explained above, Koga expressly disclosed each and every combination of features arranged in the manner recited in claims 1-18. However, to the extent that Koga might be considered as not disclosing some trivial claim limitation recited in one or more claims, the basic knowledge or "common sense" possessed by one of ordinary skill in the art would have resolved such difference. Accordingly, Requester respectfully urges the Office, in the alternative, to reject each such claim under 35 U.S.C. § 103(a) as claiming an obvious variant of Koga.

[Replacement Comments, p. 17.]

Requester's limited remarks regarding obviousness directly contest Asetek's assertions regarding patentability without going beyond the issues raised in Asetek's Amendment. The Replacement Comments do not look to any other reference in connection with challenged claims 1-18 to provide for or overcome any purported deficiency of Koga alleged by Asetek. Instead, the Replacement Comments merely contest Asetek's assertion found on Page 31 of its Amendment that the challenged claims somehow might "patentably distinguish over" Koga based Asetek's allegations regarding purported differences from Koga and the level of ordinary skill in the art.

The Replacement Comments do not go beyond the issues raised by Asetek's Amendment, and thus are proper. Asetek's Petition should be dismissed and the Replacement Comments should remain of record.

B. Asetek's Reliance on *Inter Partes* Reexamination No. 95/000115 is Misplaced

Asetek asserts that the Office should strike Requester's Replacement Comments because the Office expunged comments in *Inter Partes* Reexamination No. 95/000115 ('115 Reexamination). However, the procedural posture of the '115 Reexamination substantively differed from the current situation and thus actions by the Office in the '115 Reexamination are of no consequence here.

Specifically, the Office refused in the '115 Reexamination to adopt an anticipation rejection and the requester set forth an obviousness rejection in response to the Office's refusal to adopt the proposed rejection. There, the patent owner did not assert that the claims were patentable or raise any issues relating to the level of ordinary skill in the art. Accordingly, the requester's comments in the '115 Reexamination were limited under 37 C.F.R. § 1.947 to issues raised in the Office action, which did not include any basis for raising an obviousness rejection.

In stark contrast, the Office here adopted Requester's proposed anticipation rejections based on Koga ***and*** Asetek responded by alleging trivial differences from Koga and affirmatively asserting Asetek's theories regarding the level of ordinary skill in the art, and purporting based on those asserted theories that the challenged claims are "allowable" and "patentably distinguish" over Koga. Those specific allegations by Asetek and the content of Asetek's Amendment as a whole inherently raised the issue of whether the subject matter claimed in claims 1-18, though purportedly not identically disclosed or described in Koga, might be patentable (e.g., non-obvious).

Thus, the Replacement Comments appropriately asserted that any purported differences from Koga are trivial and would have been obvious to one of ordinary skill in the art under 37 C.F.R. § 1.947 because those comments addressed issues raised by the patent owner's response and do not raise any issues not already before the Office for consideration.[1]

Asetek's Petition should be dismissed and the Replacement Comments should remain of record.

---

[1] Under 37 C.F.R. § 1.947, Requester's comments shall be limited to issues raised by the Office action ***or*** the patent owner's response. (Emphasis added.)

C. <u>The Replacement Comments do not Add to (or "Go Beyond") the Original Comments</u>

Although Applicant agrees that MPEP 2666.05 II describes the permissible scope of replacement comments, MPEP 2666.05 II imposes no *in haec verba* requirement on replacement comments as Asetek's Petition seems to suggest. Naturally, the text of the Replacement Comments differs from the text in the Original Comments, as it must in order to respond properly to the Notice. However, the Replacement Comments do not add to the subject matter found in the original comments. Substantive differences between the Original Comments and the Replacement Comments are the result of narrowing amendments made in an attempt to comply with the Notice.

1. <u>Claims 1-18</u>

For example, as described above, the Replacement Comments assert that claims 1-18 would have been obvious from Koga. However, that assertion fits squarely within the scope of and does not add to the Original Comments. In particular, the Original Comments explained that each combination of features claimed in claims 1-18 would have been obvious from Koga, especially in view of the subject matter disclosed by Wei and in view of the subject matter disclosed by Takayuki. Original Comments, pp. 15, lines 4-16, 22-23, 28-36, and 38-48.

The Replacement Comments properly maintain that, contrary to allegations in Asetek's Amendment, claims 1-18 are not patentable over Koga to the extent Koga might not identically disclose the subject matter claims in claims 1-18. As in the Original Comments, the Replacement Comments explain that any purported differences from Koga would have been resolved by the basic knowledge or "common sense" possessed by one of ordinary skill in the art. For example, Requester invites a comparison of the discussion appearing in the Original Comments at p. 15, lines 4-16 and pp. 22-23 to the discussion appearing in the Replacement Comments, p. 17, lines 22-27.

The Replacement Comments replace approximately 22 pages in the Original Comments explaining claims 1-18 would have been obvious from Koga in view of Wei or Takayuki with one brief paragraph in Section L. pointing out that any alleged difference from Koga would be an obvious variant of Koga firmly within the grasp of an ordinary artisan. The objected-to remarks in Section L. of the Replacement Comments do not add to (i.e., do not "go beyond") the Original Comments.

2. <u>Claims 19-30</u>

Asetek's remarks pertaining to the proposed rejections of claims 19-30 are inaccurate and misleading. In particular, Asetek asserts that merely 1 ½ pages (i.e., pages 36-38) in the Original Comments were devoted to the proposed rejections of claims 19-30 based on Koga and Wei, utterly ignoring the remarks spanning pages 21-23 in the Original Comments explaining the relevance of Koga and Wei to claims 19-30 (e.g., "Reasonable Likelihood #1"). Petition, p. 5. Similarly, Asetek's assertion that merely 1 ½ pages (i.e., pages 48-49) in the Original Comments were devoted to the proposed rejections of claims 19-30 based on Koga and Takayuki ignores the remarks appearing on pages 23-24 (e.g., "Reasonable Likelihood #2). Asetek's Petition, p. 5.

As presented in the Replacement Comments, the claim charts and text in the Original Comments were slightly rearranged for convenience and readability, and several headings and some introductory text were deleted. For example, several headings appearing in the Original Comments to demarcate each respective Reasonable Likelihood arising from Wei, Takayuki and Cheon were omitted from the Replacement Comments, though the corresponding text setting forth the respective Reasonable Likelihoods was reproduced in substantially identical form (except omitting references to claims 1-18). In particular, each of Headings VII.B. (p. 21, "Summary of the Reasonable Likelihood that Requester will Prevail"), VII.C. (p. 22, "Reasonable Likelihood #1 …"), VII.D. (p. 23, "Reasonable Likelihood #2 …") and VII.E (p. 25, "Reasonable Likelihood #3 …") as presented in the Original Comments were omitted from the Replacement Comments.

As noted above, the substantive text from the Original Comments setting forth the Reasonable Likelihood in relation to Wei, Takayuki, and Cheon is substantially identically reproduced in the Replacement Comments. *Cf.* Original Comments pp. 21-25 and Replacement Comments pp. 22-23, 27-28, and 32-36. In the Original Comments, Requester explained the relevance of Cheon to, *inter alia*, new claims 19-30 in setting forth a Reasonable Likelihood as to those claims. *See, e.g.*, Original Comments, p. 25-27. The remarks from the Original Comments setting forth the Reasonable Likelihood based on Cheon as to claims 19-30 are substantially identically reproduced in the Replacement Comments. *See*, Replacement Comments, p. 32-36.

Therefore, the Replacement Comments raise a reasonable likelihood as to each of proposed claims 19-30.

In the Original Comments, Cheon was used to challenge issued claims 1-18, as well as proposed dependent claims 19-30. In the Replacement Comments, Cheon is used only to challenge proposed dependent claims 19-30. Thus, since each of proposed dependent claims 19-30 is narrower than the base claim from which it depends, the remarks regarding Cheon in the Replacement Comments must also be narrower than in the Original Comments.

Although the undersigned regrets any confusion editorial revisions between the Original Comments and the Replacement Comments might have caused, the Replacement Comments do not "go beyond" the Original Comments for the reasons stated above.

Asetek's Petition should be dismissed.

D. <u>Citation of KOGA '355 under 37 CFR 1.948(a)(2) is proper</u>

Pursuant to 37 C.F.R. § 1.948(a)(2), the Replacement Comments properly cite to Koga '355 to rebut Asetek's response as to the disclosure of Koga. Specifically, Koga '355 is presented to demonstrate that the applied Koga reference inherently discloses a feature said by PO to be lacking from Koga, and thus that Koga anticipates the challenged claims. *See, e.g.,* Replacement Comments, pp. 12-13; 37 C.F.R. § 1.948(a)(2); MPEP § 2666.05 II.

The Federal Circuit has approved of such use of an explanatory reference in an anticipation rejection. "To serve as an anticipation when the reference is silent about the asserted inherent characteristic, such gap in the reference may be filled with recourse to extrinsic evidence. Such evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." <u>Continental Can Co. USA v. Monsanto Co.</u>, 948 F.2d 1264, 1268, 20 USPQ2d 1746, 1749 (Fed. Cir. 1991).

Importantly, Koga '355 is not presented in Requester's Comments as substitute new art to provide for a purported deficiency of Koga, for that would be improper under 37 C.F.R. § 1.948(a)(2). Instead, Requester properly cites to Koga '355 to rebut Asetek's interpretation of Koga. Although Koga '355 and Koga do not share a common priority claim, the references name the same first inventor and disclose substantially similar devices. *Cf.* Koga, FIG. 7 and Koga '355, FIG. 51. However, Koga '355 expressly describes the feature said by Asetek to be lacking from Koga, whereas Koga merely illustrates the feature. *See*, Replacement Comments, pp. 12-13.

Requester notes that the Replacement Comments also cite to the learned treatise Munson as well as to the Shorter Oxford English Dictionary to rebut responses by Asetek without objection from Asetek. That Koga '355 happens to be a patent reference does not preclude its citation in a similar fashion.

For the foregoing reasons, citation of KOGA '355 under 37 CFR 1.948(a)(2) is proper, and Asetek's Petition should be dismissed.

The Replacements Comments should remain of record.

II. Conclusion

For at least the reasons stated herein, the Replacement Comments comport with 37 C.F.R. §§ 1.947 and 1.948, as well as M.P.E.P. § 2666.05 II. Accordingly, Requester respectfully requests that Asetek's Petition be dismissed in its entirety and the Replacement Comments remain of record.

Date: June 10, 2013

Respectfully submitted,
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Electronic Patent Application Fee Transmittal

Application Number:	95002386
Filing Date:	15-Sep-2012
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Filer:	Lloyd L. Pollard II
Attorney Docket Number:	COOL-1.012

Filed as Large Entity

inter partes reexam Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Petition fee- 37 CFR 1.17(f) (Group I)	1462	1	400	400
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
		Total in USD ($)		**400**

Electronic Acknowledgement Receipt

EFS ID:	15998462
Application Number:	95002386
International Application Number:	
Confirmation Number:	7254
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Customer Number:	22852
Filer:	Lloyd L. Pollard II/Tracie Semenchalam
Filer Authorized By:	Lloyd L. Pollard II
Attorney Docket Number:	COOL-1.012
Receipt Date:	10-JUN-2013
Filing Date:	15-SEP-2012
Time Stamp:	19:14:09
Application Type:	inter partes reexam

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$400
RAM confirmation Number	6432
Deposit Account	501001
Authorized User	GANZ LAW, PC

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		37CFR183PtoWaiveR1947FINAL .pdf	4067471 a2b11fbcea8090cde333f93397fca051f30d4613	yes	47

Multipart Description/PDF files in .zip description

Document Description	Start	End
Receipt of Petition in a Reexam	1	5
Reexam Certificate of Service	6	6
Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	7	38
Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	39	47

Warnings:

Information:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
2	Fee Worksheet (SB06)	fee-info.pdf	29718 dac15d64309922de1351001d12f53ddc12044e1b	no	2

Warnings:

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Total Files Size (in bytes):	4097189

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT
Customer No. 22,852
Attorney Docket No. 10494.8000-00000

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Inter Partes* Reexamination of:	)	
André Sloth ERIKSEN	)	Group Art Unit: 3993
U.S. Patent No.: 8,245,764 B2 Filed: October 7, 2011 Issued: August 21, 2012	)	Examiner: Joseph A. KAUFMAN
For: COOLING SYSTEM FOR A COMPUTER SYSTEM	)	Confirmation No.: 7254
Reexamination Proceeding Control No. 95/002,386 Filed: September 15, 2012	)	

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

PATENT OWNER'S PETITION UNDER 37 C.F.R. § 1.182 - REQUEST TO EXPUNGE THIRD PARTY REQUESTER'S REPLACEMENT COMMENTS FILED ON MAY 22, 2013 FROM THE RECORD

The Patent Owner, Asetek A/S, hereby petitions under 37 C.F.R. § 1.182 to request that the "Comments by Third-Party Requester Under 37 C.F.R. § 1.947 Subsequent to Patentee's Response to Office Action Dated October 26, 2012, and Notice Dated May 7, 2013," filed by the third-party requester, CoolIT Systems, Inc., on May 22, 2013 ("Replacement Comments"), be expunged from the record for violating several relevant rules, and the third-party Requester not be permitted to correct and resubmit its comments a third time.

To the extent that entry and consideration of this petition requires suspension of any rules, suspension is requested pursuant to 37 C.F.R. § 1.183. In addition, a petition fee of $400 under 37 C.F.R. § 1.17(f) is being submitted with this petition. If this fee is incorrect, or if there is any other fee due in connection with the filing of this petition, please charge the fee to Deposit Account No. 06-0916.

I. BACKGROUND

- On September 15, 2012, third party Requester, CoolIT Systems Inc., filed a Request for *Inter Partes* Reexamination ("Request") of claims 1-18 of U.S. Patent No. 8,245,764 ("the '764 patent") proposing 12 different counts of rejection. On October 26, 2012, in an Order granting *Inter Partes* Reexamination, the Examiner granted reexamination agreeing that one of the proposed counts of rejection presented a reasonable likelihood of success. A non-final Office Action issued on the same day rejecting claims 1-18 as being anticipated by Koga.
- On December 26, 2012, the Patent Owner filed a "Response Under 37 C.F.R. § 1.111" ("Response") to the Office Action. In the Response, new dependent claims 19-30 were proposed. The originally issued claims 1-18 remained unamended.
- On January 25, 2013, the Requester filed "Comments by Third-Party Requester Under 37 C.F.R. § 1.947 Subsequent to Patentee's Response to Office Action Dated October 26, 2012" ("Original Comments"). In the Original Comments, the Requester proposed 3 new counts of rejection of the unamended claims 1-18 and the newly added claims 19-30.
- On May 7, 2013, the Examiner issued a "Notice Re Defective Paper in *Inter Partes* Reexamination" ("Notice"). In the Notice, the Examiner held that the newly proposed rejections of the unamended claims 1-18, raised new issues not raised by the Patent Owner or the Office Action, and expunged the Original Comments from the

record. The Requester was granted an additional 15 days to correct and resubmit its comments.

- On May 22, 2013, the Requester submitted the Replacement Comments at issue here.

II. THE REPLACEMENT COMMENTS ARE DEFECTIVE

M.P.E.P. § 2666.05 II requires that "[a]ny replacement comments submitted in response to the notification [of defective paper] must be strictly limited to (i.e., must not go beyond) the comments in the original (returned) comments submission. No comments that add to those in the returned paper will be considered for entry." Contrary to this express requirement, the Requester extensively revised the Original Comments to include new arguments and proposed rejections, and filed this revised document as its Replacement Comments. As detailed in the paragraphs below, the Replacement Comments include several proposed rejections and arguments not included in the Original Comments. Additionally, similar to the Original Comments, the Replacement Comments also raise issues not raised by the Office Action or the Patent Owner's response.

A. The Replacement Comments raise issues not raised by the Patent Owner or the Office Action.

37 C.F.R. 1.947 states that:

> Each time the patent owner files a response to an Office action on the merits pursuant to § 1.945, a third party requester may once file written comments within a period of 30 days from the date of service of the patent owner's response. These comments shall be limited to issues raised by the Office action or the patent owner's response.

In section L of the Replacement Comments, Requester proposes that "Koga renders claims 1-18 obvious." Section L, p. 17, Replacement Comments. The Office Action rejected claims 1-18 as being anticipated by Koga. Office Action, p. 3. While the Office Action addressed the issue of whether claims 1-18 are anticipated by Koga, the Office Action did not address the issue of whether claims 1-18 are obvious over Koga. Since claims 1-18 were not amended in the Response, the patent owner's response also did not raise the issue of whether claims 1-18 are obvious over Koga. Therefore, the Requester, by proposing that "Koga renders claims 1-18 obvious" in its Replacement Comments, raises issues not raised by the Office Action or the Patent Owner's response[1].

M.P.E.P. § 2666.05 II states that "[w]here the third party requester written comments are directed to matters other than issues and points covered by the Office action or the patent owner's response, … the examiner should return the written comments (the entire paper) with an explanation of what is not proper …; if the comments have been scanned into the Image File Wrapper (IFW) for the reexamination proceeding prior to the discovery of the impropriety, they should be expunged from the record, with notification being sent to the third party requester." Therefore, Patent Owner respectfully requests the Examiner to expunge the Replacement Comments from the record and notify the third party requester of its removal.

B. The Replacement Comments include proposed rejections and arguments that are different from those in the Original Comments.

As explained in section A above, in the Replacement Comments, the Requester argues that claims 1-18 are obvious over Koga. *See* section L, p. 17, Replacement Comments. In

[1] Patent Owner notes that under similar circumstances, the Patent Office has previously held a third party requester's comments to be defective. In *Inter Partes* reexamination 95/000115 the Patent Office deemed defective a third party requester's comments that sought to introduce a new proposed rejection based on previously cited art. In a Notice dated 9/29/2008, the Patent Office reasoned that "[t]he third-part requester's comments filed 09/26/2007 do not comply with 37 CFR 1.947 because the comments are not limited to issues raised by the office action or the patent owner's response. In the office action mailed 07/27/2007, the examiner refused to adopt the third-party requester's proposed rejection of claims 1-6 and 9 as anticipated by DD 314. See items 78-81, 95, & 96 of the office action. The patent owner did not respond with respect to this particular issue. At p. 14 of the third-party requester's comments filed 09/26/2007, the third-party requester proposed an alternative ground of rejection: the same claims are obvious in view of the same reference. The issue raised in the office action was the refusal to adopt the anticipation rejection. The proposal of the obviousness rejection does not address this issue, but instead raises an entirely new issue: whether or not the claims are anticipated by [sic: obvious over] this reference."

addition to being in violation of 37 C.F.R. § 1.947, this argument was not present in Requester's Original Comments. The Requester added this argument in its Replacement Comments.

Further, in its Original Comments, Requester argued that proposed new claims 19-20 are unpatentable over Hamman and Cheon. *See*, Rejection No. 3 in Original Comments, pp. 22, 49 (emphasis added). In its Replacement Comments, Requester argues that claims 19-30 are unpatentable over Koga and Cheon. *See*, Section E, Replacement Comments, p. 32 (emphasis added). Rejection of proposed new claims 19-20 as being obvious over Koga and Cheon were not presented by the Requester in its Original Comments. Instead, this argument was newly introduced in its Replacement Comments. Additionally, the Requester provides about 8 pages of new arguments to describe the manner of applying the Koga and Cheon references to proposed claims 19-30. *See*, pp. 32-40, Replacement Comments. These arguments were newly introduced by the Requester in its Replacement Comments.

In the Original Comments, Requester argued that proposed claims 19-20 are (1) unpatentable over Wei and Koga, and (2) unpatentable over Takayuki and Koga. *See*, Rejections No. 1 and 2 in Original Comments, pp. 28, 38. While the Requester proposes the same two rejections of claims 19-30 in the Replacement Comments, the description of the manner of applying the references to the claims are different from than in the Original Comments. For example, in the Original Comments, only about 1 ½ pages were devoted to explain the manner of applying the Wei and Koga references to proposed claims 19-30 (*see*, pp. 36-38 of the Original Comments), while the Replacement Comments devote about 5 pages to explain the manner of applying the same two references to the same claims 19-30. *See*, pp. 22-27 of the Replacement Comments. Similarly, while only about 1 ½ pages were devoted to explain the manner of applying the Wei and Takayuki references to proposed claims 19-30 in the Original Comments (*see*, pp. 48-49 of the Original Comments), almost 5 pages are devoted for the corresponding description in the Replacement Comments. *See*, pp. 28-32, Replacement Comments. As evident from the significantly lengthier description in the Replacement Comments, the Requester added an extensive amount of arguments in the Replacement Comments that were not present in the Original Comments.

While Patent Owner does not comment on the substantive aspects of Requester's newly added arguments, Patent Owner submits that changing or introducing new arguments in the Replacement Comments "go[es] beyond[)] the comments in the original (returned) comments submission." M.P.E.P. § 2666.05 II.

C. The Replacement Comments cite additional prior art not permitted under 37 C.F.R. § 1.948(a)(1)- (3).

37 C.F.R. § 1.948(a) states that:

> After the inter partes reexamination order, the third party requester may only cite additional prior art as defined under § 1.501 if it is filed as part of a comments submission under § 1.947 or § 1.951(b) and is limited to prior art:
>
> (1) which is necessary to rebut a finding of fact by the examiner;
>
> (2) which is necessary to rebut a response of the patent owner; or
>
> (3) which for the first time became known or available to the third party requester after the filing of the request for inter partes reexamination proceeding. Prior art submitted under paragraph (a)(3) of this section must be accompanied by a statement as to when the prior art first became known or available to the third party requester and must include a discussion of the pertinency of each reference to the patentability of at least one claim.

In its Replacement Comments, the Requester cites several prior art references, simply asserting that these new references are permitted under 37 C.F.R. § 1.948(a)(1)-(2). Replacement Comments, pp. 3, 4. The Requester does not identify which of these two rules permit the introduction of each cited new reference[2]. Instead, the Requester asserts that 37 C.F.R. § 1.948(a)(2) permits the introduction of new prior art "where, as here, Patent Owner amends the claims or raises allegations regarding such art." *Id.* Contrary to the Requester's assertion, 37 C.F.R. § 1.948(a)(2) does not permit the introduction of new additional prior art if Patent Owner "raises allegations regarding such art," as claimed by the Requester. If new prior art could be introduced simply because Patent Owner challenges the Requester's interpretation of previously cited art, then the restrictions of this rule would be meaningless. With reference to § 1.948(a)(1), M.P.E.P. 2666.05 II explains that:

> … a statement in an Office action that a particular claimed feature is not shown by the prior art of record (which includes references that were cited by requester) does NOT permit the requester to then cite new art to replace the art originally advanced by requester. Such a substitution of a new art for the art of record is not a rebuttal of the examiner's finding that a feature in question is not taught by the art of record. Rather, such a substitution would amount to a rebuttal of a finding that a feature in question is not taught by any art in existence.

For similar reasons, § 1.948(a)(2) does not permit the introduction of new prior art references to rebut the Patent Owner's statement that a claimed feature is not taught by a previously cited reference.

Regarding § 1.948(a)(2), the M.P.E.P. states that this rule "permits the requester to provide a new proposed rejection, where such rejection is necessitated by the patent owner's amendment of the claims." M.P.E.P. 2666.05 II. That is, § 1.948(a)(2) permits the introduction of new references to propose rejections of the newly added claims 19-34. However, at least

[2] Patent Owner notes that, under similar circumstances, the Patent Office has previously rejected third party requester Comments that cite additional prior art references simply stating that "this submission satisfies 37 C.F.R. § 1.948." *See, Inter Partes* Reexamination no. 95/000110, Notice dated 02/25/2007.

Koga '355 (U.S. Patent No. 7,209,355) is a newly cited reference[3] that is not used in the rejection of a newly added claim. *See*, Proposed Rejections, Replacement Comments, p. 22. Instead, Koga '355 is used to argue against the Patent Owner's observations on Koga[4], a different reference. *See*, Replacement Comments, pp. 12-14. For the reasons discussed above, Koga '355 cannot be introduced under § 1.948(a)(2) to rebut the Patent Owner's observations on Koga. Therefore, at least Koga '355 is a newly cited reference that is not permitted under 37 C.F.R. § 1.948(a)(2).

37 C.F.R. § 1.948(a)(1) also does not permit the introduction of Koga '355. This rule only permits the introduction of new references "necessary to rebut a finding of fact by the examiner." 37 C.F.R. § 1.948(a)(1). In the Office Action, the Examiner did not make any findings of fact for the Requester to rebut. Therefore, Koga '355 is also not permitted under 37 C.F.R. § 1.948(a)(1).

New prior art submitted under 37 C.F.R, 1.948(a)(3) must be accompanied by a statement that explains the circumstances as to when the prior art first became known or available to the Requester. M.P.E.P. 2666.05 II. The Replacement Comments include no such statements. Therefore, Koga '355 is also not permitted under 37 C.F.R. § 1.948(a)(3).

In fact, Requester's remarks regarding Koga '355 (*see*, p. 12, Replacement Comments) is a violation of 37 C.F.R. § 1.947 because they raise issues not raised by the Office action or the patent owner's response.

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[3] Koga '355 (U.S. Patent No. 7,209,355) is not the same as, or even related to, Koga (U.S. Patent No. 7,544,049) that was previously cited and used to reject claims 1-18.

[4] On page 12 of its Replacement Comments, the Requester alleges that "[a] substantially similar device to the one shown in Koga's FIG. 7 is shown and described in FIG. 51 of Koga '355," and proceeds to use the newly cited Koga '355 reference to argue against the Patent Owner's observations on Koga.

D. The Replacement Comments does not include a showing of a reasonable likelihood that the requester will prevail with respect to at least one of the challenged claims.

As explained in section C above, 37 C.F.R. § 1.948(a)(2) permits the Requester to "provide a new proposed rejection, where such new rejection is necessitated by the patent owner's amendment of the claims." M.P.E.P. 2666.05 II. Therefore, the addition of new claims 19-30 by the Patent Owner permits the Requester to propose new grounds of rejection for these claims using newly cited prior art. However, the M.P.E.P. further states that, "the third party requester must present the[se] newly proposed rejection in compliance with the guidelines set forth in MPEP § 2617, since any such new proposed rejection stands on the same footing as a proposed rejection presented with the request for reexamination, and is treated the same way as to future Office actions and any appeal." *Id.* M.P.E.P. § 2617 meanwhile requires the comments to satisfy the requirements of 37 C.F.R. § 1.915(b)(3). 37 C.F.R. § 1.915(b)(3), after recent amendments, requires that "[a] statement pointing out, based on the cited patents and printed publications, each showing of a reasonable likelihood that the requester will prevail with respect to at least one of the claims challenged in the request," be included in the comments. Federal Register Volume 76, Number 185, Friday, September 23, 2011, p. 59056. Therefore, while new rejections based on newly cited prior art references may be proposed to reject the newly added claims, the Requester's comments should include a showing of a reasonable likelihood that the requester will prevail with respect to at least one of the challenged claims using the newly cited references. The Replacement Comments do not include any such showing[5].

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[5] The Original Comments included sections attempting to demonstrate a showing of "reasonable likelihood" for each proposed rejection. *See*, Sections VII B-E, pp. 21-25. However, these sections were removed from the Replacement Comments.

III. THE THIRD PARTY REQUESTER SHOULD NOT BE PERMITTED TO RESUBMIT ITS COMMENTS

M.P.E.P. 2666.05 II explains that, the first time a third party requester's comments are defective, the requester is given a period of 15 days to rectify the defect, and resubmit its comments. However,

> … If, upon the second submission, the comments are still not proper, the comments will be returned to third party > requester < with an explanation of what is not proper, and at that point the comments can no longer be resubmitted. … To the extent that 37 CFR 1.947 provides that the third party requester "may once" file written comments, that provision is hereby waived to the extent of providing the third party requester the one additional opportunity to remedy a comments paper containing merits-content that goes beyond what is permitted by the rules; 37 CFR 1.947 is not waived to provide any further opportunity in view of the statutory requirement for special dispatch in reexamination.
>
> M.P.E.P. 2666.05 II.

Accordingly, Patent Owner respectfully requests that the third party Requester not be permitted to correct the numerous errors in its Replacement Comments and resubmit its comments a third time.

IV. CONCLUSION

For the foregoing reasons, Patent Owner respectfully requests that the Office grant this petition, expunge the Replacement Comments from the record of this reexamination proceeding, and not permit the Requester to correct and resubmit its comments a third time.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, L.L.P.

Dated: May 31, 2013

By: ______________________

Biju I. Chandran
Reg. No. 63,684

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 1.248 and 1.903 and M.P.E.P. § 2666.06, the undersigned attorney for the Patent Owner certifies that a complete copy of this "PATENT OWNER'S PETITION UNDER 37 C.F.R. § 1.182 - REQUEST TO EXPUNGE THIRD PARTY REQUESTER'S REPLACEMENT COMMENTS FILED ON MAY 22, 2013 FROM THE RECORD," was served by Federal Express on May 31, 2013, on counsel for the third-party Requester at the following address:

Lloyd L. Pollard II
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P.O. Box 2200
Hillsboro, Oregon 97123

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

Dated: May 31, 2013

By: ______________________________
Biju I. Chandran
Reg. No. 63,684

Electronic Patent Application Fee Transmittal

Application Number:	95002386
Filing Date:	15-Sep-2012
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Filer:	Abhay Ashok Watwe/Brenda Coleman
Attorney Docket Number:	COOL-1.012

Filed as Large Entity

inter partes reexam Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Petition fee- 37 CFR 1.17(f) (Group I)	1462	1	400	400
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
		Total in USD ($)		**400**

Electronic Acknowledgement Receipt

EFS ID:	15920559
Application Number:	95002386
International Application Number:	
Confirmation Number:	7254
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Customer Number:	22852
Filer:	Abhay Ashok Watwe/Brenda Coleman
Filer Authorized By:	Abhay Ashok Watwe
Attorney Docket Number:	COOL-1.012
Receipt Date:	31-MAY-2013
Filing Date:	15-SEP-2012
Time Stamp:	15:48:39
Application Type:	inter partes reexam

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$400
RAM confirmation Number	2869
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1		10494_8000_reexamination_proceedings.pdf	517697 7c9ca549b3bda4eda69bf8fc2dee3340c6505596	yes	12

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Receipt of Petition in a Reexam	1	11
	Reexam Certificate of Service	12	12

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30425 a81fbb22161797d8a9df1a7fbecb2e8d8519e94a	no	2

Warnings:

Information:

Total Files Size (in bytes):	548122

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

ATTORNEY DOCKET NO. COOL-1.012
FILED VIA EFS ON MAY 22, 2013

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent No.: 8,245,764 **Currently in Litigation Styled:** *Asetek Holdings, Inc et al v. Coolit Systems Inc*, Case No. 3:12-cv-04498-EMC (N.D. Cal.) **Issued:** August 21, 2012 **Filed:** October 7, 2011 **Applicant:** Andre Sloth Eriksen **Title:** COOLING SYSTEM FOR A COMPUTER SYSTEM	**R.C.N.:** 95/002,386 **Confirmation No.:** 7254 **Examiner:** Joseph A. Kaufman **Art Unit:** 3993

SUBMITTED VIA ELECTRONIC FILING SYSTEM ON MAY 22, 2013
UNITED STATES PATENT AND TRADEMARK OFFICE

COMMENTS BY THIRD-PARTY REQUESTER UNDER 37 C.F.R. § 1.947 SUBSEQUENT TO PATENTEE'S RESPONSE TO OFFICE ACTION DATED OCTOBER 26, 2012, AND NOTICE DATED MAY 7, 2013

Pusuant to 37 C.F.R. § 1.947, and following a Notice dated May 7, 2013, from the Office, Requester submits its comments in reponse to Asetek's "Response Under 37 C.F.R. § 1.111," filed with the Office on December 26, 2012 (referred to hereafter as the "Amendment").

TABLE OF CONTENTS

I. CLAIM CONSTRUCTION

During *inter partes* reexamination, claims are interpreted according to the "broadest reasonable interpretation" standard. *See* MPEP § 2658; 2258(I)(G) (citing In re Yamamoto, 740 F.2d 1569 (Fed. Cir. 1984)). The analysis in these Comments is intended to comport with this standard.

Because the standards of claim interpretation applied by the Federal Courts during patent litigation proceedings differ from the claim interpretation standard that must be used in the Patent Office during claim reexamination proceedings, any interpretations of terms in the claims discussed herein for the purpose of reexamination are not binding on Requester in any litigation related to the '764 Patent (or other patents) and do not necessarily correspond to the construction of claims under the legal standards that must be applied by the Federal Courts in litigation. *See*, In re Zletz, 893 F.2d 319, 321-322 (Fed. Cir. 1989). In applying the particular prior art references identified herein, Requester neither admits nor acquiesces as to any interpretation of any claim of the '764 Patent asserted now or in the future in litigation before the Federal Courts, or in any other proceeding before any other tribunal. Requester reserves all rights to challenge in any proceeding, before any forum, any claim interpretations proferred by the Patent Owner in putting forth allegations of infringement against Requester.

II. ISSUES RAISED BY PATENT OWNER'S AMENDMENT MAKE CITATION OF ADDITIONAL PRIOR ART PROPER

In accordance with 37 C.F.R. § 1.948(a)(1)-(2), several additional prior art references cited in these Comments are necessary to rebut a response of the Patent Owner and/or a finding by the Examiner. In particular, but not exclusively, reliance on art not presently a basis of the reexamination proceeding is proper where, as here, Patent Owner amends the claims or raises allegations regarding such art. 37 C.F.R. § 1.948(a)(2). Available art includes references previously considered by the Office, as well as references not previously considered by the Office.[1] Moreover, the Office can adopt new prior art rejections anytime during the reexamination proceeding.[2] Each of the following references has been provided to the Office and listed on an Information Disclosure Statement:

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[1] *See*, MPEP §§ 2258-2258.01.

[2] *See, e.g.,* Belkin Int'l, Inc. v. Kappos, Slip Op. 2012-1090 (Fed. Cir., 2012). Although the Belkin decision concerned an *inter partes* reexamination under the pre-AIA "substantial new question" standard, the Court's statement regarding the Office's ability to raise new grounds of rejection does not appear to be so limited. *Also see*, MPEP § 2258.01 (stating that "in the examining stage of a reexamination proceeding, the examiner will consider whether the claims are subject to rejection based on art," without limitation on the scope of the body of art).

1. Shinya Koga, *et al.*, U.S. Patent No. 7,209,355, issued April 24, 2007, from an application filed on October 29, 2004, and claiming priority from an application filed on October 4, 2002 (hereinafter "**Koga '355**");
2. Bruce Munson, *et al.*, Fundamentals of Fluid Mechanics, 3rd Ed., pp. 45-48, 1998 (hereinafter, "**Munson**");
3. Shorter Oxford English Dictionary, 5th Ed (2002), p. 3526;
4. Qiang-Fei Duan, *et al.*, U.S. Patent No. 7,325,591, issued on February 5, 2008, from an application filed February 18, 2005 (hereinafter "**Duan**");
5. Oliver Laing, *et al.*, U.S. Publication No. 2004/0052663, published March 18, 2004, from an application filed on May 7, 2003 (hereinafter "**Laing**");
6. Jie Wei, *et al.*, U.S. Patent No. 7,222,661, issued May 29, 2007, from an application filed on November 18, 2004 (hereinafter "**Wei**");
7. Shin Takayuki, Japanese Publication No. 2002-151638, published on May 24, 2002 (hereinafter "**Takayuki**") (accompanied by English-language translation generated by the Japanese Patent Office website);
8. Brian A. Hamman, U.S. Patent No. 6,529,376, issued March 4, 2003, from an application filed August 3, 2001 (hereinafter "**Hamman**"); and
9. Kioan Cheon, U.S. Patent No. 5,731,954, issued on March 24, 1998, from an application filed August 22, 1996 (hereinafter "**Cheon**").

Each prior art patent and publication cited herein constitutes effective prior art as to the challenged claims of the '764 Patent under 35 U.S.C. § 102 and/or 35 U.S.C. § 103.[3] Requester relies on the entirety of these Comments to support the propriety of citing to additional prior art under 37 C.F.R. § 1.948(a).

III. <u>THE NEW CLAIMS DO NOT SATISFY 35 U.S.C. § 112</u>

Pursuant to 37 C.F.R. § 1.906, the new claims shall be examined, in part, on the basis of the requirements of 35 U.S.C. § 112. (Consistent with 37 CFR 1.906(a), Requester does not herein explain the many ways in which the **issued** claims are invalid under Section 112.)

At the outset, Requester notes that admissions by the Patent Owners as to matters affecting patentability may be used to reject claims in a reexamination proceeding. 37 C.F.R. § 103(c)(3).

A. PROPOSED NEW CLAIMS 20, 21, 24, 25, 28 AND 29 ARE INDEFINITE

During examination, after applying the broadest reasonable interpretation to the claim, if the metes and bounds of the claimed invention are not clear, the claim is indefinite and should be rejected. *Zletz*, 893 F.2d at 322. For example, if the language of a claim, given its broadest reasonable

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[3] *See* Patent Owner's admissions in its Amendment dated December 26, 2012, for example but not exclusively on pages 26-27, and as discussed herein, below.

interpretation, is such that a person of ordinary skill in the relevant art would read it with more than one reasonable interpretation, then a rejection under 35 U.S.C. 112, second paragraph is appropriate. MPEP § 2173.02(I). In reviewing a claim for compliance with 35 U.S.C. 112, second paragraph, the examiner must consider the claim as a whole to determine whether the claim apprises one of ordinary skill in the art of its scope and, therefore, serves the notice function required by 35 U.S.C. 112, second paragraph, by providing clear warning to others as to what constitutes infringement of the patent. MPEP § 2173.02(II) (citing *Solomon v. Kimberly-Clark Corp.*, 216 F.3d 1372, 1379 (Fed. Cir. 2000)).

Proposed claims 20, 21, 24, 25, 28 and 29 are indefinite on account of their use of at least the following terms and phrases, all of which is new claim language not found in the issued claims (or anywhere else in the specification).

"*the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber*" (recited in each of claims 20, 24 and 28): From this phrase, it is unclear whether the claimed thing "that opens into the thermal exchange chamber" is the "reservoir," the "plurality of passages positioned within the reservoir" or "the one or more passages." A review of the portions of the '764 Patent cited by Asetek (e.g., FIG. 17; 22:26-43) does nothing to resolve the ambiguous claiming. The exploded assembly view in FIG. 17 does not even identify the claimed "thermal exchange chamber," leaving one to wonder about the path a fluid would take into the claimed thermal exchange chamber. For example, it is unclear from FIG. 17 and its associated description whether the intermediate member 47 seats against the housing 14 and thus whether "reservoir" opens into the thermal exchange chamber, whether the outlet 34 opens into the thermal exchange chamber and whether either or both of the first passage 48 and second passage 49 opens into the thermal exchange chamber. Each of claims 20, 24 and 28 should be cancelled or amended to resolve the indefinite formulation currently proposed.

"*wherein an entire surface of the heat-exchanging[4] interface in contact with the cooling liquid in the reservoir forms the boundary wall of the thermal exchange chamber*" (expressly recited in claims 21 and 29, and similarly claimed in claim 25): This new claim language is indefinite on several fronts. First, it is unclear how a "surface," which by definition is two-dimensional, could form the claimed "boundary wall," a three-dimensional structure configured, according to the claims, to be placed into contact with a heat generating component. Second, the recitation "the heat-exchanging interface" in claims 21 and 29, and "the heat-exchange" interface in claim 25, lacks an antecedent basis. For example, independent claim

[4] Claim 25 recites "heat-exchange interface," but suffers similar deficiencies with regard to this recitation as discussed in connection with "heat-exchanging interface."

1 from which claim 21 depends merely recites "a heat-exchanging interface forming a boundary wall of the thermal exchange chamber, and configured to be placed in thermal contact with a surface of the heat-generating component." Neither claim 21 nor claim 1 claims a "heat-exchanging interface in contact with the cooling liquid in the reservoir." Accordingly, it is unclear which surface could constitute the newly claimed "entire surface" in proposed claim 21. Claim 25 suffers a similar deficiency in relation to the base claims from which it depends (i.e., claims 10 and 12). Moreover, independent claim 15 recites a "heat-exchange interface," yet proposed claim 29 recites "the heat-exchanging interface." Accordingly, each of claims 21, 25 and 29 should be cancelled or amended to resolve the indefinite proposed claiming.

B. NEW CLAIMS 19-30 LACK WRITTEN DESCRIPTION-ENABLEMENT SUPPORT

Much of the new claim language added to the proposed claims, and not found in the issued claims, is unsupported under Section 112, ¶ 1.

Asetek points to no drawing or description in the patent of a complete cooling system practiced as a single embodiment having the following features, which appear for the first time in the proposed claims. Instead, Asetek attempts to cherry pick elements from different portions of the specification and drawings and assemble them into new, and in some instances inoperative, combinations. Even with this improper attempt to assemble disparate elements of different embodiments, some of which result in inoperative combinations, collectively they still do not describe the recited cooling systems.

"<u>wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber</u>" (required by claims 19, 23 and 27): Claims 19, 23 and 27 depend from issued independent claims 1, 10 and 15, respectively. Issued claim 1 requires "an impeller cover having one or more passages." As Asetek admits on Page 15 of its Amendment, independent claims 1, 10 and 15 recite common features and should be read together, including the claimed "one or more passages." Thus, the impeller cover must define the claimed "passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber."

The written description does not use the phrase "direct cooling liquid from the pump chamber directly into the thermal exchange chamber." Apart from Asetek's vague statement in the Amendment that FIG. 17 somehow provides "support" for this new element, the patent has no drawing purporting to describe or otherwise define what is meant by this phrase. In particular, the patent does not expressly or necessarily disclose any embodiment showing any passage in the impeller cover configured to direct cooling liquid from the pump chamber **directly** into the thermal exchange chamber identified by Asetek in its latest response. In particular, FIG. 17 (reproduced below from Asetek's Amendment with additional annotations for convenience) and FIG. 20 (also reproduced below for additional clarity) show that neither the outlet 34 nor the unnumbered opening in the impeller cover 46A is configured to direct cooling liquid from the pump chamber **directly** into the purported themal exchange chamber as required by the new recitation.

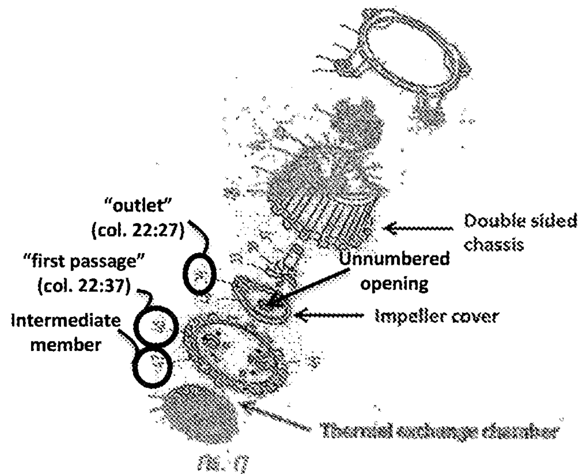

FIG. 17 AS PRESENTED IN ASETEK'S AMENDMENT ON PAGE 28 (WITH ADDITIONAL ANNOTATIONS FOR CONVENIENCE)

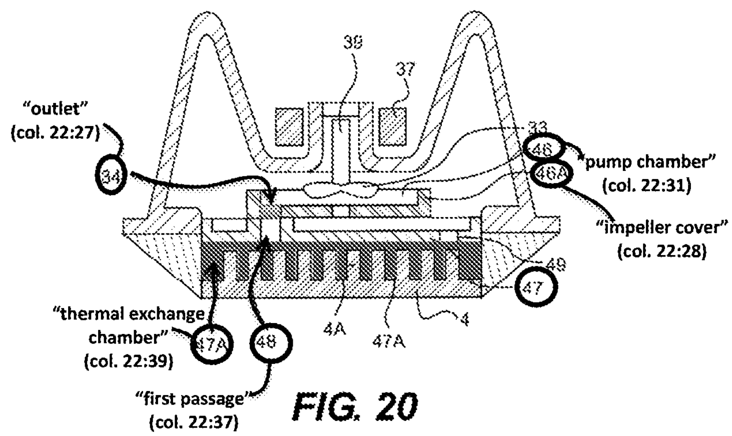

FIG. 20 FROM THE '764 PATENT, ANNOTATED[5]

Instead, any cooling liquid passing from the pump chamber must pass through (or at least by) the intermediate member 47 before entering the purported thermal exchange chamber 47A. Indeed, the text relied on by Asetek expressly states as much: "The intermediate member 47 is provided with a first passage 48 for leading cooling liquid from the pump chamber 46 to a thermal exchange chamber 47A provided at the opposite of the intermediate member 47." '764 Patent, col. 22:36-39. Thus, what Asetek cites as "support" for this claim element (Amendment, pp. 13 and 28) does not support the element.

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[5] Requestor notes the unresolved issue of whether the subject matter shown in FIG. 20 was adequately described in the original International Application.

"wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber" (required by claims 20, 24 and 28): Claims 20, 24 and 28 depend from independent claims 1, 10 and 15, respectively. Issued independent claim 1 requires "an impeller cover having one or more passages." As Asetek admits on Page 15 of its Amendment, independent claims 1, 10 and 15 recite common features and should be read together, including the claimed "one or more passages." Thus, the impeller cover must define the claimed "plurality of passages positioned within the reservoir that opens into the thermal exchange chamber."

However, the written description does not use the phrase "a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber." Apart from Asetek's vague statement in the Amendment that FIG. 17 somehow provides "support" for this new element, the patent has no drawing purporting to describe or otherwise define what is meant by this phrase. In particular, the patent does not expressly or necessarily disclose any embodiment showing any passage in the impeller cover (let alone a plurality of passages) that opens into the thermal exchange chamber. To the contrary, FIG. 17 (reproduced above) shows that neither the outlet 34 nor the unnumbered opening in the impeller cover 46A opens into the thermal exchange chamber.

Instead, any cooling liquid passing from the pump chamber must pass through (or at least by) the intermediate member 47 before entering the purported thermal exchange chamber. Indeed, the text relied on by Asetek expressly states as much: "The intermediate member 47 is provided with a first passage 48 for leading cooling liquid from the pump chamber 46 to a thermal exchange chamber 47A provided at the opposite of the intermediate member 47." '764 Patent, col. 22:36-39. Thus, what Asetek cites as "support" for this claim element (Amendment, pp. 13 and 28) does not support the element.

"an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms the boundary wall of the thermal exchange chamber" (required by claims 21, 25 and 29):

As noted above, this new claim element is indefinite, and Requester cannot ascertain what is intended to be claimed by this new requirement. Regardless, the written description does not use the newly coined phrasing. In particular, the patent does not expressly or necessarily disclose any embodiment that would put one of ordinary skill in the art on notice as to what is intended to be claimed.

Whatever surface this new element refers to, Asetek's citation to "FIG. 17, '34', '48'; Col. 22: 26-43" does nothing to clarify the matter. The patent has no drawing or description purporting to describe or otherwise define what is meant by this new claiming. Asetek's citation is irrelevant to the claimed surface. For example, reference numeral "34" is referred to as an "outlet" and reference numeral "48" is referred to as a "first passage" in the cited text. *See* '764 Patent, col. 22:26-43.

Asetek's Amendment lacks any indication of where support for any surface, let alone "an entire surface" that forms the claimed "boundary wall of the thermal exchange chamber," can be found in the patent. Indeed, one cannot even ascertain what constitutes a "thermal exchange chamber" from the cited text. For example, the specification non-sensically states "An intermediate member 47 is provided between the pump chamber 46 together with the interior of the reservoir and a heat exchanging interface 4." Id. at 22:33-36. Thus, what Asetek cites as "support" for this claim element does not support the element.

"the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir" (required by claims 22, 26 and 30): Although Asetek cites to FIG. 4 in the '764 Patent as allegedly providing support for these new features, Asetek points to no drawing or any description in the patent of a complete cooling system practiced as a single embodiment having the features required by these new dependent claims and the base claims from which they depend. For example, claims 22, 26 and 30 depend from independent claims 1, 10 and 15, respectively. Issued independent claim 1 requires, *inter alia*, an "a pump chamber including the impeller and … a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber, the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages." Asetek admits on Page 15 of its Amendment that independent claims 1, 10 and 15 recite common features and should be read together, including the claimed vertical spacing.

However, the embodiment shown in FIG. 4 in the '764 Patent (identical to the the embodiment shown in FIGS. 6 and 8 (*see* '764 Patent, 9:43-45, 48-49)) lacks any combination of features that apparently can be construed as a pump chamber vertically spaced from a thermal exchange chamber, contrary to the requirements of each of claims 1, 10 and 15.[6] That said, the '764 Patent explains that the embodiment shown in FIG. 17 has such a combination of features. However, the embodiment illustrated in FIG. 17, and later purportedly illustrated in FIG. 20, lacks any indication of an inlet or an outlet as required by the newly proposed claims.

Admittedly, the specification mentions in passing that "the reservoir housing 14 may be provided with an inlet (not shown) and an outlet (not shown) for the cooling liquid." '764 Patent, 21:62-64.

[6] This is particularly evident based on Asetek's assertion that two chambers cannot be considered as vertically spaced apart from each other if even a minor portion of one chamber overlaps with a portion of another chamber (i.e., if the portions are "at the same level" as each other). *See* Amendment, p. 20 (alleging that Koga does not disclose vertically spaced chambers).

However, simply adding an inlet 15 and an outlet 16 of the type shown in FIG. 4 to the reservoir housing 14 shown in FIGS. 17 and 20 would not allow the cooling system to operate as required by the proposed claims – i.e., to direct cooling liquid into the reservoir and to discharge the cooling liquid from the reservoir. Instead, the cooling liquid within the reservoir housing 14 would simply continue to recirculate within the reservoir housing. The '764 Patent lacks any description of how to prevent such recirculation in order for the cooling liquid to flow along the path required by the proposed claims.

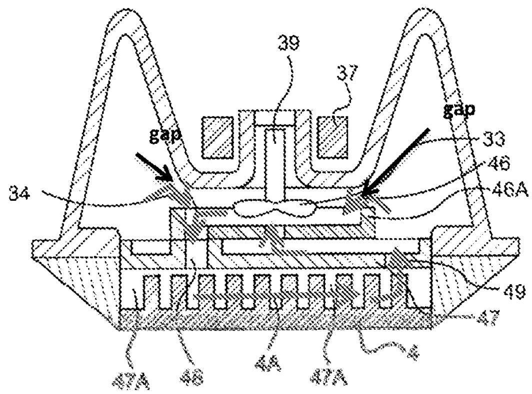


FIG. 20

FIG. 20 FROM THE '764 PATENT, ANNOTATED TO SHOW A GAP THAT PERMITS THE COOLING LIQUID TO RECIRCULATE, AS WELL AS THE PATH OF RECIRCULATION

Accordingly, even with the improper attempt to assemble disparate elements of different embodiments, the result is an inoperative combination of elements, providing evidence that Asetek did not fully appreciate, let alone enable or describe, such a combination. Taken collectively, the cherry-picked elements inadequately describe the cooling systems recited in the proposed claims. Accordingly, what Asetek cites as "support" does not support proposed claims 22, 26 and 30.

IV. THE OFFICE SHOULD DECLINE ASETEK'S EXTREME REWRITING OF THE ISSUED CLAIMS IN THE GUISE OF "CONSTRUCTION" AND MAINTAIN THE REJECTIONS BASED ON KOGA

In an attempt to distinguish the issued claims from the prior art, Asetek proposes new constructions that are contrary to the language of the claims, contrary to examples of "the invention" shown in the '764 Patent, and contrary to the plain meaning one of ordinary skill in the art would have understood from reading the existing claims. In the guise of construing the claims, Asetek in effect replaces them with a rewriting that adds supposed limitations not recited in the claims or even expressly described in the specification (to try to avoid invalidating prior art). Asetek's lack of confidence in its extreme "construction" positions is shown by its submission of a dozen new claims reciting new limitations.

Moreover, no basis exists in the file history of the '764 Patent for one of ordinary skill in the art to independently arrive at the Patent Owner's strained and unduly narrow interpretation of "chamber" and "vertical" set forth in its December 26, 2012, Amendment, particularly in versions of the specification and drawings pre-dating the application's expansion to include FIG. 20 and its corresponding description. Accordingly, Patent Owner's proffered interpretation of these terms should be rejected as failing to comport with the "broadest reasonable interpretation" required in the reexamination context.

Asetek's proposed "constructions" have no support in the claim language, in any definitions in the patent, in any description of the "invention" in the patent, or in the prosecution history. Moreover, Asetek points to no art-accepted definition for the terms "chamber" and "vertical" in a technical treatise or a dictionary that refutes the construction already adopted by the Office.

A. Asetek's Proposed Definition Of The Term "Chamber" Subsumes Asetek's Description Of Koga's "Sucking Channel 19"

Asetek agrees with the Examiner's construction of the term "chamber" as meaning "any enclosed space; compartment …." Amendment, p. 18 (citing to the Order, pp. 4 and 7). However, Asetek does not explain any basis for its conclusion that Koga's "sucking channel 19" is somehow not an enclosed space or a compartment. Indeed, Asetek even presents a definition of the term "channel" as being "a tubular passage for liquids; a conduit." Amendment, p. 18, FN 5.

These definitions of "chamber" and "channel" are not mutually exclusive. In contrast to Asetek's apparent position, the definition of "chamber" adopted by Asetek subsumes its propounded definition of "channel". A "tubular passage for liquids" necessarily constitutes an "enclosed space." Accordingly, the definition of the term "channel" proposed by Asetek fits squarely within the definition of the term "chamber" adopted by Asetek. Thus, Koga's "sucking channel 19" is properly considered a "chamber."

B. Asetek Does Not Refute That Koga's Sucking Channel Is An Enclosed Space

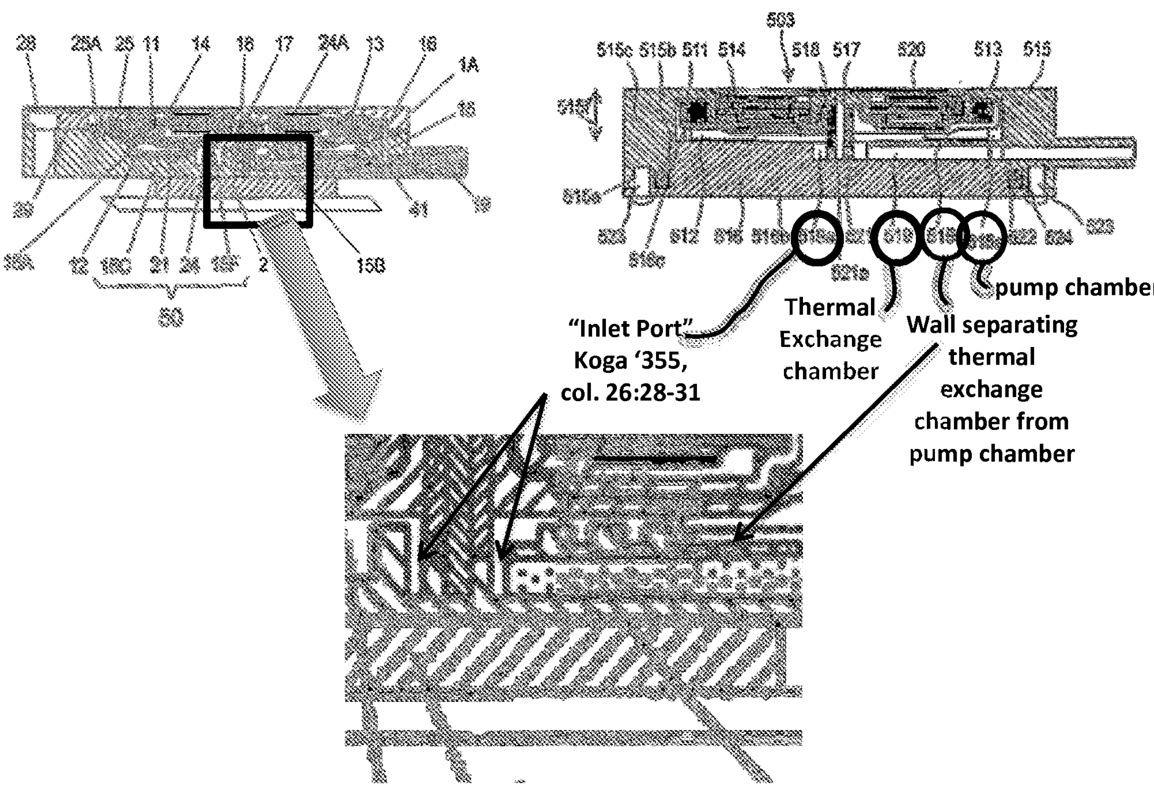
Moreover, Asetek does not refute that Koga's "sucking channel 19" is an enclosed space or a compartment. Rather, Asetek makes qualified allegations that Koga's "sucking channel" does not constitute a portion of Koga's "pump room 15A." Amendment, p. 18. Although this admission by Asetek squarely confirms that Koga's sucking channel 19 is separate from Koga's pump chamber 15A, it does nothing to distinguish Koga's "sucking channel 19" from a claimed "chamber." Thus, despite the verbosity of Asetek's argument, Asetek does not seriously challenge that Koga's "sucking channel 19" constitutes a "chamber," as claimed.

Asetek's conclusory and unfounded attorney argument on pages 18-20 concerning the alleged understanding one of ordinary skill in the art would have given Koga cannot supplant evidence as to what one of ordinary skill in the art would have understood. The specification does not clearly and unquestionably define the term "chamber" to mean anything that would distinguish over Koga's channel 19. Instead, the evidence merely confirms the Examiner's interpretation that Koga discloses a chamber.

C. CONTRARY TO ASETEK'S MERE ARGUMENT, EVIDENCE CONFIRMS THAT KOGA'S "SUCKING CHANNEL 19" IS PROPERLY CONSTRUED AS A CLAIMED "THERMAL EXCHANGE CHAMBER"

A substantially similar device to the one shown in Koga's FIG. 7 is shown and described in FIG. 51 of Koga '355. For convenience, these drawings are reproduced below.

FIG.7 Fig. 51



ANNOTATED COMPARISION OF FIG. 7 IN KOGA AND FIG. 51 IN KOGA '355 SHOWING THAT BOTH DEVICES INCLUDE AN "INLET PORT" TO THE PUMP CHAMBER

Koga's so-called "sucking channel 19" is relabeled in Koga '355 as a "passage 519". *Cf.* Koga, FIG. 7, col 8:4-24; and Koga '355, FIG. 51, col. 28:32-34, 42-46. Moreover, Koga '355 explains that the passage 519 is formed by overlaying a "sealing portion 515d of the upper case 515" on a groove 519b in the lower case 516 "for sealing between the pump chamber 515a and the inlet passage 519 to allow no leakage of the coolant." Koga '355 28:34-58. Clearly, the passage 519 constitutes an enclosed space, and thus is a "chamber," as claimed.

Koga's "sucking channel 19" must also be considered an enclosed space in at least the same way that the passage 519a in Koga '355 constitues an enclosed space. Thus, Koga's "sucking channel 19" is properly construed in the outstanding Office action as being a claimed "chamber." The Office should continue to consider Koga's channel 19 as being a "chamber," which it clearly is.

The specification and file history impart no special or different meaning to the phrase "thermal exchange." Accordingly, its plain and ordinary meaning controls. For example, during operation, energy in the form of heat is absorbed by the cooling liquid in the chamber 19 from the casing wall 15. *See, e.g.*, Request, p. 37 (citing Koga FIG. 7, col. 9:10-47).

As explained in the Request and confirmed in the Office Action, Koga's sucking channel 19 consitutes a "thermal exchange chamber". Id.

D. Asetek's Comments Regarding Laing and Duan Are Inapposite

The inlet and outlet ports shown in each of Laing and Duan are irrelevant to whether Koga discloses a pump chamber vertically spaced apart from a thermal exchange chamber. *See*, Amendment, p. 21. First, neither of Laing's ports 20, 26 and neither of Duan's ports 11, 12 houses a pump. Second, neither of Laing's ports and neither of Duan's ports is placed in thermal contact with a heat generating component. Accordingly, Requester never alleged and the Office has not determined whether either of Laing's ports and/or either of Duan's ports should be considered as a pump chamber or as a thermal exchange chamber. Asetek's remarks are misplaced and irrelevant.

E. Koga Discloses A Pump Chamber

Moreover, Koga's so-called "pump room 15A" is relabeled in Koga '355 as a "pump chamber 515a" in accordance with idiomatic English. *Cf.* Koga, FIG. 7, col 8:4-24; and Koga '355, FIG. 51, col. 28:32-34, 42-46. Thus, Koga's pump room 15A clearly constitutes a "pump chamber."

F. Koga Discloses A Vertical Separation Between The Pump Chamber And The Thermal Exchange Chamber

The sole remaining question, then, is whether Koga's pump chamber 15A is vertically spaced from the thermal exchange chamber 19. The answer is a resounding "yes," particularly considering that Asetek has admitted in this reexamination that Koga's thermal exchange chamber 19 does not constitute a portion of the pump chamber. *See*, Amendment p. 18 (stating "sucking channel 19 is not a 'chamber' of Koga's pump room 15A").

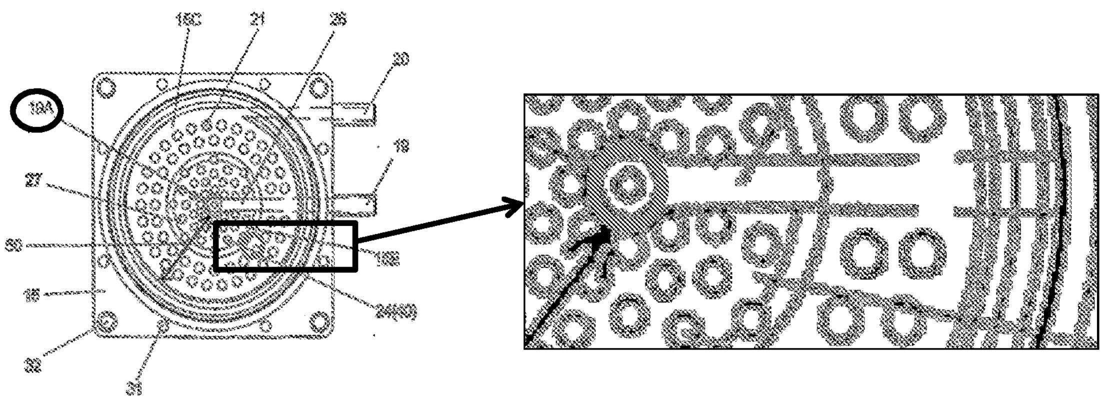
As shown in Koga's FIG. 7, above, a horizontal wall extends between Koga's thermal exchange chamber 19 and the pump chamber 15A. (A similar wall 515d extends between the thermal exchange chamber 519 and the pump chamber 515A in Koga '355). The Shorter Oxford English Dictionary, 5th Ed.

even defines "vertical" to mean "placed, extending, moving or operating at right angles to a horizontal plane …."[7] The horizontal wall of Koga has a finite thickness extending vertically, and thus separates the thermal exchange chamber 19 from the pump chamber 15A, as admitted by Asetek, in a vertical direction. Moreover, Koga's summary describes an aspect of its disclosure as "a sucking channel [Koga's thermal exchange chamber] prepared between the heat receiving plane and an inner wall of the pump room [Koga's pump chamber]." Koga, col. 3:24-25; 4:58-60.

G. ASETEK MISCONSTRUES KOGA IN AN ATTEMPT TO DISTINGUISH IT

Asetek urges, incorrectly, on page 20 of its Amendment that a portion of Koga's pump chamber is positioned at the same level as the thermal exchange chamber 19. Instead, as Koga explains with regard to FIG. 5 (reproduced below), the feature Asetek regards as a portion of the pump chamber 15A is actually an inlet port to the pump chamber. *See*, Koga, FIGS. 5 and 7, col. 6:6, 8, 19; *also see,* Koga '355, col. 26:27-30 (describing a similar inlet port 519a). Thus, contrary to Asetek's allegations, no portion of Koga's pump chamber 15A is "at the same level as" Koga's thermal exchange chamber 19. Koga's chambers are vertically spaced apart, as claimed.

FIG.5



KOGA FIG. 5 (ANNOTATED AND ENLARGED TO SHOW DETAIL OF INLET PORT 19A, SHADED)

H. ASETEK'S PROPOSED CONSTRUCTION OF "VERTICAL" FLIES IN THE FACE OF COMMON SENSE AND DOES NOT COMPORT WITH THE CONCEPT OF "VERTICAL" UNDERSTOOD IN THE ART

Even assuming, *arguendo*, that Koga's inlet port to the pump chamber 15A could be construed as being a portion of the pump chamber, the mere fact that such a port might be "at the same level as" the thermal exchange chamber 19 does not prevent the pump chamber 15A and the thermal exchange

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[7] An excerpt of the Shorter Oxford English Dictionary (OED) accompanies these Comments.

chamber 19 from being vertically separated under the "broadest reasonable interpretation" standard governing reexamination.

First, practical experience reveals that liquids flow under gravity from higher elevations to lower elevations. Common sense dictates that a liquid could flow under gravity from Koga's pump chamber 15A into Koga's thermal exchange chamber 19 when the device is disconnected from a fluid circuit. Thus, based simply on common sense, Koga's thermal exchange chamber should be considered as being below Koga's pump chamber. Asetek's assertion to the contrary based on the position of an inlet is farcical.

Second, the Munson reference, an introductory textbook concerning fluid mechanics, confirms that pressure in a static body of liquid of the type used in claimed cooling systems is "not influenced by the size or shape of the tank or container in which the fluid is held." Munson, p. 46. Rather, Munson explains, the depth of the fluid is what controls. Id. Accordingly, one of ordinary skill in the art would readily understand from this single passage, as well as from the totality of Munson (as well as common sense), that Koga's pump chamber 15 is positioned above Koga's thermal exchange chamber 19, even if Koga's inlet port could be considered as being a portion of the pump chamber chamber.

Moreover, Asetek's illogical assertions regarding Koga's inlet port 19A do nothing to address that Koga discloses a wall overlying the thermal exchange chamber and vertically separating the pump chamber from the thermal exchange chamber. *See, e.g.*, Koga, FIG. 7 (reproduced above). Asetek even admits that Koga's thermal exchange chamber 19 constitutes no portion of Koga's pump chamber 15. *See*, Amendment, p. 18.

I. ASETEK'S PROPOSED CONSTRUCTION OF "VERTICAL" DOES NOT EVEN COMPORT WITH THE '764 PATENT'S CONCEPT OF THE PURPORTED "INVENTION"

According to the '764 Patent, FIG. 4 shows "an exploded view of the invention and the surrounding elements." '764 Patent, col. 9, 38-39. FIG. 6 shows an exploded view of the purported "invention". Id. at 9:43-45. FIGS. 4 and 6 from the '764 Patent are reproduced below and annotated for convenience.

From even a cursory review of FIGS. 4 and 6, the purported "invention" appears to be no more than a pump 21 positioned within a box 14. From a study of FIGS. 4 and 6, it is difficult to understand Asetek's allegations that Koga somehow does not disclose vertically spaced apart chambers given that the purported "invention" shown in FIGS. 4 and 6 seems to completely immerse all features associated with the pump 21 in the box 14.

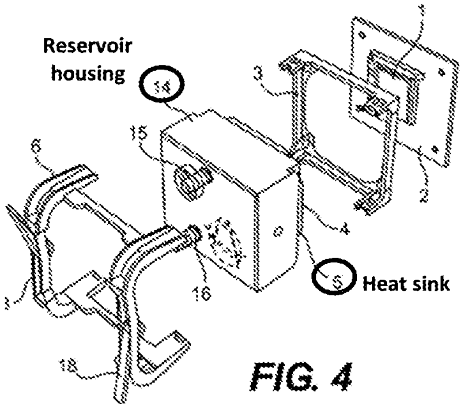


FIG. 4

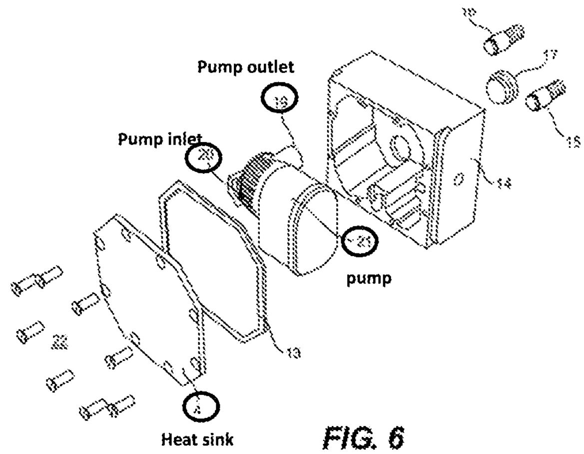


FIG. 6

FIGS. 4 AND 6 FROM THE '764 PATENT SHOWING THE PURPORTED "INVENTION"

J. THE REJECTION OF EACH OF EXISTING INDEPENDENT CLAIMS 1, 10 AND 15 AS BEING ANTICIPATED BY KOGA SHOULD BE MAINTAINED

Asetek's attempts to distinguish issued claims 1, 10 and 15 from the prior art are contrary to the language of the claims, contrary to examples of "the invention" shown in the '764 Patent, and contrary to the plain meaning one of ordinary skill in the art would have understood from reading the claims. In the guise of construing the claims, Asetek in effect attempts to replace them with a rewriting that adds supposed limitations not recited in the claims or even expressly described in the specification (to try to avoid invalidating prior art). However, Asetek has the option of amending the claims in an attempt to overcome the properly set forth prior art rejections based on Koga. Requester respectfully urges the Office to reject Patent Owner's proffered constructions and instead require Patent Owner to amend the claims if it wishes to overcome the outstanding rejections of claims 1, 10 and 15 based on Koga.

K. THE REJECTION OF EACH OF DEPENDENT CLAIMS 2-9, 11-14 AND 16-18 AS BEING ANTICIPATED BY KOGA SHOULD BE MAINTAINED

Asetek merely alleges that each of existing dependent claims 2, 3, 5-9, 11-14 and 16-18 should be determined to be patentable by virtue of its respective dependency from an existing base claim, without alleging any other basis of patentability. Requester respectfully urges that the Office should maintain the outstanding rejection of each of existing claims 2, 3, 5-9, 11-14 and 16-18, at least because the base claims should remain rejected and Asetek has set forth no other basis for withdrawing the outstanding rejections of existing dependent claims 2, 3, 5-9, 11-14 and 16-18.

Dependent claim 4 recites "The cooling system of claim 3, wherein the first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber." Although it is unclear what is meant by "adapted to increase heat transfer" (e.g., "increase" relative to what?), Requester submits that Koga discloses each and every element arranged as claimed in dependent claim 4 (as well as the base claims from which it depends).

As a first example, Koga explains that the casing 15 and thus the heat exchanging interface 15B is made of "highly conductive material," which "adapts" the first side of the heat exchanging interface (e.g., the side in contact with cooling liquid in the thermal exchange chamber 19) to increase heat transfer to the cooling liquid in the thermal exchange chamber 19 (e.g., relative to a material with low thermal conductivity). *See, e.g.*, Koga, col. 10:22-23.

As a second example, the "first side" of the heat exchanging interface 15B is adapted to direct coolant through the thermal exchange chamber 19 toward the center of the impeller 11, increasing cooling efficiency. *See, e.g.*, Koga, col. 8:4-9, 31-33 (stating "as a result, much more heat transferred to casing 15 can be collected by coolant 41").

As a third example, Koga explaines that the "backside of heat receiving plane 15B," a portion of which consititutes the claimed "first side" in contact with coolant in the thermal exchange chamber 19, can be dimpled. Koga, col. 6:52-53. Koga explains further that such features on the "backside" facilitates heat transfer by distrupting a boundary layer. Koga, col. 6:56-62.

Thus, Koga discloses that a first side of the heat-exchanging interface 15B includes features (e.g., conductive material, configuration to direct coolant, and dimples) that are adapted to increase heat transfer from the heat-exchanging interface 15B to the cooling liquid in the thermal exchange chamber 19, as claimed in dependent claim 4. The rejection of claim 4 as being anticipated by Koga should be maintained.

L. In the Alternative, Koga Renders Claims 1-18 obvious

As explained above, Koga expressly disclosed each and every combination of features arranged in the manner recited in claims 1-18. However, to the extent that Koga might be considered as not disclosing some trivial claim limitation recited in one or more claims, the basic knowledge or "common sense" possessed by one of ordinary skill in the art would have resolved such difference. Accordingly, Requester respectfully urges the Office, in the alternative, to reject each such claim under 35 U.S.C. § 103(a) as claiming an obvious variant of Koga.

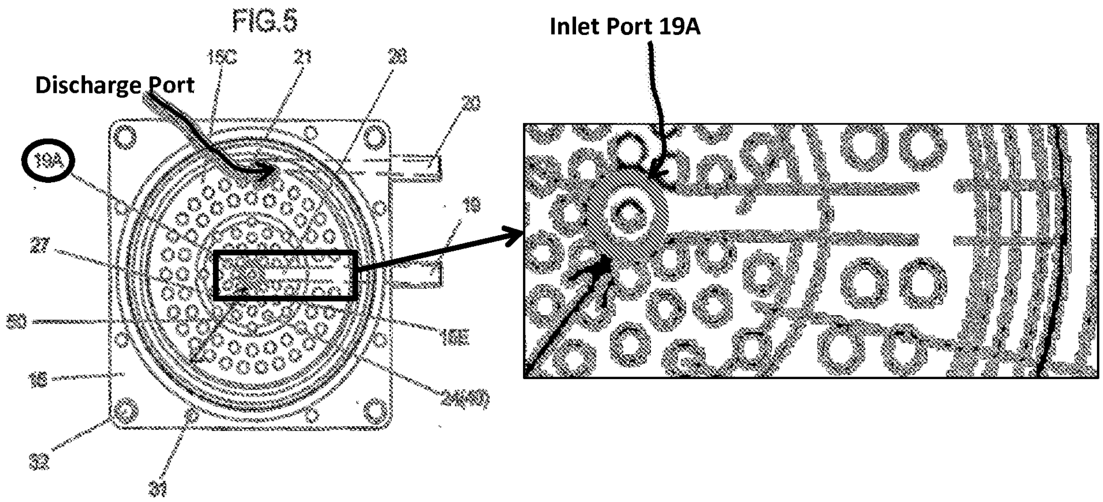
V. THE NEW CLAIMS ARE UNPATENTABLE OVER KOGA

As explained below, Koga discloses each and every feature arranged as claimed in each of proposed claims 19-30. Thus, Koga anticipates each proposed claim. In the alternative, Koga renders each proposed claim unpatentable under 35 U.S.C. § 103(a).

A. Koga Anticipates New Claims 19, 23 and 27

Each of proposed claims 19, 23 and 27 requires that the "one or more passages include[s] a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber." As stated in the Request, Koga's pump chamber 15A is defined by Koga's casings 15 and 16, which form an impeller cover. *See*, Request, pp. 152, 158, 161. As described above and shown in Koga's FIG. 5 (reproduced below for convenience), the casings 15 and 16 also define an inlet port 19A extending between Koga's thermal exchange chamber 19 and pump chamber 15A. The inlet port 19A constitutes a "passage".

Moreover, claims 19, 23 and 27 merely require that the claimed "passage" be configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber. Koga's inlet port 19A is not encumbered by any valve or otherwise impeded by any device that would prevent a coolant from flowing from the the pump chamber 15A directly into the thermal exchange chamber 19 as required by claims 19, 23 and 27. Thus, Koga's inlet port 19A, a passage, is configured to direct cooling liquid from the pump chamber 15A directly into the thermal exchange chamber 19, as claimed.



KOGA FIG. 5 (ANNOTATED AND ENLARGED TO SHOW DETAIL OF INLET PORT 19A, SHADED)

Koga anticipates each of claims 19, 23 and 27. Accordingly, Requester respectfully urges the Office to reject each of claims 19, 23 and 27 for anticipation by Koga.

B. KOGA ANTICIPATES NEW CLAIMS 20, 24 AND 28

Each of proposed claims 20 and 24 requires that the "one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber." Claim 28 requires that the thermal exchange chamber and the pump chamber are fluidly coupled together by a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber."

Koga's pump chamber 15A and thermal exchange chamber 19 are fluidly coupled to each other, in part, by the discharge port (shown in annotated FIG. 5, above) from the pump chamber 15A opening into the discharge channel 20. *See*, Request, pp. 153, 158 and 161. For example, coolant passes from the pump chamber 15A, through the discharge port, through the discharge channel 20, through the radiator 3 (FIG. 1) and returns to the thermal exchange chamber 19. Id. As well, the thermal exchange chamber 19 and the pump chamber 15A are fluidly coupled to each other by the inlet port 19A, also shown in annotated FIG. 5, above.

The inlet port 19A constitutes a "passage" positioned within Koga's reservoir. As well, the discharge port from Koga's pump chamber 15A into the discharge channel 20 consititutes a "passage" positioned within the reservoir.

Thus, Koga discloses a "plurality of passages positioned within the reservoir," as claimed in each of claims 20, 24 and 28. Moreover, Koga's reservoir opens into the thermal exchange chamber 19, precisely as claimed in each of these claims.

Because Koga discloses each and every feature arranged as claims 20, 24 and 28 require, Koga anticipates each of proposed claims 20, 24 and 28.

Accordingly, Requester respectfully urges the Office to reject proposed claims 20, 24 and 28 for anticipation by Koga.

C. KOGA ANTICIPATES NEW CLAIMS 21, 25 AND 29

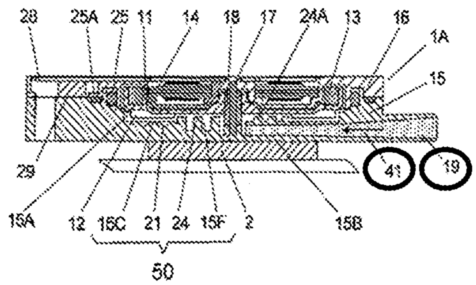
Each of proposed claims 21, 25 and 29 requires "an entire surface of the heat-exchanging/e interface in contact with the cooling liquid in the reservoir forms [a] boundary wall of the thermal exchange chamber."

Koga's FIG. 7 (reproduced below) shows that an inner surface of the thermal exchange chamber 19 is in contact with the cooling liquid 41 in the reservoir. To the extent that a "surface" can form a "wall", as required by each of claims 21, 25 and 29, the entire inner surface of the thermal exchange chamber forms a boundary wall of the thermal exchange chamber, as required by each of proposed claims 21, 25 and 29.

Koga discloses each and every feature arranged as claimed in each of proposed claims 21, 25 and 29. Thus, Koga anticipates proposed claims 21, 25 and 29.

Accordingly, Requester respectfully urges the Office to reject proposed claims 21, 25 and 29 for anticipation by Koga.

FIG.7



KOGA FIG. 7 (ANNOTATED)

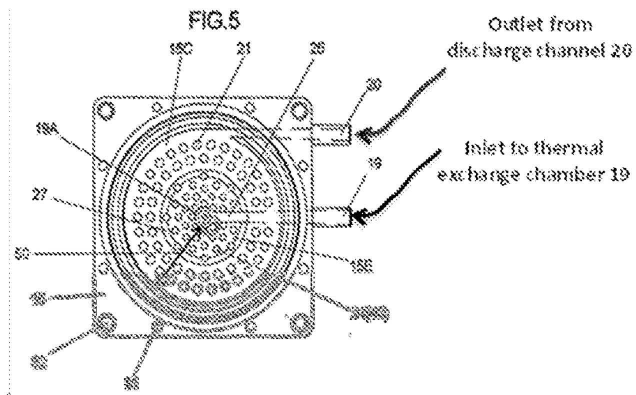
D. KOGA ANTICIPATES NEW CLAIMS 22, 26 AND 30

Each of proposed claims 22, 26 and 30 requires that the "reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir."

As shown in the annoted FIG. 7, below, an aperture positioned near the terminal end (e.g., distally from the pump chamber 15A) of Koga's discharge channel 20 consitutes an outlet configured to discharge the cooling liquid from the reservoir. *See,* Koga, col. 8:4-5. As well, Koga's thermal exchange chamber has an aperture constituting an inlet configured to direct the cooling liquid into the reservoir. Id.

Therefore, Koga discloses each and every feature arranged as claimed in each of proposed claims 22, 26 and 30. Thus, Koga anticipates proposed claims 22, 26 and 30.

Accordingly, Requester respectfully urges the Office to reject proposed claims 22, 26 and 30 for anticipation by Koga.



KOGA FIG. 5 (ANNOTATED)

E. IN THE ALTERNATIVE, KOGA RENDERS PROPOSED CLAIMS 19-30 OBVIOUS

As explained above, Koga expressly disclosed each and every combination of features arranged in the manner recited in proposed claims 19-30. However, to the extent that Koga might be considered as not disclosing some trivial claim limitation recited in one or more claims, the basic knowledge or "common sense" possessed by one of ordinary skill in the art would have resolved such difference. Accordingly, Requester respectfully urges the Office, in the alternative, to reject each such claim under 35 U.S.C. § 103(a) as claiming an obvious variant of Koga.

VI. EACH OF PROPOSED CLAIMS 19-30 IS INVALID OVER KOGA COMBINED WITH ADDITIONAL PRIOR ART

A. ASETEK ADMITS THAT REFERENCES FILED EARLIER THAN MAY 6, 2005 CONSTITUTE VALID PRIOR ART

Asetek admits in its Amendment that all referenences relied upon in the Request constitute valid prior art to the claims in the '764 Patent. Amendment, pp. 26-27. In particular, Asetek states that "the priority date of the '764 claims is not an issue relevant to this reexamination proceeding. … [A]ll prior art references relied upon in the Request predate the filing date of the International Application." Id. at 26. On this basis, Asetek admits that "the availability of the references relied upon in the proposed rejections is not dependent on the priority date of the '764 Patent." Id. at 27. From these and other statements in Asetek's Amendment, Requester understands that Asetek admits any reference predating the filing date of the International Application (i.e., May 6, 2006) constitutes valid prior art to the '764 Patent. In any event, Duan was the latest-filed reference cited in the Request and was filed on February 18, 2005.

Requester maintains the assertions set forth in the Request that no claim in the '764 Patent is entitled to priority predating the '764 Patent's filing date of July 14, 2011. However, in view of Asetek's admission that all references relied on in the Request constitute valid prior art to the '764 Patent, the issue of priority is presently moot for purposes of this reexamination. Accordingly, to comport with 37 CFR 1.906(a), to save on costs and/or to expedite reexamination, Requester presently declines to rebut Asetek's remarks regarding whether any issued claim might somehow be entitled to priority from the International Application's filing date (or any other date earlier than July 14, 2011). That is to say, Requester expressly reserves the right to contest, in any relevant forum, including this reexamination proceeding and the co-pending litigation, each and every allegation in Asetek's Amendment (e.g., including but not limited to allegations on pages 27 through 31 therein).[8]

B. SUMMARY OF PROPOSED REJECTIONS UNDER 35 U.S.C. § 103(A)

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[8] As but one example, Requester reserves the right to contest the availability of priority from any previously filed application, including the International Application, if Asetek in the future challenges the availability of any references cited herein (or in future filings) as prior art. At this time, however, the alleged priority is not at issue given the understanding that Asetek admits any reference predating May 6, 2005, constitutes valid prior art to the claims in the '764 Patent.

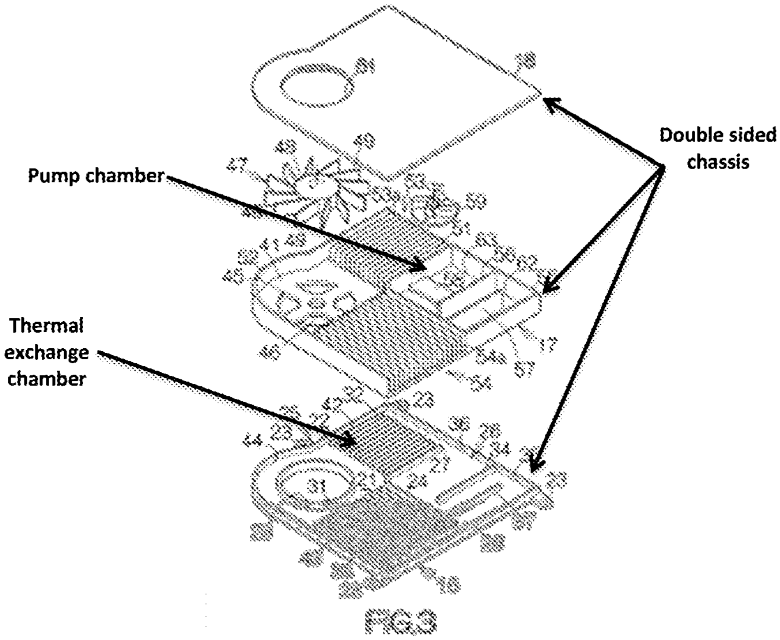
As explained above and in the Request, and acknowledged in the outstanding Office Action, each of claims 1-18 is unpatentable over Koga. As also explained above, each of claims 19-30 is unpatentable over Koga. Nonetheless, to the extent any features recited in any of proposed claims 19-30 might be considered lacking from the Koga reference, each of the additional prior art references cited herein supply some or all of the features recited in proposed claims 19-30, as explained more fully below. Thus, these references are important to decide patentability and are properly presented herein under 37 C.F.R. 1.1948 to respond to issues raised by the Patent Owner, as follows:

No.	Proposed Rejections
1	Each of proposed claims 19 through 30 should be rejected under § 103 as obvious from Wei and Koga.
2	Each of proposed claims 19 through 30 should be rejected under § 103 as obvious from Takayuki and Koga.
3	Each of proposed claims 19 through 30 should be rejected under § 103 as obvious from Cheon and Koga.

C. Proposed Claims 19-30 Would Have Been Obvious From Wei and Koga

The newly found Wei reference having been filed on November 18, 2004, presumptively qualifies as prior art to the '764 Patent under 35 U.S.C. § 102(a) and (e), as well as under 35 U.S.C. § 103. In any event, Wei constitutes valid prior art to the '764 Patent based on Asetek's admissions discussed above. Amendment, pp. 26-27. Koga also constitutes valid prior art to the '764 Patent. Id.

For convenience, an exploded view of Wei's device is reproduced and annotated below. As shown and explained more fully below in connection with the proposed rejections based on Wei and Koga, Wei discloses each of the features Patent Owner alleges to be lacking from the Koga reference.

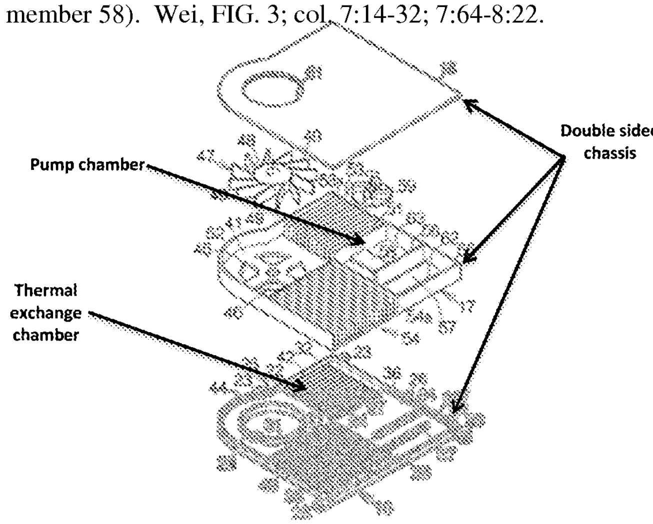


WEI FIG. 3 (ANNOTATED)

Indeed, Wei expressly disclosed every feature arranged in the manner recited in proposed claims 19 through 30. To the extent that Wei might be considered as not disclosing some trivial claim limitation, the basic knowledge or "common sense" possessed by one of ordinary skill in the art would have resolved such difference, particularly following a review of Koga's disclosure. Accordingly, each combination of features claimed in proposed claims 19-30 would have been obvious to one of ordinary skill in the art from a review of Wei and Koga at the time of the purported invention claimed in the '764 Patent, as set forth below.

Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" - choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or motivation to combine.

All of these rationale apply here with regard to proposed claims 19-30, as detailed below. First, combining Wei with Koga yields predictable results. Second, simply substituting Koga's stator/impeller for Wei's pump achieves predictable results. Third, at least based on Koga's disclosed concept of a stator separated from a cooling liquid and an impeller in contact with the liquid, it would have been obvious to at least try to incorporate such a configuration into Wei's device to drive Wei's impeller. Fourth, both Wei and Koga at least suggest providing cooling systems as claimed (e.g., having, *inter alia*, vertically spaced apart thermal exchange and pump chambers).

Proposed Claim Language	Correspondence to Wei and Koga
19. (New) The cooling system of claim 1, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 1. Moreover, Koga disclosed a passage configured as claimed in claim 19. However, to the extent Koga might be considered not to disclose such a passage, Wei disclosed a passage configured to direct cooling liquid as claimed (e.g., passage adjacent to member 58). Wei, FIG. 3; col. 7:14-32; 7:64-8:22. 
20. (New) The cooling system of claim 1, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 1. Moreover, Koga disclosed a plurality of passages configured as claimed in claim 20. However, to the extent Koga might be considered not to disclose such a plurality of passages, FIG. 3 in Wei shows at least two openings from pump chamber 63 positioned on opposed sides of support member 58 and opening into the thermal exchange chamber 42 ("endoergic chamber 42"). *See*, Wei col. 7:14-32; 7:64-8:22.
21. (New) The cooling system of claim 1, wherein an entire surface of the heat-exchanging interface in contact with the cooling	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 1. Moreover,

liquid in the reservoir forms the boundary wall of the thermal exchange chamber.	Koga disclosed an entire surface configured as claimed in claim 21. However, to the extent Koga might be considered not to disclose the claimed entire surface, FIG. 3. in Wei shows an entire inner surface of the thermal exchange chamber 42 in contact with cooling liquid and forming a boundary wall of the chamber 42.
22. (New) The cooling system of claim 1, wherein the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 1. Moreover, Koga disclosed an inlet and an outlet configured as claimed in claim 22. For example, an aperture positioned near the terminal end (e.g., distally from the pump chamber 15A) of Koga's discharge channel 20 consitutes an outlet configured to discharge the cooling liquid from the reservoir. *See,* Koga, col. 8:4-5. As well, Koga's thermal exchange chamber has an aperture constituting an inlet configured to direct the cooling liquid into the reservoir. <u>Id.</u> In any event, FIG. 3. in Wei shows such an inlet and an outlet. For example, the opening 28 constitutes an inlet to the reservoir 62 as claimed and the opening by wall 56 into pump chamber 63 constitutes an outlet from the reservoir 62 as claimed.
23. (New) The cooling system of claim 10, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 10. Moreover, Koga disclosed a passage configured as claimed in claim 23. However, to the extent Koga might be considered not to disclose such a passage, Wei disclosed a passage configured to direct cooling liquid as claimed (e.g., passage adjacent to member 58). Wei, FIG. 3; col. 7:14-32; 7:64-8:22. Wei, FIG. 3.
24. (New) The cooling system of claim 10, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 10. Moreover, Koga disclosed a plurality of passages configured as claimed in claim 24. However, to the extent Koga might be considered not to disclose such a plurality of passages, FIG. 3 in Wei shows at least two openings from pump chamber 63 positioned on opposed sides of support member 58 and opening into the thermal exchange chamber 42 ("endoergic chamber 42"). *See*, Wei col. 7:14-32; 7:64-8:22.

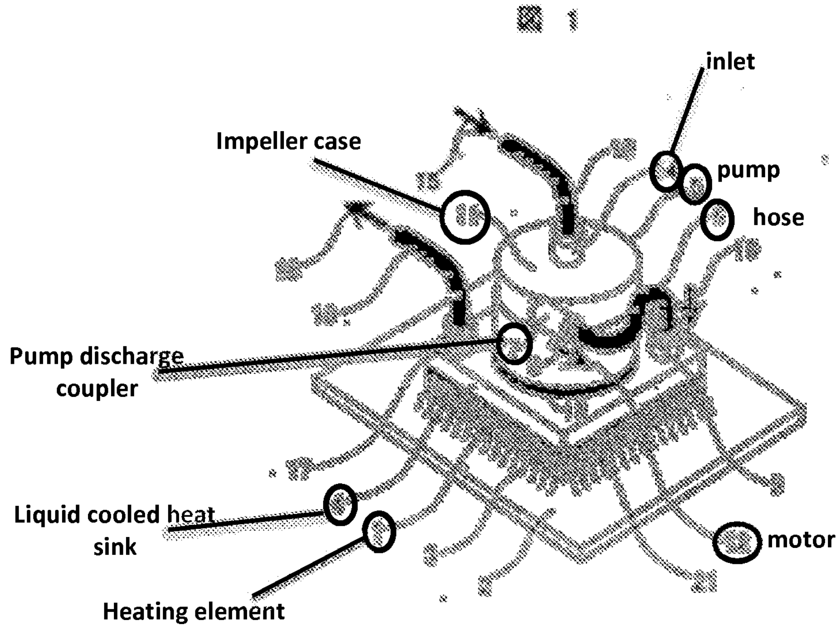
25. (New) The cooling system of claim 12, wherein an entire surface of the heat-exchange interface in contact with the cooling liquid in the reservoir forms a boundary wall of the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 12. Moreover, Koga disclosed an entire surface configured as claimed in claim 25. However, to the extent Koga might be considered not to disclose the claimed entire surface, FIG. 3. in Wei shows an entire inner surface of the thermal exchange chamber 42 in contact with cooling liquid and forming a boundary wall of the chamber 42.
26. (New) The cooling system of claim 10, wherein the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 10. Moreover, Koga disclosed an inlet and an outlet configured as claimed in claim 26. For example, an aperture positioned near the terminal end (e.g., distally from the pump chamber 15A) of Koga's discharge channel 20 consitutes an outlet configured to discharge the cooling liquid from the reservoir. *See,* Koga, col. 8:4-5. As well, Koga's thermal exchange chamber has an aperture constituting an inlet configured to direct the cooling liquid into the reservoir. Id. In any event, FIG. 3. in Wei shows such an inlet and an outlet. For example, the opening 28 constitutes an inlet to the reservoir 62 as claimed and the opening by wall 56 into pump chamber 63 constitutes an outlet from the reservoir 62 as claimed.
27. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, the one or more passages including a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 15. Moreover, Koga disclosed a passage configured as claimed in claim 27. However, to the extent Koga might be considered not to disclose such a passage, Wei disclosed a passage configured to direct cooling liquid as claimed (e.g., passage adjacent to member 58). Wei, FIG. 3; col. 7:14-32; 7:64-8:22.
28. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by a plurality of passages positioned within the reservoir that open into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 15. Moreover, Koga disclosed a passage configured as claimed in claim 28. However, to the extent Koga might be considered not to disclose such a passage, Wei disclosed a passage configured to direct cooling liquid as claimed (e.g., passage adjacent to member 58). Wei, FIG. 3; col. 7:14-32; 7:64-8:22.

29. (New) The cooling system of claim 15, wherein an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms a boundary wall of the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 15. Moreover, Koga disclosed an entire surface configured as claimed in claim 29. However, to the extent Koga might be considered not to disclose the claimed entire surface, FIG. 3. in Wei shows an entire inner surface of the thermal exchange chamber 42 in contact with cooling liquid and forming a boundary wall of the chamber 42.
30. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, and the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 15. Moreover, Koga disclosed a pump chamber and a thermal exchange chamber fluidly coupled together by one or more passages, and an inlet and an outlet configured as claimed in claim 30. For example, an aperture positioned near the terminal end (e.g., distally from the pump chamber 15A) of Koga's discharge channel 20 consitutes an outlet configured to discharge the cooling liquid from the reservoir. *See,* Koga, col. 8:4-5. As well, Koga's thermal exchange chamber has an aperture constituting an inlet configured to direct the cooling liquid into the reservoir. Id. In any event, FIG. 3. in Wei shows such an inlet and an outlet, as well as a pump chamber and a thermal exchange chamber configured as claimed. For example, the opening 28 constitutes an inlet to the reservoir 62 as claimed and the opening by wall 56 into pump chamber 63 constitutes an outlet from the reservoir 62 as claimed. The thermal exchange chamber 42 is coupled to the pump chamber as claimed.

D. PROPOSED CLAIMS 19-30 WOULD HAVE BEEN OBVIOUS FROM TAKAYUKI AND KOGA

The newly found Takayuki reference having been publishd on May 24, 2002, qualifies as prior art to the '764 Patent under 35 U.S.C. § 102(b), as well as under 35 U.S.C. § 103. In any event, Takayuki constitutes valid prior art to the '764 Patent based on Asetek's admissions discussed above. Amendment, pp. 26-27. Koga also constitutes valid prior art to the '764 Patent. Id.

For convenience, an exploded view of Takayuki's device is reproduced and annotated below.



TAKAYUKI FIG. 1 (ANNOTATED)

Takayuki discloses each of the features Patent Owner alleges to be lacking from the Koga reference. *See*, Takayuki, FIG. 1 (impeller case 11 and pump 5; liquid-cooled heat sink 4). Indeed, Takayuki expressly disclosed virtually every feature arranged in the manner recited in proposed claims 19 through 30.

To the extent that Koga or Takayuki might be considered as not disclosing some trivial claim limitation, the basic knowledge or "common sense" possessed by one of ordinary skill in the art would have resolved such difference, particularly following a review of Koga's and Takayuki's disclosure. Accordingly, each combination of features claimed in proposed claims 19-30 would have been obvious to one of ordinary skill in the art from a review of Takayuki and Koga at the time of the purported invention claimed, as set forth below.

Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" - choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or motivation to combine.

All of these rationale apply here as detailed below. First, combining Takayuki with Koga yields predictable results. Second, simply substituting Koga's stator/impeller for Takayuki's pump achieves predictable results. Third, at least based on Koga's disclosed concept of a stator separated from a cooling liquid and an impeller in contact with the liquid, it would have been obvious to at least try to incorporate such a configuration into Takayuki's device. Fourth, both Takayuki and Koga at least suggest providing cooling systems as claimed (e.g., having, *inter alia*, vertically spaced apart thermal exchange and pump chambers).

Proposed Claim Language	**Correspondence to Takayuki[9] and Koga**
19. (New) The cooling system of claim 1, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 1. Moreover, Koga disclosed a passage configured as claimed in claim 19. However, to the extent Koga might be considered not to disclose such a passage, Takayuki FIG. 1 shows that the passage formed by the outlet 7, hose 6 and inlet 9 is configured to direct cooling liquid from the pump chamber (inside cover 11) directly into the thermal exchange chamber inside heat sink 4.
20. (New) The cooling system of claim 1, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 1. Moreover, Koga disclosed a plurality of passages configured as claimed in claim 20. However, to the extent Koga might be considered not to disclose such a plurality of passages, Takayuki FIG. 1 shows an inlet 9 and an outlet 17. Both of these passages open into the thermal exchange chamber as claimed. *See*, Takayuki, ¶¶ 13 and 18.
21. (New) The cooling system of claim 1, wherein an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms the boundary wall of the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 1. Moreover, Koga disclosed an entire surface configured as claimed in claim 21. However, to the extent Koga might be considered not to disclose the claimed entire surface, Takayuki describes

[9] All references herein to paragraphs in Takayuki's specification refer to the paragraph numbers in the English-language translation accompanying the submission of the Japanese-language Takayuki publication.

	exactly this combination of features. *See*, Takayuki, ¶¶ 13 and 18.
22. (New) The cooling system of claim 1, wherein the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 1. Moreover, Koga disclosed an inlet and an outlet configured as claimed in claim 22. For example, an aperture positioned near the terminal end (e.g., distally from the pump chamber 15A) of Koga's discharge channel 20 consitutes an outlet configured to discharge the cooling liquid from the reservoir. *See,* Koga, col. 8:4-5. As well, Koga's thermal exchange chamber has an aperture constituting an inlet configured to direct the cooling liquid into the reservoir. Id. In any event, Takayuki discloses exactly this combination of features. For example, FIG. 1 shows an inlet 14 and a wastewater coupler 17, constituting the claimed inlet and outlet, respectively. *See*, Takayuki, ¶¶ 13 and 18.
23. (New) The cooling system of claim 10, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 10. Moreover, Koga disclosed a passage configured as claimed in claim 23. However, to the extent Koga might be considered not to disclose such a passage, Takayuki FIG. 1 shows that the passage formed by the outlet 7, hose 6 and inlet 9 is configured to direct cooling liquid from the pump chamber (inside cover 11) directly into the thermal exchange chamber inside heat sink 4.
24. (New) The cooling system of claim 10, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 10. Moreover, Koga disclosed a plurality of passages configured as claimed in claim 24. However, to the extent Koga might be considered not to disclose such a plurality of passages, Takayuki FIG. 1 shows an inlet 9 and an outlet 17. Both of these passages open into the thermal exchange chamber as claimed. *See*, Takayuki, ¶¶ 13 and 18.
25. (New) The cooling system of claim 12, wherein an entire surface of the heat-exchange interface in contact with the cooling liquid in the reservoir forms a boundary wall of the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 12. Moreover, Koga disclosed an entire surface configured as claimed in claim 25. However, to the extent Koga might be considered not to

	disclose the claimed entire surface, Takayuki describes exactly this combination of features. *See*, Takayuki, ¶¶ 13 and 18.
26. (New) The cooling system of claim 10, wherein the reservoir further includes an inlet configure~ to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 10. Moreover, Koga disclosed an inlet and an outlet configured as claimed in claim 26. For example, an aperture positioned near the terminal end (e.g., distally from the pump chamber 15A) of Koga's discharge channel 20 consitutes an outlet configured to discharge the cooling liquid from the reservoir. *See,* Koga, col. 8:4-5. As well, Koga's thermal exchange chamber has an aperture constituting an inlet configured to direct the cooling liquid into the reservoir. Id. In any event, Takayuki discloses exactly this combination of features. For example, FIG. 1 shows an inlet 14 and a wastewater coupler 17, constituting the claimed inlet and outlet, respectively. *See*, Takayuki, ¶¶ 13 and 18.
27. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, the one or more passages including a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 15. Moreover, Koga disclosed a passage configured as claimed in claim 27. However, to the extent Koga might be considered not to disclose such a passage, Takayuki FIG. 1 shows that the passage formed by the outlet 7, hose 6 and inlet 9 is configured to direct cooling liquid from the pump chamber (inside cover 11) directly into the thermal exchange chamber inside heat sink 4.
28. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by a plurality of passages positioned within the reservoir that open into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 15. Moreover, Koga disclosed a passage configured as claimed in claim 28. However, to the extent Koga might be considered not to disclose such a passage, Takayuki FIG. 1 shows an inlet 9 and an outlet 17. Both of these passages open into the thermal exchange chamber as claimed. *See*, Takayuki, ¶¶ 13 and 18. The inlet 9 and the outlet 17 also fluidly couple the pump chamber and the thermal exchange chamber to each other (e.g., by way of the radiator).
29. (New) The cooling system of claim 15, wherein an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms a boundary wall of	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 15. Moreover, Koga disclosed an entire surface configured as

the thermal exchange chamber.	claimed in claim 29. However, to the extent Koga might be considered not to disclose the claimed entire surface, Takayuki describes exactly this combination of features. *See*, Takayuki, ¶¶ 13 and 18.
30. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, and the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 15. Moreover, Koga disclosed a pump chamber and a thermal exchange chamber fluidly coupled together by one or more passages, and an inlet and an outlet configured as claimed in claim 30. For example, an aperture positioned near the terminal end (e.g., distally from the pump chamber 15A) of Koga's discharge channel 20 consitutes an outlet configured to discharge the cooling liquid from the reservoir. *See,* Koga, col. 8:4-5. As well, Koga's thermal exchange chamber has an aperture constituting an inlet configured to direct the cooling liquid into the reservoir. Id. In any event, Takayuki discloses exactly this combination of features. Takayuki FIG. 1 shows that the passage formed by the outlet 7, hose 6 and inlet 9 is configured to direct cooling liquid from the pump chamber (inside cover 11) directly into the thermal exchange chamber inside heat sink 4. FIG. 1 also shows an inlet 14 and a wastewater coupler 17, constituting the claimed inlet and outlet, respectively. *See*, Takayuki, ¶¶ 13 and 18.

E. Proposed Claims 19-30 Would Have Been Obvious From Koga and Cheon

Each combination of features claimed in proposed claims 19-30 would have been obvious to one of ordinary skill in the art from a review of Koga and Cheon at the time of the purported invention claimed in the '764 Patent, as set forth herein. Accordingly, Requester urges reconsideration of the teachings of Cheon in view of the reading one of ordinary skill in the art would have given it, particularly following a review of the Koga reference. U.S. Patent No. 5,731,954 (Cheon) constitutes valid prior art to the '764 Patent.

Cheon disclosed a reservoir (e.g., casing 50 defines a reservoir) having at least a first chamber 60 and a second chamber 58 separated from each other by a wall 62 and fluidly coupled together by one or more passages 66 on the wall. Cheon, 4:67-5:20; FIGS. 2, 4 and 5.

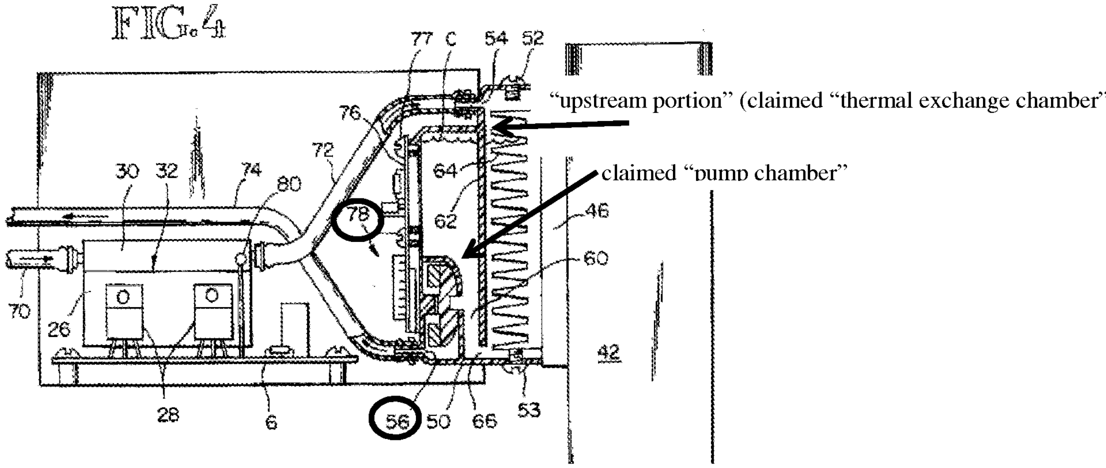
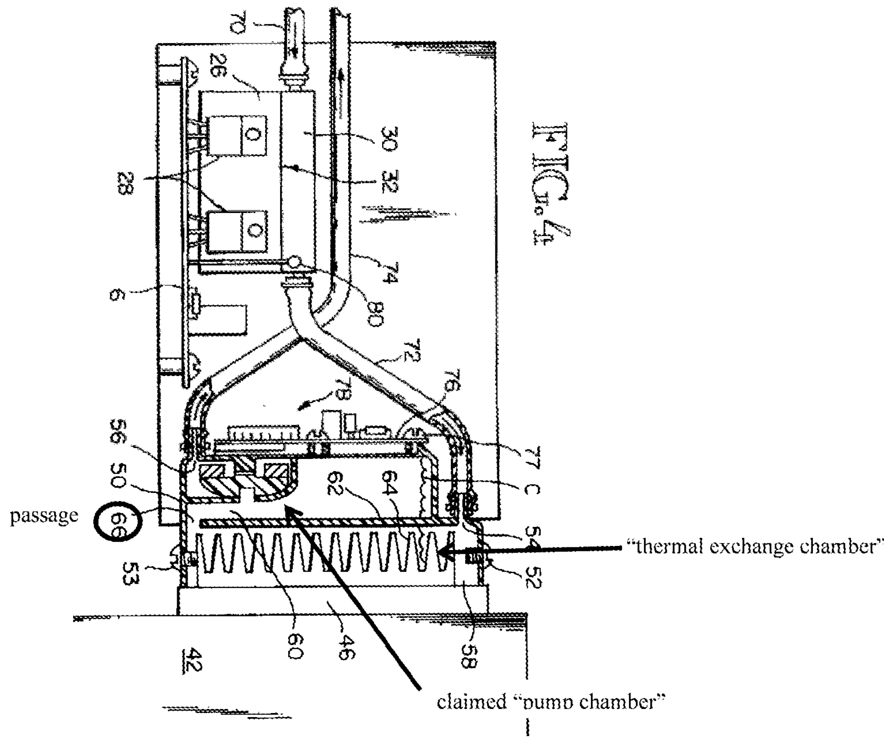


FIG. 4 IN CHEON SHOWS A RESERVOIR AND CHAMBERS 58, 60 SEPARATED BY A WALL 62 AND FLUIDLY COUPLED TOGETHER BY A PASSAGE 66 ON THE WALL

For example, Cheon states "The interior space of the reservoir 48 is divided into an upstream portion 58 in communication with the inlet opening 54 and a downstream portion 60 in communication with the outlet opening 56. An internal divider wall 62 substantially separates the two interior portions 58, 60." Cheon, 4:67-5:4; FIG. 4. Cheon also states "The divider wall 62 has a passage 66 extending therethrough and communicating the upstream portion 58 with the downstream portion 60. The passage 66 is positioned so that liquid coolant C entering the interior space of the reservoir through the inlet opening 54 passes through the upstream portion 58 by and through the heat-gathering fins 64 and then flows through the passage 66 into the downstream portion 60 and out the outlet opening 56." Cheon, 5:14-20.

Cheon expressly contemplated alternative cooling system configurations compared to those briefly described above. For example, Cheon stated "it is intended to be understood by those skilled in the art that various modifications and omissions in form and detail may be made without departing from the spirit and scope of the invention as defined by the following claims." Id. at 7:20-24. At the time of purported invention of the subject matter claimed in the '764 Patent, it was notoriously well-understood by those of ordinary skill in the art that relative terms (e.g., terms such as "upper," "lower," "vertical," and "horizontal") may be used to facilitate discussion or explanation of relative relationships and do not necessarily imply an absolute relationship, position or orientation. For example, with respect to an object, an "upper" chamber can become a "lower" chamber simply by turning the object over. Nevertheless, it is still the same chamber and the object remains the same. *Cf.* FIGS. 1 and 2, and FIGS. 4 and 5, in the '764 Patent.



CHEON'S FIG. 4 (ANNOTATED) ROTATED CLOCKWISE BY 90 DEGREES

Thus, one of ordinary skill in the art would have appreciated that merely by rotating Cheon's reservoir clockwise by 90-degrees (as shown above), Cheon's reservoir would have vertically separate and spaced apart pump and thermal exchange chambers, as claimed.

Requester submits one of ordinary skill in the art, based on ordinary creativity, would have understood "that various modifications and omissions in form and detail may be made" to Cheon's reservoir by merely rotating it "without departing from the spirit and scope of the invention[s]" disclosed and claimed by Cheon. Cheon at 7:21-24. For example, at the time of filing the application leading to the '362 Patent, as well as filing the Parent Application, those of ordinary skill in the art regularly considered various orientations for cooling system components. *See, e.g.*, Takayuki, FIGS. 1 and 2 (showing reoriented pump chambers). Moreover, Koga disclosed a cooling device oriented as shown in Cheon's rotated FIG. 4, above.

Moreover, even if, *arguendo*, Cheon might not expressly describe a reservoir oriented as shown above, Cheon did contemplate reorienting components of his disclosed cooling system, as shown by a comparison of Cheon's FIGS. 5 and 7 (reproduced in Figure 3, below, for convenience), showing a reoriented outlet opening 56. Id. For example, with regard to FIG. 5 (shown below), "A dome-like rounded cover and fluid guide 90 substantially surrounds the propeller 82, magnet 84, and stem 86." Cheon 6:33-34.

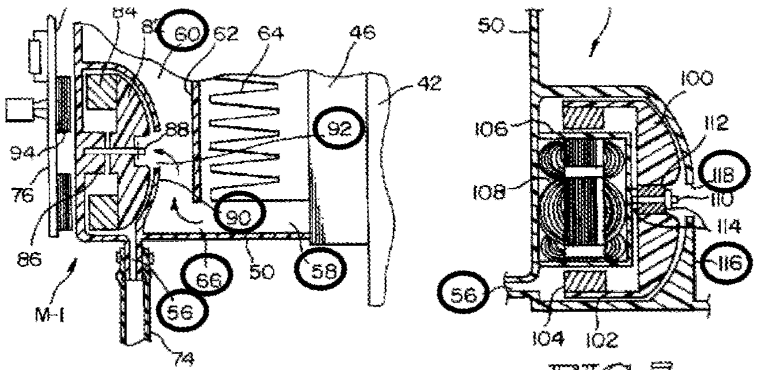


FIG.5 FIG.7

FIGS. 5 AND 7 IN CHEON SHOW ROTATED OUTLET (56) CONFIGURATIONS

Further, Cheon broadly claimed a reservoir of a cooling system with a casing defining an interior space. Id. at 7:60-61; Claim 3. Cheon's claimed reservoir "includes an internal divider wall substantially separating the interior space into an upstream portion in communication with the inlet opening and a downstream portion in communication with the outlet opening, and a plurality of heat-gathering fins in the upstream portion." Id. at 7:61-8:5; Claim 3. "Said divider wall [has] a passage therethrough communicating the upstream portion and the downstream …." Id. at 8:5-7; Claim 3. Nothing in Cheon's broad claim 3 would have deterred one of ordinary skill in the art from horizontally orienting the Cheon's internal divider wall to vertically separate the upstream portion from the downstream portion, as shown in Figure 2, above, and claimed in the '362 Patent. Id.

Cheon described fluidicly coupling the various chambers as required by the claims in the '764 Patent. For example, Cheon states, "A central opening 92 in the cover and guide 90 allows coolant C that has entered the downstream portion 60 of the interior space of the reservoir 48 from the upstream portion 58 to enter the space inside the cover and guide 90 and be directed by the propeller 82 out through the outlet opening 56." Id. at 6:41-46. With regard to FIG. 7, Cheon explained that "a rounded cover and fluid guide 116 substantially surrounds the propeller 100 …. A central opening 118 in the cover and fluid guide 116 draws coolant C into the space defined by the cover and guide 116 to efficiently direct coolant C out through the outlet opening 56 …." Id. at 7:9-14. Thus, the region within either of the respective fluid guides 90, 116 would correspond to a claimed vertically spaced apart pump chamber when Cheon's reservoir is rotated as shown in Figure 2, above. The respective central opening 92, 118 is positioned on the corresponding wall and fluidly couples the thermal exchange chamber (e.g., the upstream portion 58).

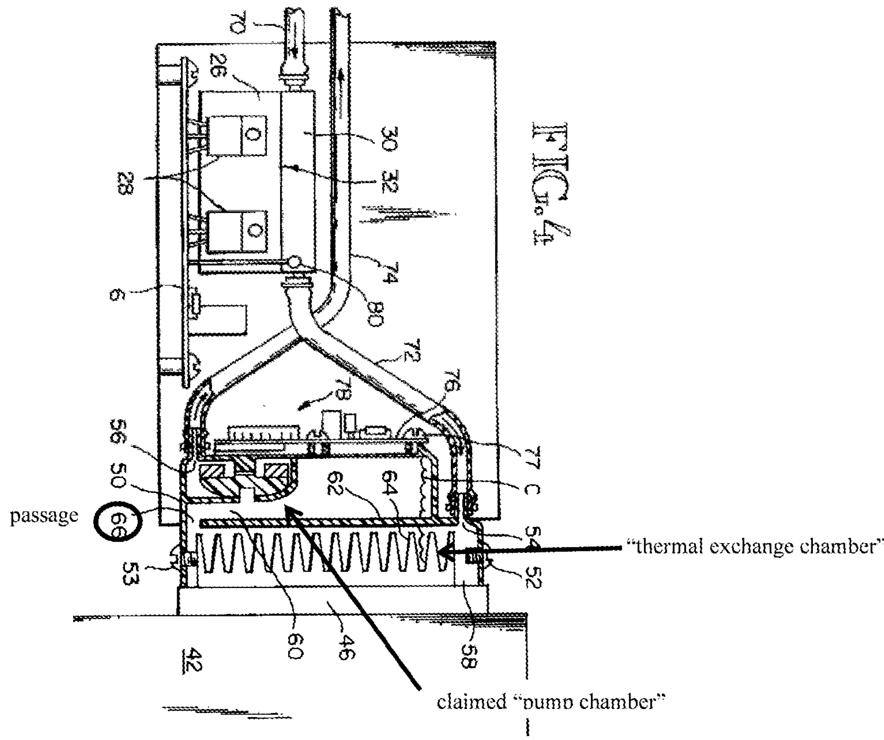
Still further, nothing in Cheon, or any other reference, would have deterred one of ordinary skill in the art from at least trying to rotate Cheon's reservoir as shown above, and in Koga. *See*, Cheon, generally. Moreover, when rotated as shown above, any air bubble would be trapped by the fluid guide outside the pump. Thus, such a rotation would have had at least a reasonable likelihood of succeeding, and was disclosed in the prior art. *Cf.* Takayuki, FIGS. 1 and 2.

As shown above and explained more fully below in connection with the proposed rejections of claims 19-30 based on Koga and Cheon, Cheon disclosed the features recited in each of proposed claims 19-30. To the extent that Cheon might be considered as not disclosing some trivial claim limitation, the basic knowledge or "common sense" possessed by one of ordinary skill in the art would have resolved such a difference, particularly following a review of Koga's disclosure.

To the extent that Koga or Cheon might be considered as not disclosing some trivial claim limitation, the basic knowledge or "common sense" possessed by one of ordinary skill in the art would have resolved such difference, particularly following a review of Koga's and Cheon's disclosure. Accordingly, each combination of features claimed in proposed claims 19-30 would have been obvious to one of ordinary skill in the art from a review of Cheon and Koga at the time of the purported invention claimed, as set forth below.

Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" - choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or motivation to combine.

All of these rationale apply here as detailed below. First, combining Koga with Cheon yields predictable results, at least since Cheon's device could operate if rotated as shown above. Second, simply substituting Cheon's reservoir for Koga's cooling device achieves predictable results. As noted above, Cheon's device would have been understood to operate as intended if rotated by 90 degrees as shown above. Third, at least based on Cheon's disclosed reservoir concept, it would have been obvious to at least try to incorporate such a configuration into Koga's device. Fourth, both Cheon and Koga at least suggest providing cooling systems as claimed (e.g., having, *inter alia*, vertically spaced apart thermal exchange and pump chambers fluidly coupled together by one or more passages).



CHEON'S FIG. 4 (ANNOTATED) ROTATED CLOCKWISE BY 90 DEGREES

The remarks above regarding Cheon are incorporated in the following claim chart by this reference for conciseness and to avoid unnecessary duplication.

Proposed Claim Language	Correspondence to Cheon and Koga
19. (New) The cooling system of claim 1, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 1. Moreover, Koga disclosed a passage configured as claimed in claim 19. However, to the extent Koga might be considered not to disclose such a passage, Cheon's unobstructed passage 66 is configured exactly as claimed. (Note that a flow direction of cooling liquid does not depend on the passage configuration.)
20. (New) The cooling system of claim 1, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 1. Moreover, Koga disclosed a plurality of passages configured as claimed

chamber.	in claim 20. However, to the extent Koga might be considered not to disclose such a plurality of passages, Cheon's passages 54 and 66 open into the thermal exchange chamber. Cheon, FIG. 4.
21. (New) The cooling system of claim 1, wherein an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms the boundary wall of the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 1. Moreover, Koga disclosed an entire surface configured as claimed in claim 21. However, to the extent Koga might be considered not to disclose the claimed entire surface, Cheon's heat gathering fins 64 constitute an entire surface of the heat exchanging interface in conact with the cooling liquid and forms a boundary wall of the thermal exchange chamber, exactly as claimed.
22. (New) The cooling system of claim 1, wherein the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 1. Moreover, Koga disclosed an inlet and an outlet configured as claimed in claim 22. For example, an aperture positioned near the terminal end (e.g., distally from the pump chamber 15A) of Koga's discharge channel 20 consitutes an outlet configured to discharge the cooling liquid from the reservoir. *See,* Koga, col. 8:4-5. As well, Koga's thermal exchange chamber has an aperture constituting an inlet configured to direct the cooling liquid into the reservoir. Id. In any event, Cheon discloses exactly this combination of features. For example, FIG. 4 in Cheon shows an inlet 54 and an outlet 56, constituting the claimed inlet and outlet, respectively. *See*, Cheon, 4:63-64.
23. (New) The cooling system of claim 10, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 10. Moreover, Koga disclosed a passage configured as claimed in claim 23. However, to the extent Koga might be considered not to disclose such a passage, Cheon's unobstructed passage 66 is configured exactly as claimed.
24. (New) The cooling system of claim 10, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 10. Moreover, Koga disclosed a plurality of passages configured as claimed in claim 24. However, to the extent Koga might be considered not to

	disclose such a plurality of passages, Cheon's passages 54 and 66 open into the thermal exchange chamber. Cheon, FIG. 4.
25. (New) The cooling system of claim 12, wherein an entire surface of the heat-exchange interface in contact with the cooling liquid in the reservoir forms a boundary wall of the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 12. Moreover, Koga disclosed an entire surface configured as claimed in claim 25. However, to the extent Koga might be considered not to disclose the claimed entire surface, Cheon's heat gathering fins 64 constitute an entire surface of the heat exchanging interface in conact with the cooling liquid and forms a boundary wall of the thermal exchange chamber, exactly as claimed.
26. (New) The cooling system of claim 10, wherein the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 10. Moreover, Koga disclosed an inlet and an outlet configured as claimed in claim 26. For example, an aperture positioned near the terminal end (e.g., distally from the pump chamber 15A) of Koga's discharge channel 20 consitutes an outlet configured to discharge the cooling liquid from the reservoir. *See,* Koga, col. 8:4-5. As well, Koga's thermal exchange chamber has an aperture constituting an inlet configured to direct the cooling liquid into the reservoir. Id. In any event, Cheon disclosed exactly this combination of features. For example, FIG. 4 in Cheon shows an inlet 54 and an outlet 56, constituting the claimed inlet and outlet, respectively. *See*, Cheon, 4:63-64.
27. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, the one or more passages including a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 15. Moreover, Koga disclosed a passage configured as claimed in claim 27. However, to the extent Koga might be considered not to disclose such a passage, Cheon's unobstructed passage 66 is configured exactly as claimed. Cheon's FIG. 4 shows the thermal exchange chamber and the pump chamber fluidly coupled together by the passage 66 as claimed.
28. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by a plurality of passages positioned within the reservoir that open into the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 15. Moreover, Koga disclosed a passage configured as claimed in claim 28.

	However, to the extent Koga might be considered not to disclose such a plurality of passages, Cheon's passages 92 and 66 (in Cheon's FIG. 5) fluidly couple the pump chamber and the thermal exchange chamber together and are positioned as claimed. *See*, FIG. 4.
29. (New) The cooling system of claim 15, wherein an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms a boundary wall of the thermal exchange chamber.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 15. Moreover, Koga disclosed an entire surface configured as claimed in claim 29. However, to the extent Koga might be considered not to disclose the claimed entire surface, Cheon's heat gathering fins 64 constitute an entire surface of the heat exchanging interface in conact with the cooling liquid and forms a boundary wall of the thermal exchange chamber, as claimed.
30. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, and the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.	As acknowledged in the outstanding Office Action and set forth in the Request, as well as the remarks above, Koga disclosed a cooling system according to claim 15. Moreover, Koga disclosed a pump chamber and a thermal exchange chamber fluidly coupled together by one or more passages, and an inlet and an outlet configured as claimed in claim 30. For example, an aperture positioned near the terminal end (e.g., distally from the pump chamber 15A) of Koga's discharge channel 20 consitutes an outlet configured to discharge the cooling liquid from the reservoir. *See,* Koga, col. 8:4-5. As well, Koga's thermal exchange chamber has an aperture constituting an inlet configured to direct the cooling liquid into the reservoir. Id. In any event, Cheon FIG. 4 shows a pump chamber and a thermal exchange chamber fluidly coupled together by the passage 66 as claimed, and Cheon's reservoir includes an inlet 54 and an outlet 56, as claimed. *See*, Cheon, 4:63-64.

VII. THE EXAMINER'S DECISION NOT TO ORDER REEXAMINATION BASED ON A GROUND PROPOSED IN THE ORIGINAL REQUEST DOES NOT CONSTITUTE A DETERMINATION FAVORABLE TO PATENTABILITY AS TO THAT PROPOSED GROUND

Asetek mischarachterizations of the Order dated October 26, 2012, and allegations that the Office made in the Order a determination upholding patentability runs contrary to existing law, reaffirmed in at least one Federal Circuit opinion[10] since this Reexamination was Requested. Specifically, the Belkin opinion clarifies that an examiner's refusal to institute a reexamination on a proposed ground does not act as a decision favorable to patentability. Id. at 8-9. Moreover, the Belkin court confirmed that the Patent Office may, at any time, make any new rejection, as long as the rejection meets the requirement for instituting reexamination. Id. at 7.

VIII. CONCLUSION

An Action Closing Prosecution (ACP) is proper where, as here, issues of patentability have been considered a second or subsequent time and any new grounds of rejection are necessitated by an amendment. The Office previously determined that each of the existing claims is invalid over prior art, as set forth in the Office action dated October 26, 2012. In response to that Office action, Asetek amended the claims (literally and through its extreme rewriting of the claims in the guise of "construction"). In response to those amendments, Requester respectfully urges the Office to reject the existing and proposed claims on grounds set forth above and in the Request. Each new ground of rejection is necessitated by Asetek's amendments to the claims, making an Action Closing Prosecution proper.

Accordingly, Requester respectfully asks the Office to promptly reject all claims in an Action Closing Prosecution.

Respectfully submitted,
GANZ LAW, P.C

Date: May 22, 2013

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[10] *See,* e.g., Belkin Int'l, Inc. v. Kappos, Slip Op. 2012-1090 (Fed. Cir., 2012), FN 2 above.

CERTIFICATE OF SERVICE

The undersigned hereby certifies that a complete copy of these COMMENTS BY THIRD-PARTY REQUESTER UNDER 37 C.F.R. § 1.947 SUBSEQUENT TO PATENTEE'S RESPONSE TO OFFICE ACTION DATED OCTOBER 26, 2012 was served on the official correspondence address for the '764 Patent shown in PAIR:

Finnegan, Henderson, Farabow, Garrett & Dunner LLP
901 New York Avenue, NW
Washington, D.C. 20001-4413

via first class mail, on May 22, 2013.

By: */Lloyd L. Pollard II/*

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Electronic Acknowledgement Receipt

EFS ID:	15846138
Application Number:	95002386
International Application Number:	
Confirmation Number:	7254
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Customer Number:	22852
Filer:	Lloyd L. Pollard II/Tracie Semenchalam
Filer Authorized By:	Lloyd L. Pollard II
Attorney Docket Number:	COOL-1.012
Receipt Date:	22-MAY-2013
Filing Date:	15-SEP-2012
Time Stamp:	16:33:46
Application Type:	inter partes reexam

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Third Party Requester Comments after Non-final Action	CommentsByThird-PartyRequester.pdf	3987648 80e417403c62086a7b84d6b69aa7787e62c4d395	no	42

Warnings:

Information:

Total Files Size (in bytes):	3987648

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
95/002,386	09/15/2012	8245764	COOL-1.012	7254

22852 7590 05/07/2013
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

EXAMINER	
KAUFMAN, JOSEPH A	

ART UNIT	PAPER NUMBER
3993	

MAIL DATE	DELIVERY MODE
05/07/2013	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Transmittal of Communication to Third Party Requester *Inter Partes* Reexamination	Control No. 95/002,386	Patent Under Reexamination 8245764	
	Examiner JOSEPH KAUFMAN	Art Unit 3993	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

(THIRD PARTY REQUESTER'S CORRESPONDENCE ADDRESS)

GANZ LAW, P.C.
P.O. BOX 2200
HILLSBORO, OR 97123

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above-identified reexamination prceeding. 37 CFR 1.903.

Prior to the filing of a Notice of Appeal, each time the patent owner responds to this communication, the third party requester of the *inter partes* reexamination may once file written comments within a period of 30 days from the date of service of the patent owner's response. This 30-day time period is statutory (35 U.S.C. 314(b)(2)), and, as such, it cannot be extended. See also 37 CFR 1.947.

If an *ex parte* reexamination has been merged with the *inter partes* reexamination, no responsive submission by any *ex parte* third party requester is permitted.

All correspondence relating to this inter partes reexamination proceeding should be directed to the **Central Reexamination Unit** at the mail, FAX, or hand-carry addresses given at the end of the communication enclosed with this transmittal.

NOTICE RE DEFECTIVE PAPER IN INTER PARTES REEXAMINATION	Control No. 95/002,386	Patent Under Reexamination 8245764
	Examiner JOSEPH KAUFMAN	Art Unit 3993

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

1. ☐ No proof of service is included with the paper filed by ☐ patent owner ☐ requester on _____. 37 CFR 1.248 and 1.903. Proof of service is required within a time period of 30-days or one month from the date of this letter, whichever is longer. Failure to serve the paper may result in the paper being refused consideration. If the failure to comply with this requirement results in a patent owner failure to file a timely and appropriate response to any Office action, the prosecution of the reexamination proceeding will be terminated under 37 CFR 1.957(b) or limited under 37 CFR 1.957(c) (as is appropriate for the case).

2. ☐ The paper filed on _____ by the ☐ patent owner ☐ requester is unsigned. A duplicate paper or ratification, properly signed, is required within a time period of 30-days or one month from the date of this letter, whichever is longer. Failure to comply with this requirement will result in the paper not being considered. If the failure to comply results in a patent owner failure to file a timely and appropriate response to any Office action, the prosecution of the reexamination proceeding will be terminated under 37 CFR 1.957(b) or limited under 37 CFR 1.957(c) (as is appropriate for the case).

3. ☐ The paper filed on _____ by the ☐ patent owner ☐ requester is signed by _____ who is not of record. A ratification or a new power of attorney with a ratification, or a duplicate paper signed by a person of record, is required within a time period of 30-days or one month from the date of this letter, whichever is longer. Failure to comply with this requirement will result in the paper not being considered. If the failure to comply results in a patent owner failure to file a timely and appropriate response to any Office action, the prosecution of the reexamination proceeding will be terminated under 37 CFR 1.957(b) or limited under 37 CFR 1.957(c) (as is appropriate for the case).

4. ☐ The amendment filed by patent owner on _____, does not comply with 37 CFR 1.530. Patent owner is given a time period of 30-days or one month from the date of this letter, whichever is longer, to correct this informality, or the prosecution of the reexamination proceeding will be terminated under 37 CFR 1.957(b) or limited under 37 CFR 1.957(c) (as is appropriate for the case). The amendment will not be entered, although the argument the rein will be considered as it applies to the proceeding without the amendment should the prosecution be limited under 37 CFR 1.957(c).

5. ☐ The amendment filed by patent owner on _____, does not comply with 37 CFR ☐1.20(c)(3) and/or ☐1.20(c)(4), as to excess claim fees. Patent owner is given a time period of 30-days or one month from the date of this letter, whichever is longer, to correct this fee deficiency, or the prosecution of the reexamination proceeding will be terminated under 37 CFR 1.957(b) or limited under 37 CFR 1.957(c) (as is appropriate for the case), to effect the "abandonment" set forth in 37 CFR 1.20(c)(5).

6. ☒ Other: see attached.

NOTE: PATENT OWNER EXTENSIONS OF TIME ARE GOVERNED BY 37 CFR 1.956. NO EXTENSION OF TIME IS PERMITTED FOR THIRD PARTY REQUESTER. 35 U.S.C. § 314(b)(2).

All correspondence relating to this *inter partes* reexamination proceeding should be directed to the **Central Reexamination Unit** at the mail, FAX, or hand-carry addresses given at the end of this Office action.

Reexamination

Rule 1.947 states:

§ 1.947 Comments by third party requester to patent owner's response in *inter partes* reexamination.

Each time the patent owner files a response to an Office action on the merits pursuant to § 1.945, a third party requester may once file written comments within a period of 30 days from the date of service of the patent owner's response. These comments shall be limited to issues raised by the Office action or the patent owner's response. The time for submitting comments by the third party requester may not be extended. For the purpose of filing the written comments by the third party requester, the comments will be considered as having been received in the Office as of the date of deposit specified in the certificate under § 1.8.

[Added, 65 FR 76756, Dec. 7, 2000, effective Feb. 5, 2001]

In the paper filed January 25, 2013, titled "Comments by Third-Party Requester Under C.F.R. §1.947 Subsequent to Patentee's Response to Office Action Dated October 26, 2012", requester has proposed new rejections for claims 1-18. As claims 1-18 have not been amended, the response raises issues not raised by Patent Owner or the Office action. Therefore, the new rejections of claims 1-18 set forth on pages 22-49 of the January 25, 2013 communication based on the Wei, Takayuki, Hamman, and Cheon references, are improper and must be withdrawn.

While MPEP § 2267 indicates that such inappropriate papers are to be returned to the sender, this may not be possible in an Image File Wrapper (IFW) proceeding where a paper is inappropriately entered into the record. The papers filed 25 January 2013 have been scanned into an IFW, and cannot be returned to sender. However, for the reasons set forth above, the papers have been designated "closed" and "not public", will form no part of the record, and will not be available to the public. This decision will be made of record in the reexamination file.

A period of **15 DAYS** from the date of this letter is set in which the Requester may submit a response under 37 CFR 1.943(b) that complies with the terms of the rule. In accordance with 37 CFR 1.903, the response submission must be served on Patent Owner by the Requester. If no response to this letter is received, the improper Requester submission will not be considered.

Conclusion

All correspondence relating to this *inter partes* reexamination proceeding should be directed:

By EFS: Registered users may submit via the electronic filing system EFS-Web, at https://efs.uspto.gov/efile/myportal/efs-registered

By Mail to: Mail Stop *Inter Partes* Reexam
Attn: Central Reexamination Unit
Commissioner for Patents
United States Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

By Fax to: (571) 273-9900
Central Reexamination Unit

By hand: Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

For EFS-Web transmissions, 37 CFR 1.8(a)(1)(i)(C) and (ii) states that correspondence (except for a request for reexamination and a corrected or replacement request for reexamination) will be considered timely if (a) it is transmitted via the Office's electronic filing system in accordance with 37 CFR 1.6(a)(4), and (b) includes a certificate of transmission for each piece of correspondence stating the date of transmission, which is prior to the expiration of the set period of time in the Office action.

Any inquiry concerning this communication or earlier communications from the examiner, or as to the status of this proceeding, should be directed to the Central Reexamination Unit at telephone number (571) 272-7705.

Signed:

/Joseph A. Kaufman/
Joseph A. Kaufman
Primary Examiner
Art Unit 3993

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	95002386
	Filing Date	2012-09-15
	First Named Inventor	8245764
	Art Unit	3993
	Examiner Name	Joseph Kaufman
	Attorney Docket Number	COOL-1.012

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code1	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7209355		2007-04-24	Koga	
	2	7222661		2007-05-29	Wei	

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code1	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Foreign Document Number3	Country Code2 i	Kind Code4	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T5
	1	JP2002151638	JP		2002-05-24	Takayuki		☐

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NON-PATENT LITERATURE DOCUMENTS

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	95002386
	Filing Date	2012-09-15
	First Named Inventor	8245764
	Art Unit	3993
	Examiner Name	Joseph Kaufman
	Attorney Docket Number	COOL-1.012

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	BRUCE R. MUNSON, et al., Fundamentals of Fluid Mechanics, Third Edition, pp. 45-48, Copyright 1998 by John Wiley & Sons, Inc. New York (7 pages).	☐
	2	OXFORD UNIVERSITY PRESS, Shorter Oxford English Dictionary, Fifth Edition, p. 3526, definition of "vertical", 2002 (4 pages)	☐

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

(12) **United States Patent**
Koga et al.

(10) **Patent No.: US 7,209,355 B2**
(45) **Date of Patent: Apr. 24, 2007**

(54) **COOLING DEVICE AND AN ELECTRONIC APPARATUS INCLUDING THE SAME**

(75) Inventors: **Shinya Koga**, Fukuoka (JP); **Toshihiko Matsuda**, Fukuoka (JP); **Kyo Niwatsukino**, Fukuoka (JP); **Toshisuke Sakai**, Fukuoka (JP); **Toshiyuki Kubota**, Fukuoka (JP); **Masashi Hirose**, Fukuoka (JP); **Shigeru Narakino**, Fukuoka (JP); **Yoshimitsu Aizono**, Fukuoka (JP); **Kazuyuki Kasahara**, Kanagawa (JP)

(73) Assignee: **Matsushita Electric Industrial Co., Ltd.**, Okasa (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 271 days.

(21) Appl. No.: **10/976,324**

(22) Filed: **Oct. 29, 2004**

(65) **Prior Publication Data**

US 2005/0117298 A1 Jun. 2, 2005

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/446,152, filed on May 28, 2003, now Pat. No. 6,839,234, which is a continuation-in-part of application No. 10/264,265, filed on Oct. 4, 2002, now abandoned.

(30) **Foreign Application Priority Data**

May 15, 2002 (JP) 2002-139598
Jan. 15, 2003 (JP) 2003-007168

(51) **Int. Cl.**
H05K 7/20 (2006.01)
F04B 35/04 (2006.01)

(52) **U.S. Cl.** **361/699**; 257/714; 165/80.4; 417/353

(58) **Field of Classification Search** .... None
See application file for complete search history.

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(Continued)

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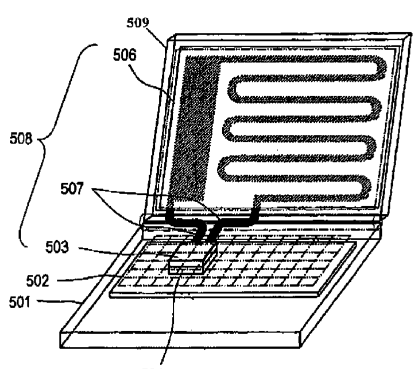
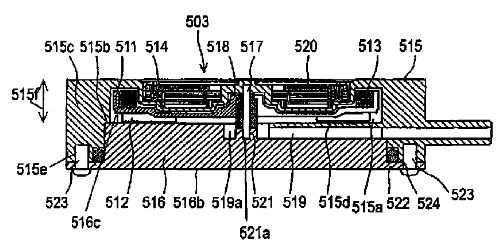
Primary Examiner—Boris Chérvinsky
(74) *Attorney, Agent, or Firm*—McDermott Will & Emery LLP

(57) **ABSTRACT**

A cooling device for cooling a heat-generating component includes a circulating passage arranged to have coolant circulate therein, a centrifugal pump including a first case made of metallic material, a second case made of resin material, and an impeller accommodated in the pump chamber, and a radiator provided at the circulating passage and being operable to release heat from the coolant. The first case has a surface arranged to contact the heat-generating component. The second case forms a pump chamber between the first case and the second case. The pump chamber stores the coolant therein. The impeller includes open-type vanes arranged to pressurize the coolant as to have the coolant flow through the circulating passage. The cooling device has a high cooling efficiency as well as a high operating efficiency of the motor while having a simple construction and a small overall size and a small thickness.

10 Claims, 36 Drawing Sheets





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* cited by examiner

FIG. 1

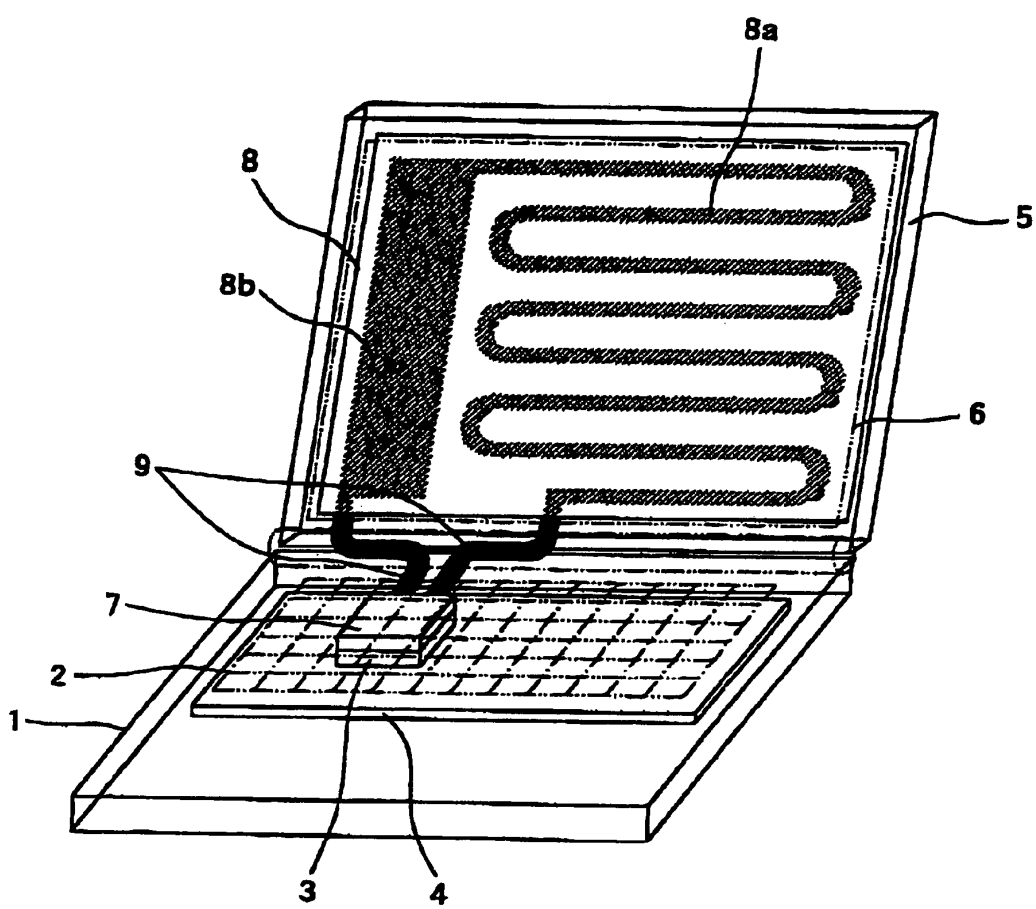


FIG. 2

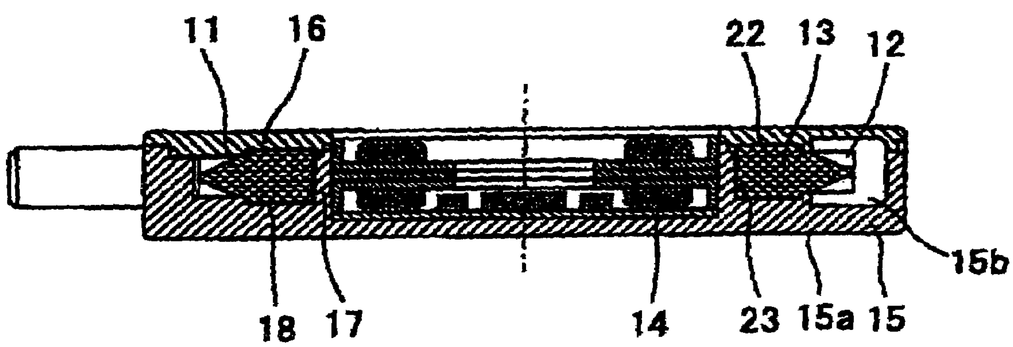


FIG. 3

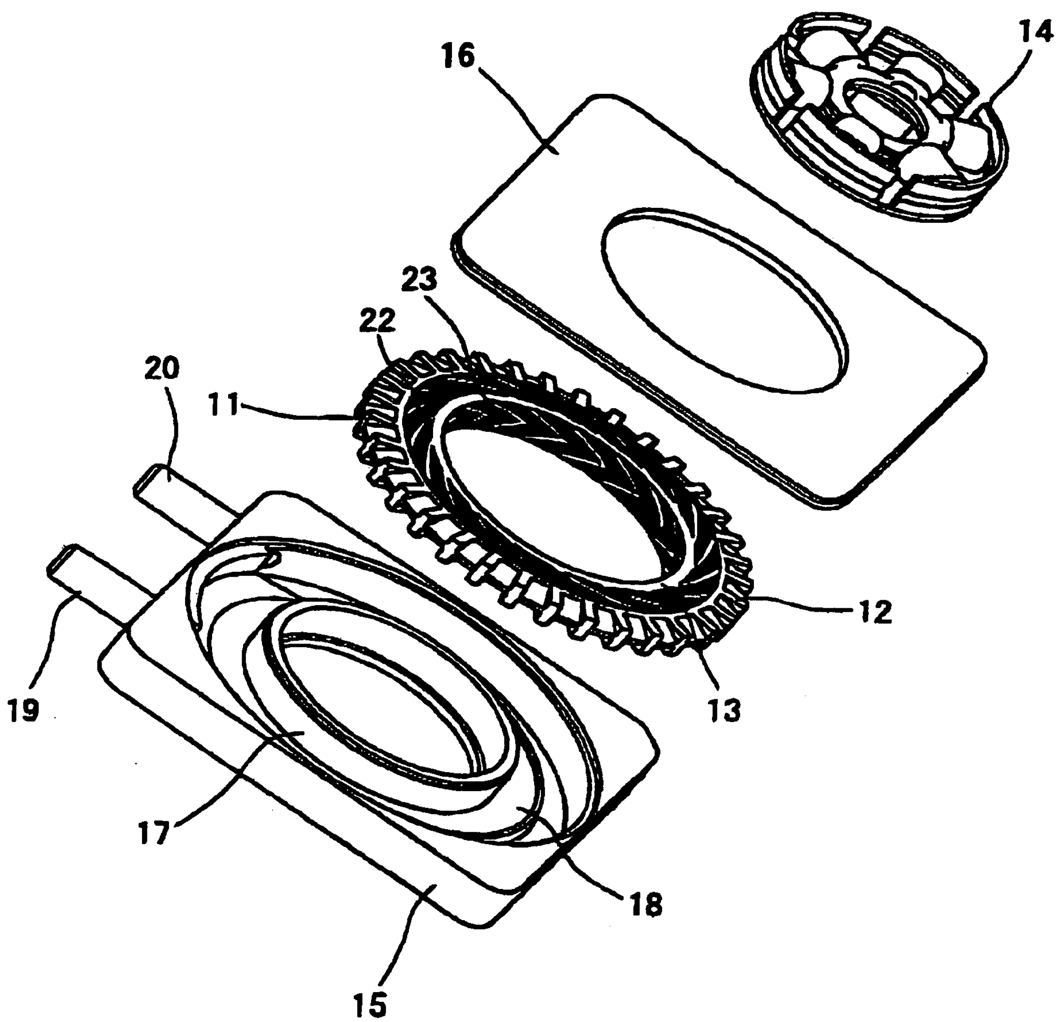


FIG. 4

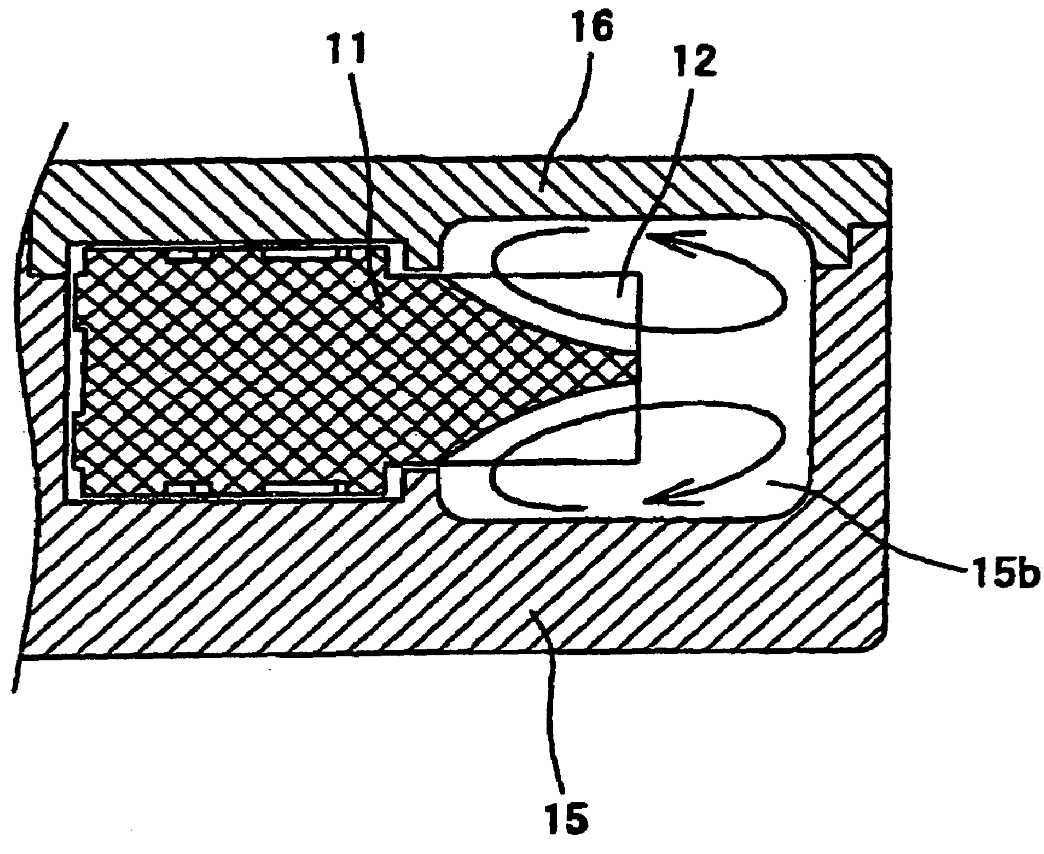


FIG. 5

(a)

Outlet Pressure	Inlet Pressure	Outlet Flow Rate	θ
(kPa)	(kPa)	(mL/min)	(deg)
2.0	-0.64	213	18
4.0	-0.36	158	15
6.0	-0.15	104	12
8.0	-0.02	39	10

(b)

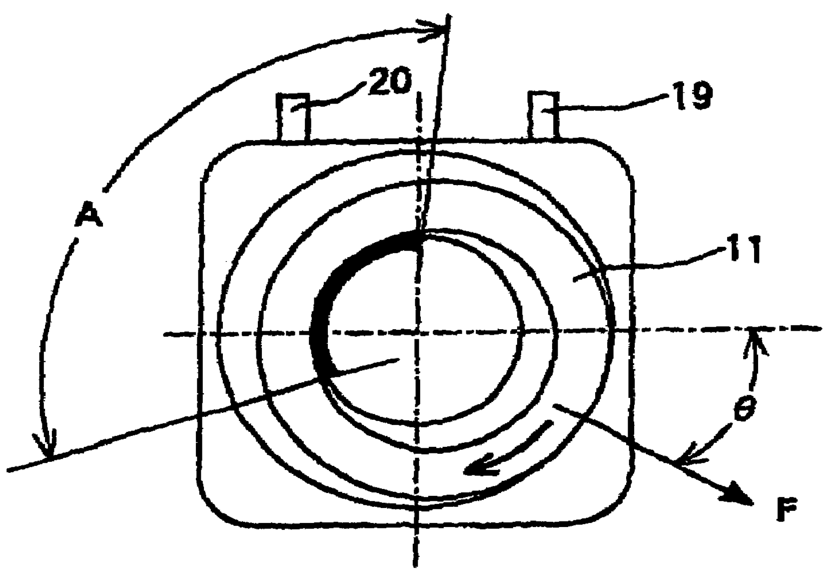


FIG. 6

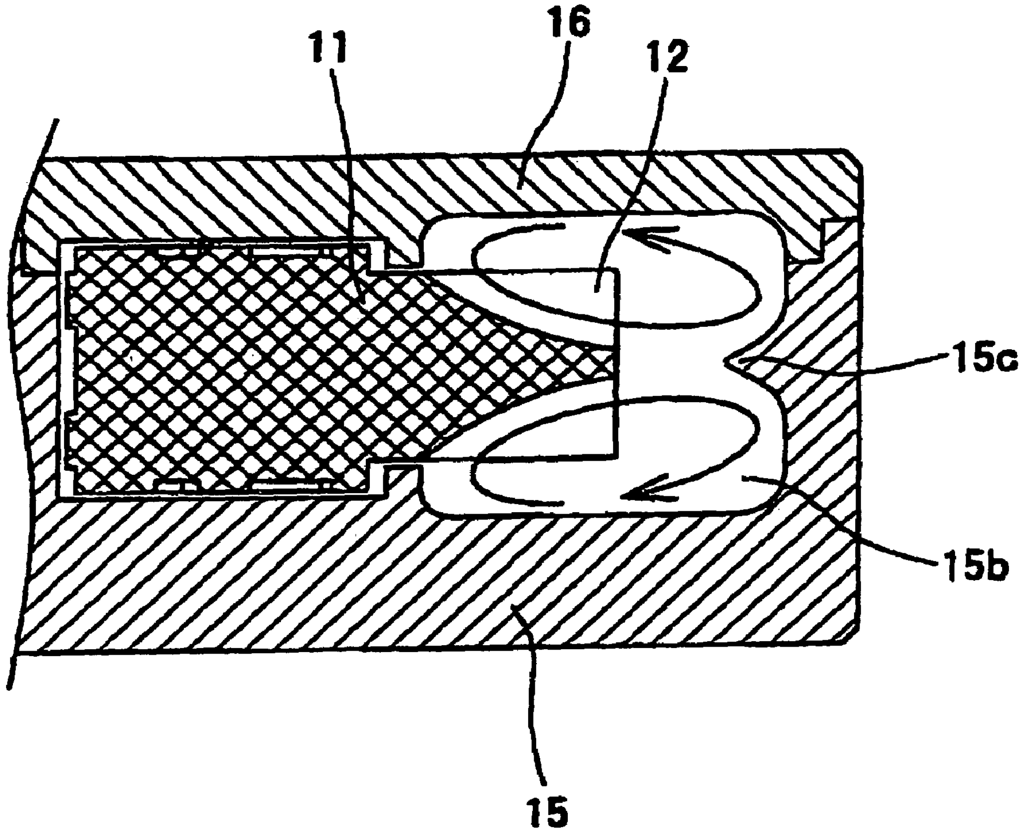


FIG. 7

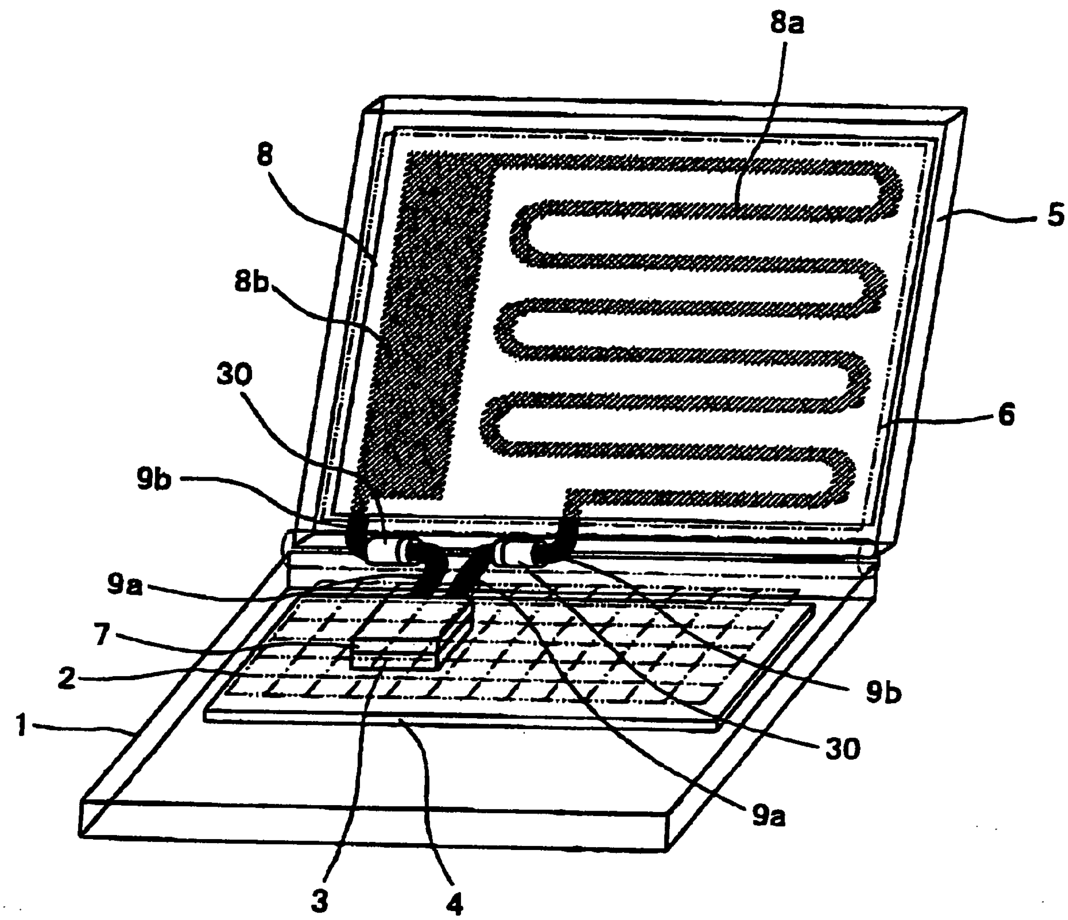


FIG. 8

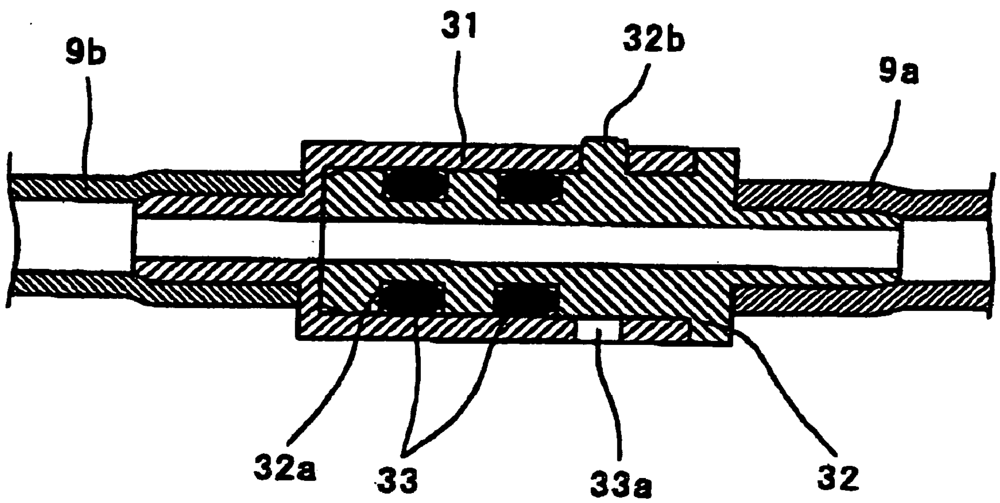

31
32b
9b
9a
32a
33
33a
32

FIG. 9

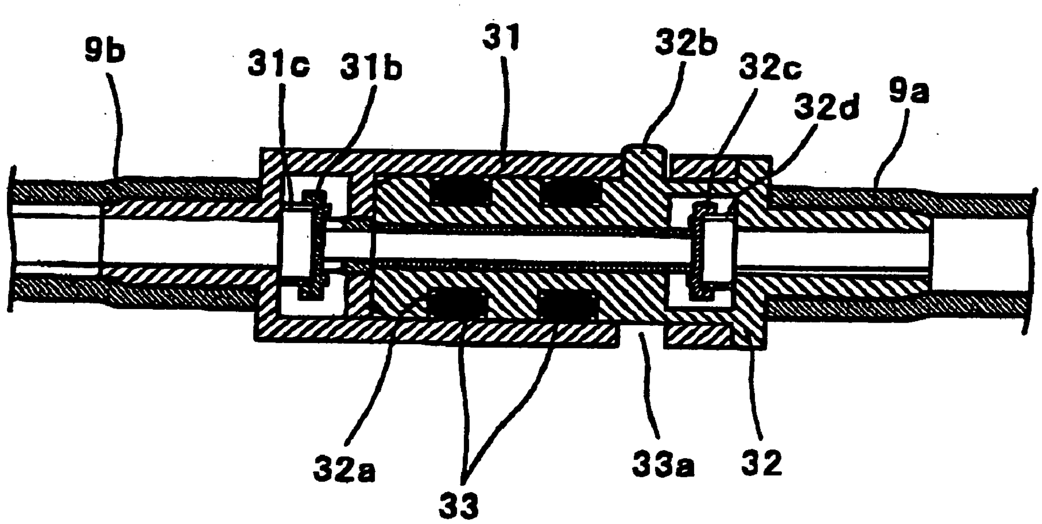

9b
31c
31b
31
32b
32c
32d
9a
32a
33
33a
32

FIG. 10

PRIOR ART

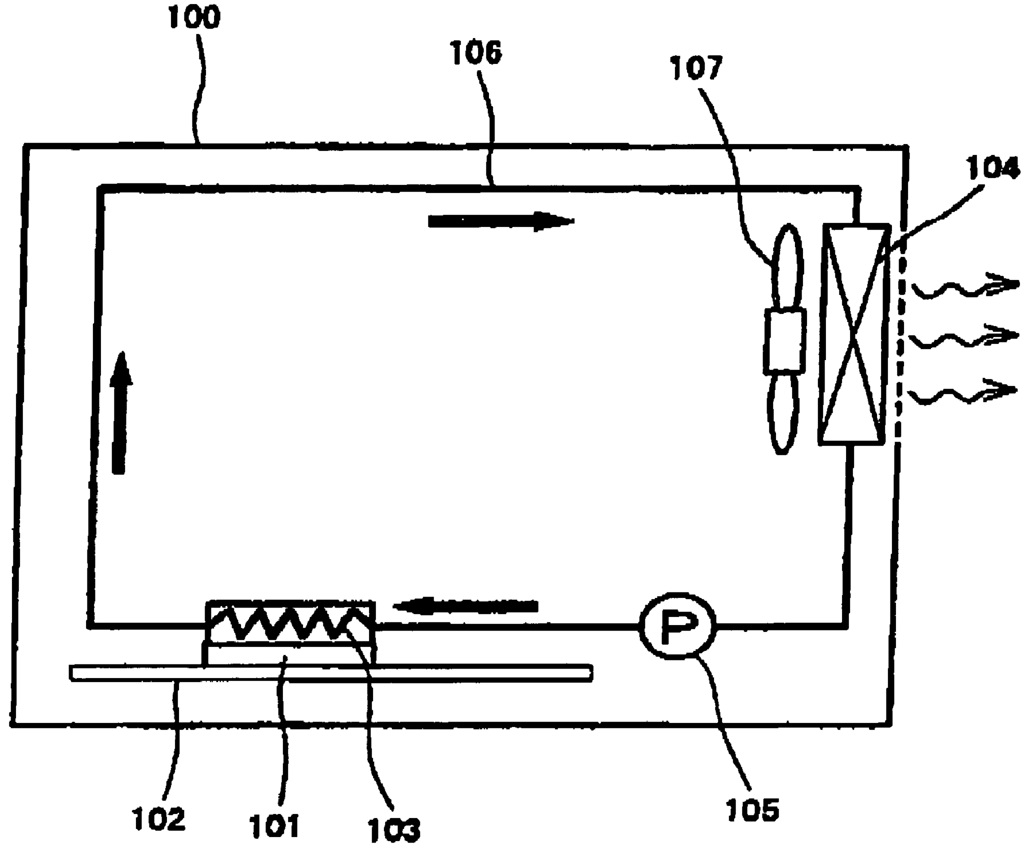


FIG. 11
PRIOR ART

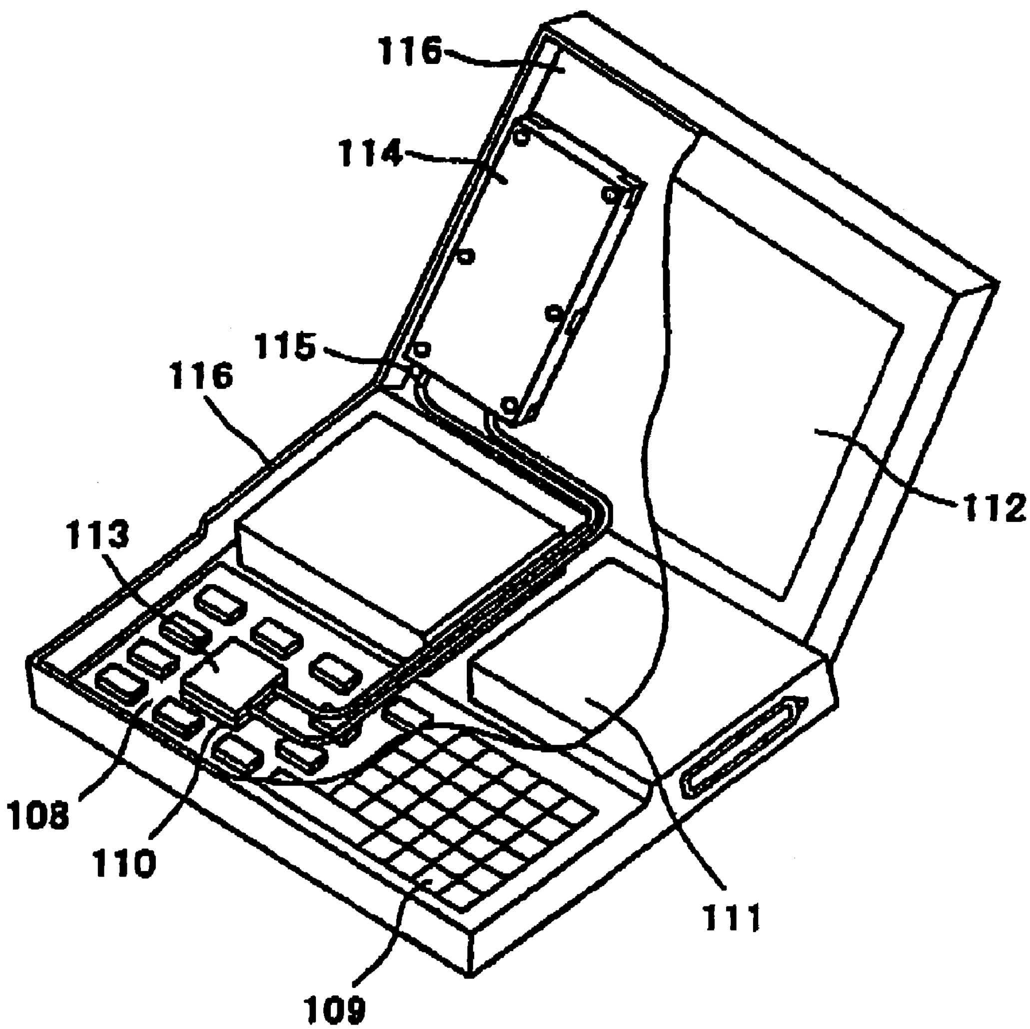


FIG. 12

PRIOR ART

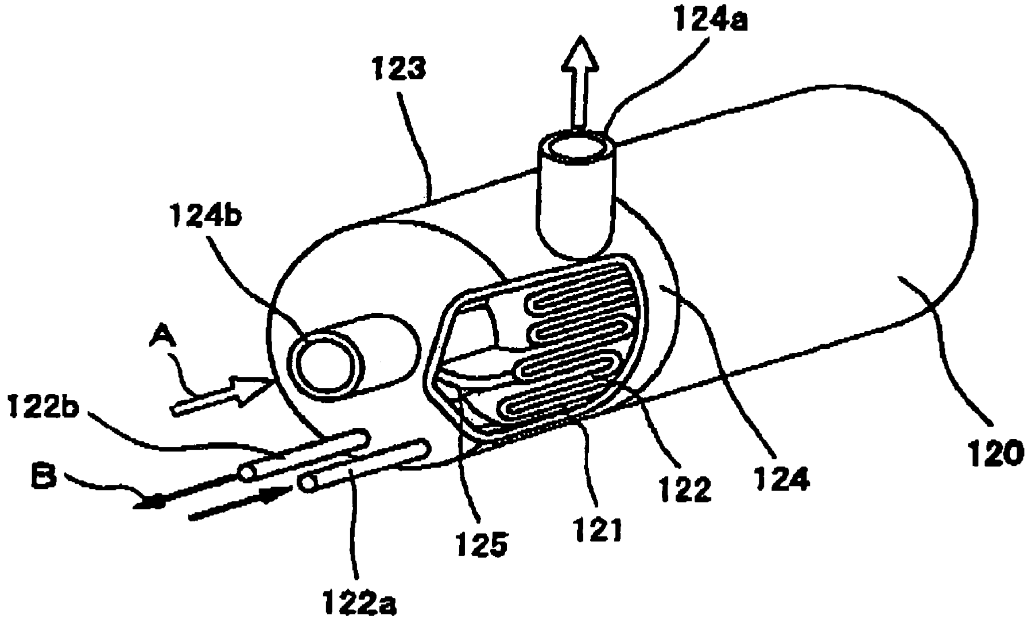
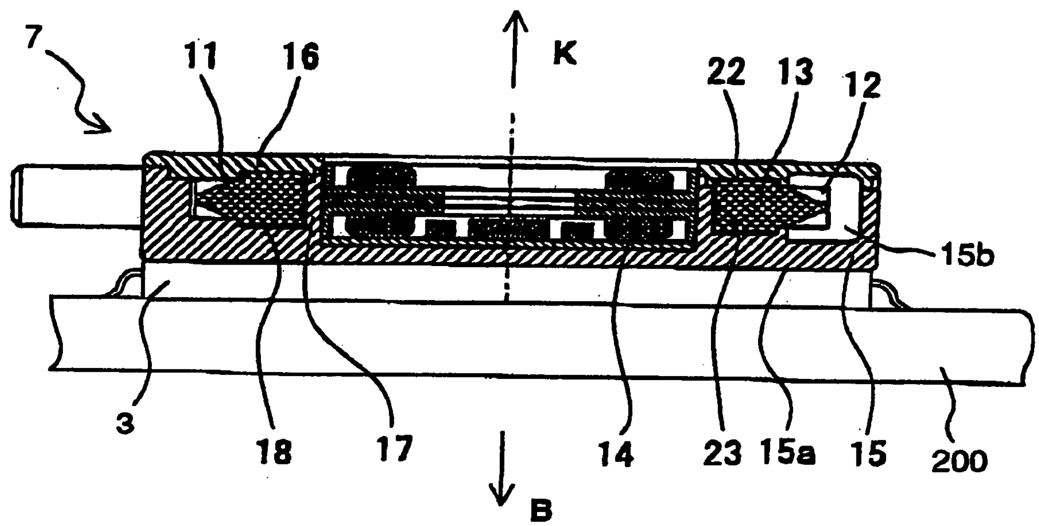


FIG. 13


7
11
16
K
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13
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15b
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18
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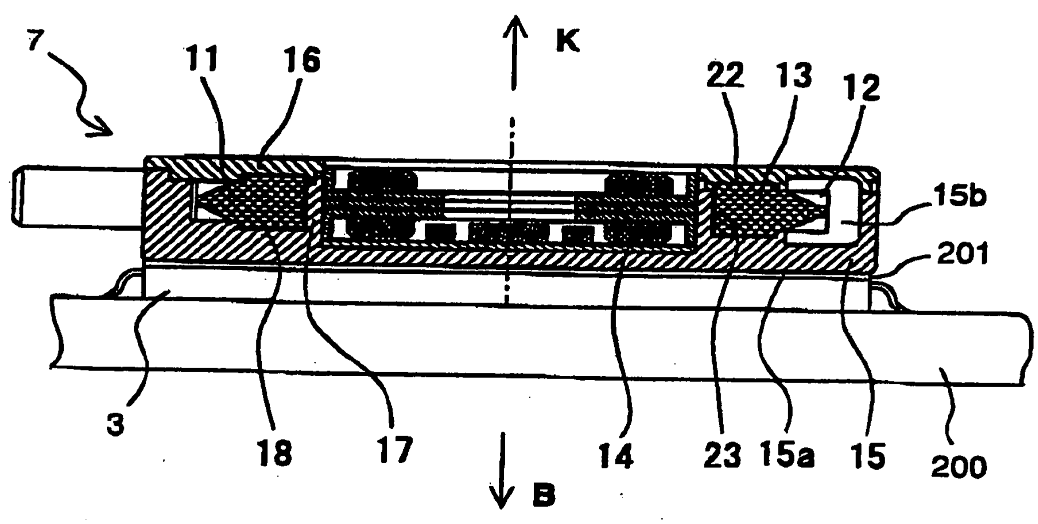
14
23
15a
15
200
B

FIG. 14


7
11
16
K
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15b
201
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18
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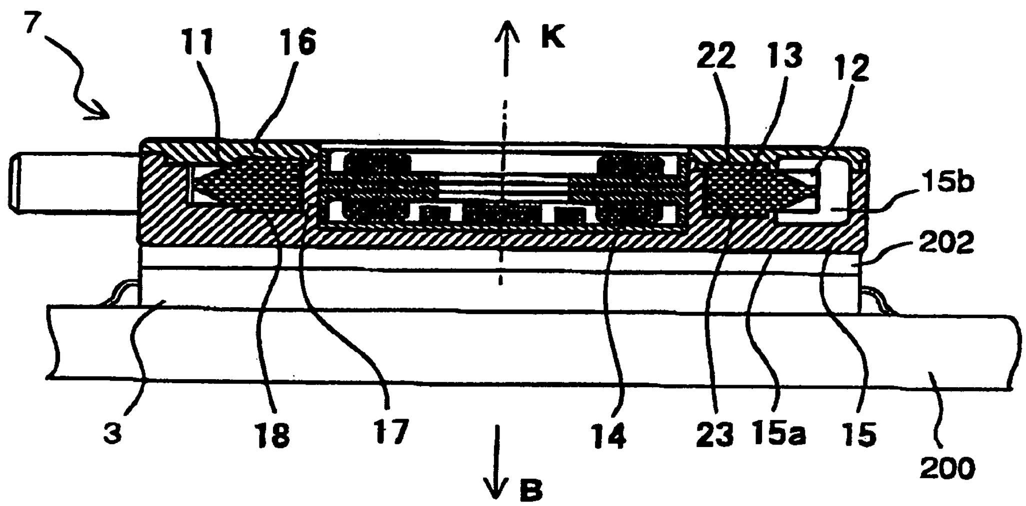
23
15a
15
200
B

FIG. 15


7
11
16
K
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15b
202
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14
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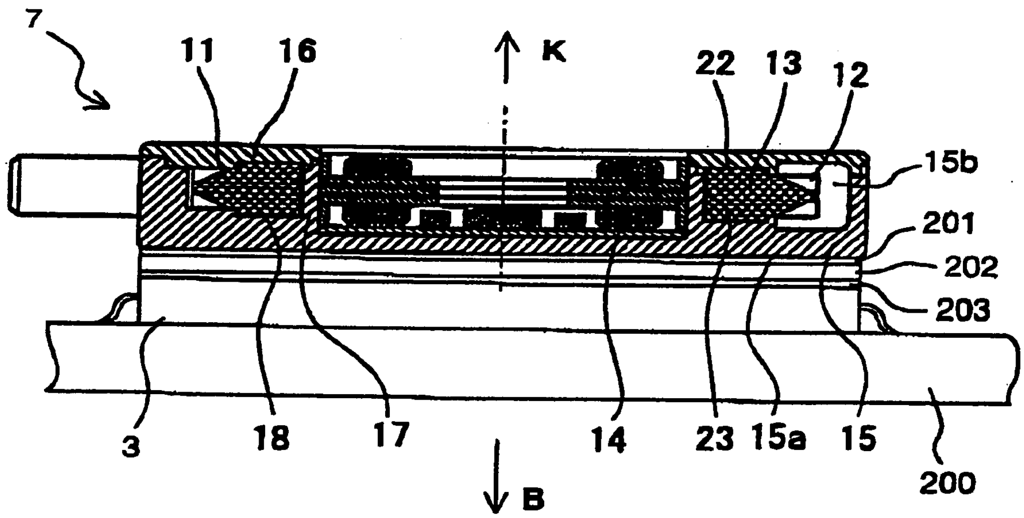
15a
15
200
B

FIG. 16


7
11
16
K
22
13
12
15b
201
202
203
3
18
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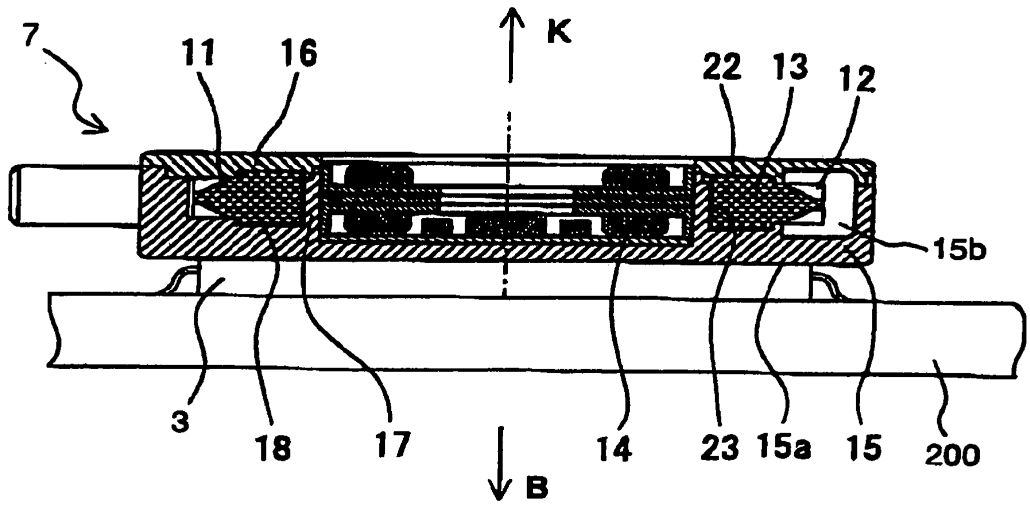
14
23
15a
15
200
B

FIG. 17


7
11
16
K
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13
12
15b
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B
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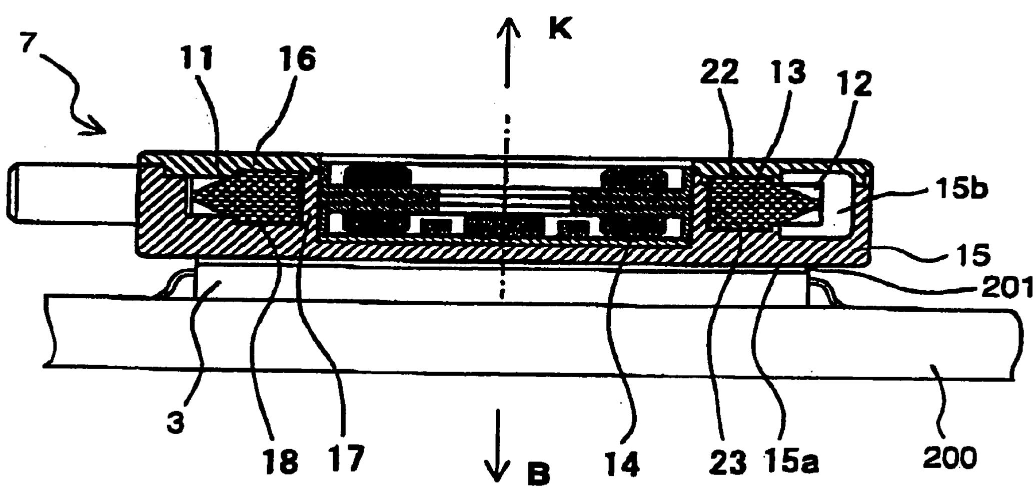
15a
15
200

FIG. 18


7
11
16
K
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15b
15
201
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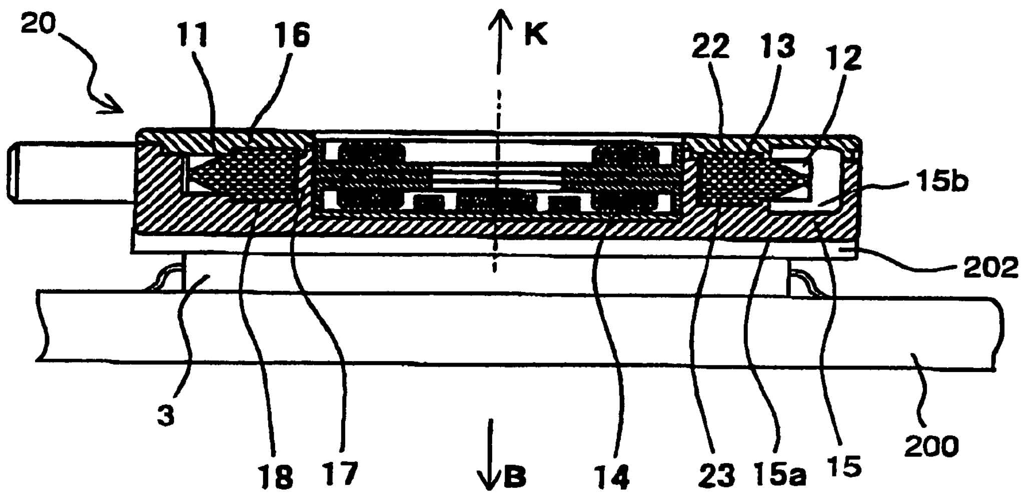
15a
200

FIG. 19


20
11
16
K
22
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12
15b
202
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18
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B
14
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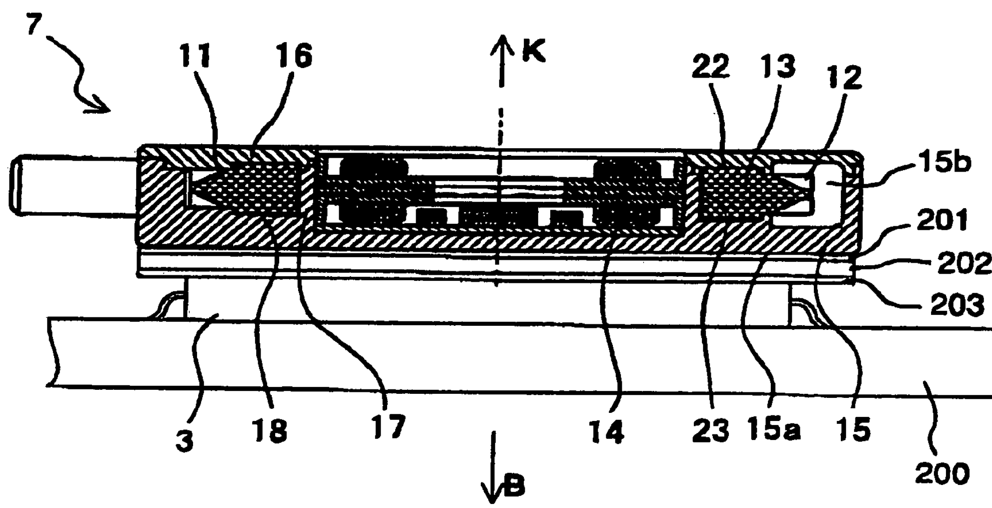
15a
15
200

FIG. 20


7
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201
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203
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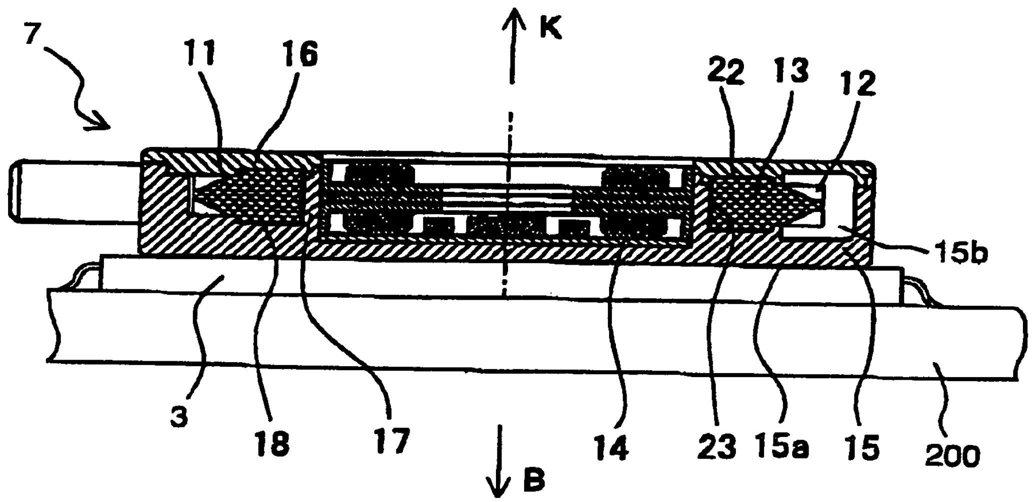
23
15a
15
200
B

FIG. 21


7
11
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K
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15b
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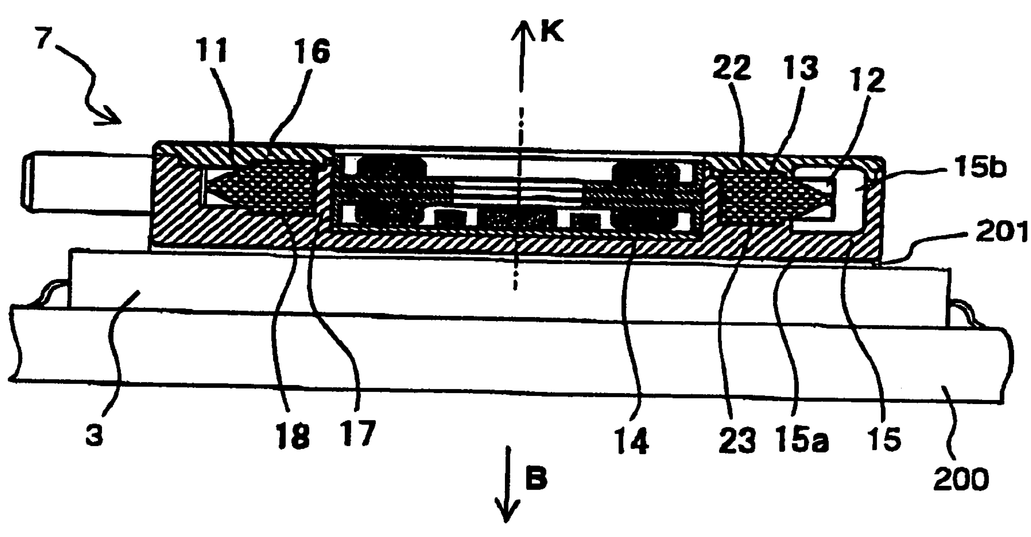
15a
15
200
B

FIG. 22


7
11
16
K
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15b
201
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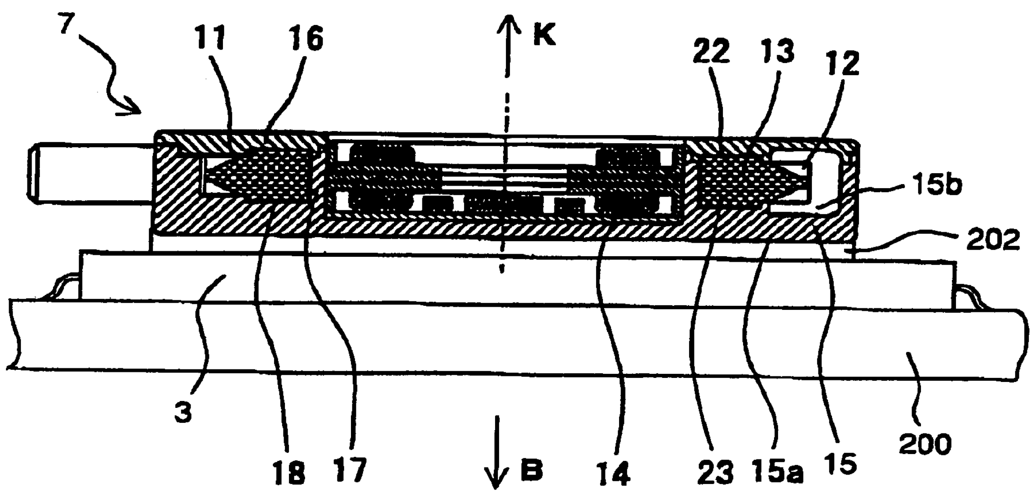
15a
15
200
B

FIG. 23


7
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K
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15b
202
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B
14
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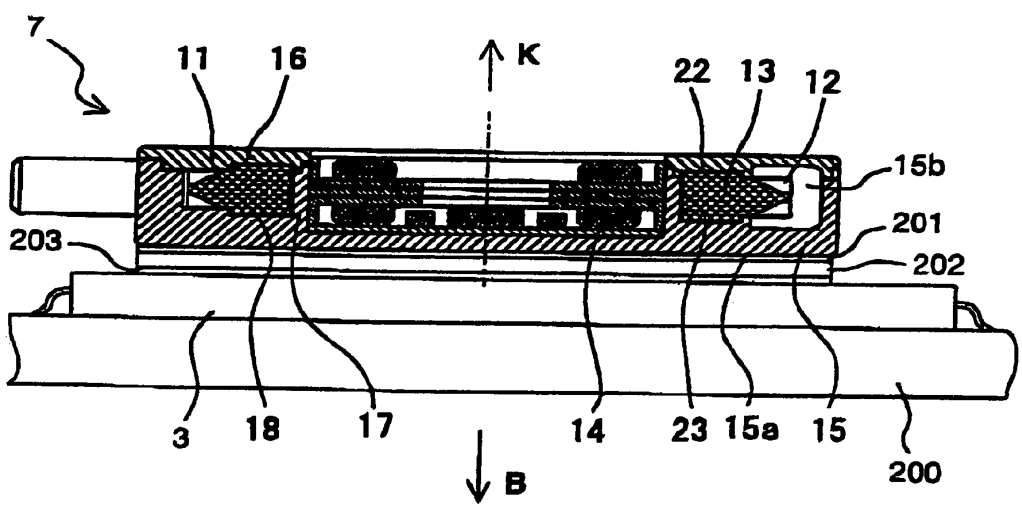
15a
15
200

FIG. 24


7
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202
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15a
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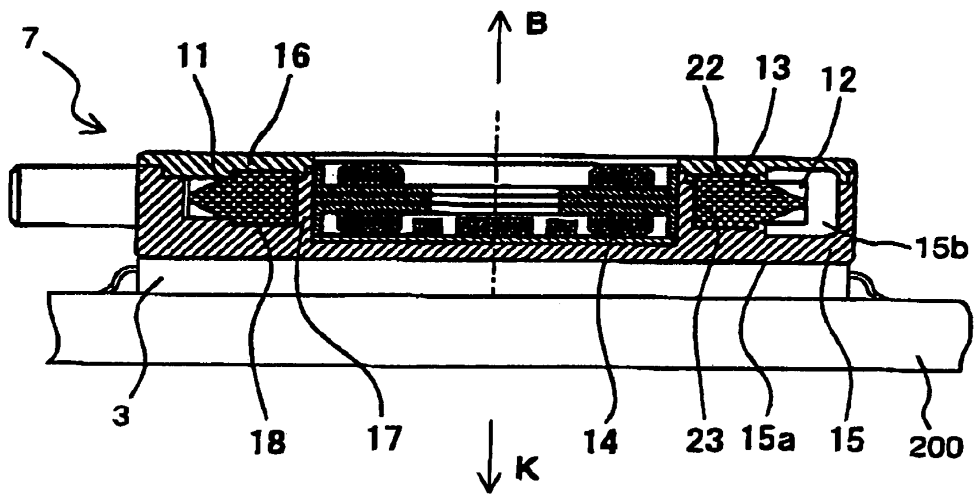
200
B

FIG. 25


B
7
11
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15b
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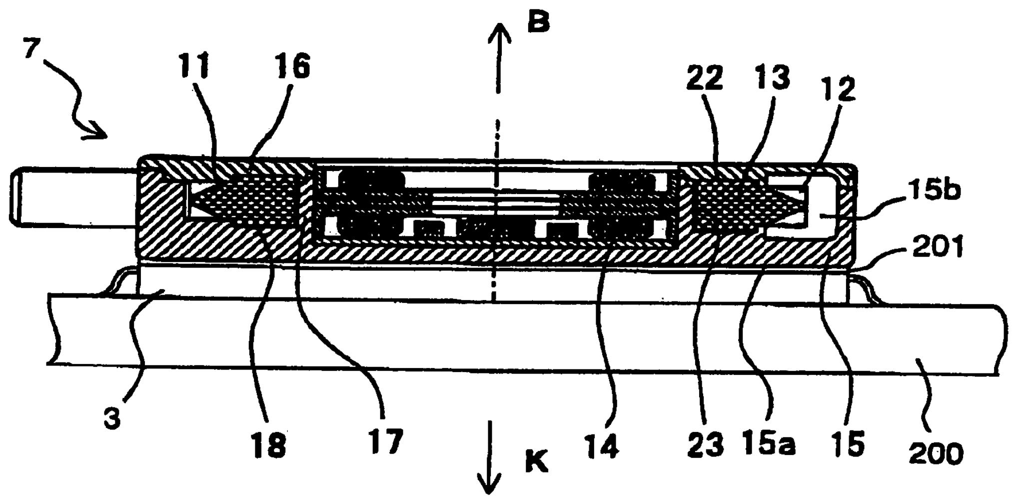
23
15a
15
200
K

FIG. 26


B
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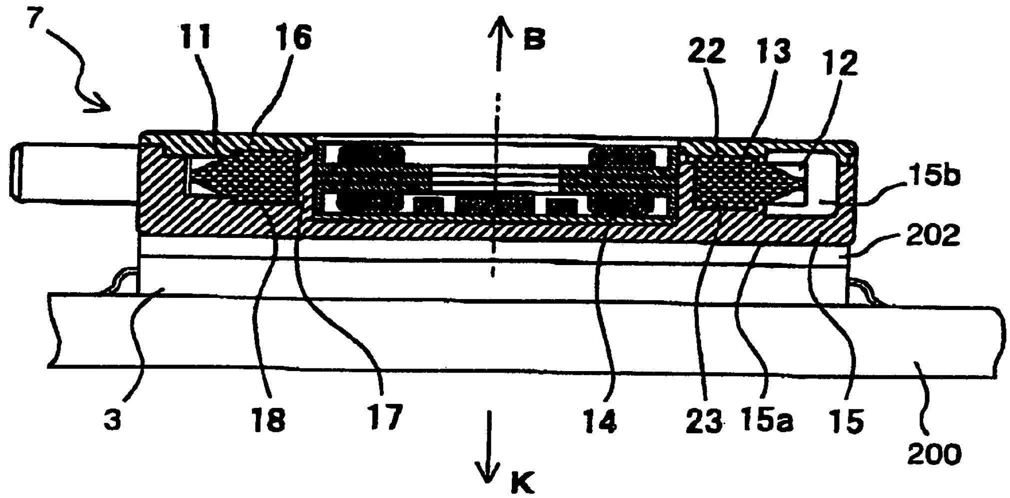
15a
15
200
K

FIG. 27


7
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202
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15a
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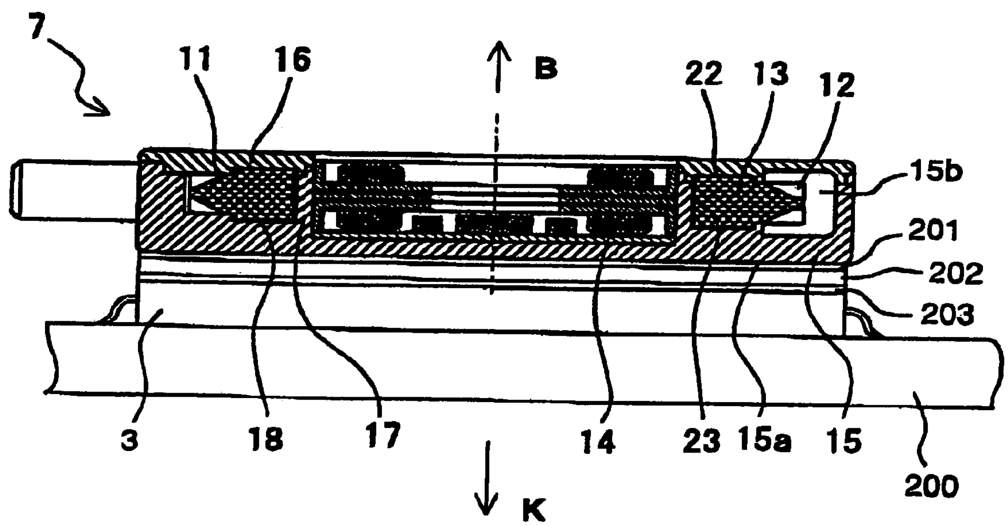
200
K

FIG. 28


7
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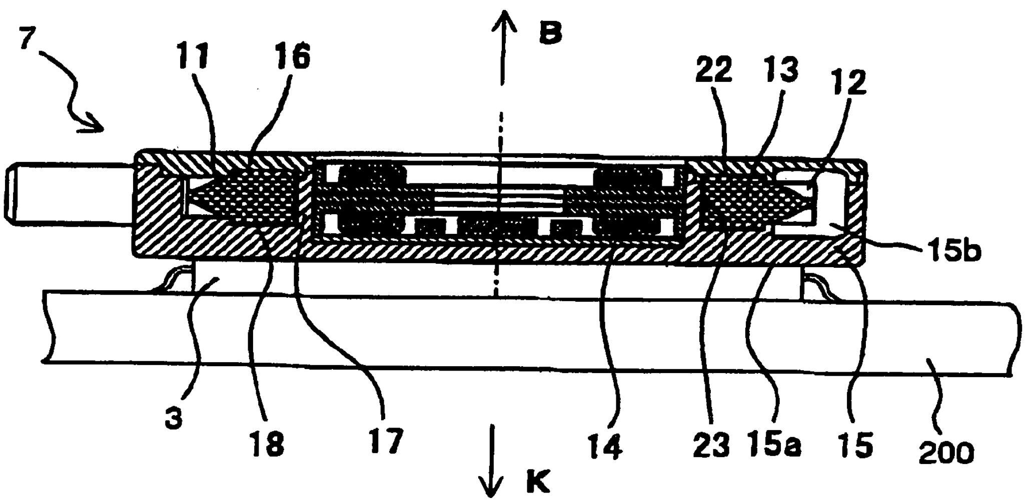
15a
15
200
K

FIG. 29



7
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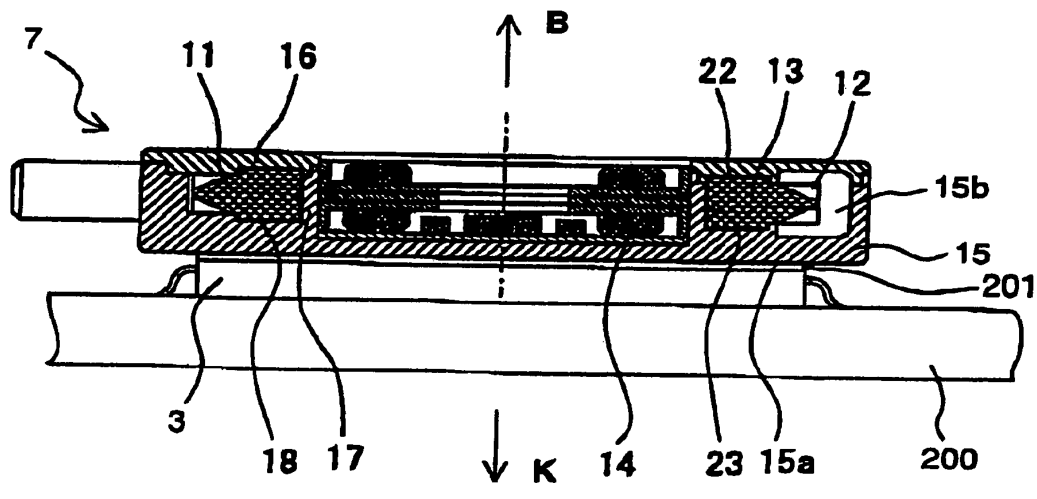
15a
15
200
K

FIG. 30



7
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201
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K
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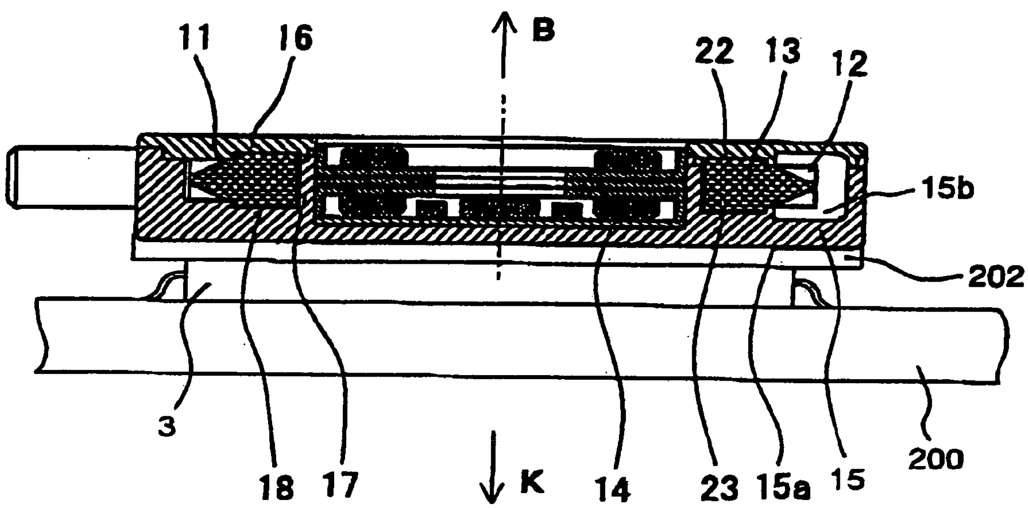
23
15a
200

FIG. 31



11
16
B
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15b
202
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17
K
14
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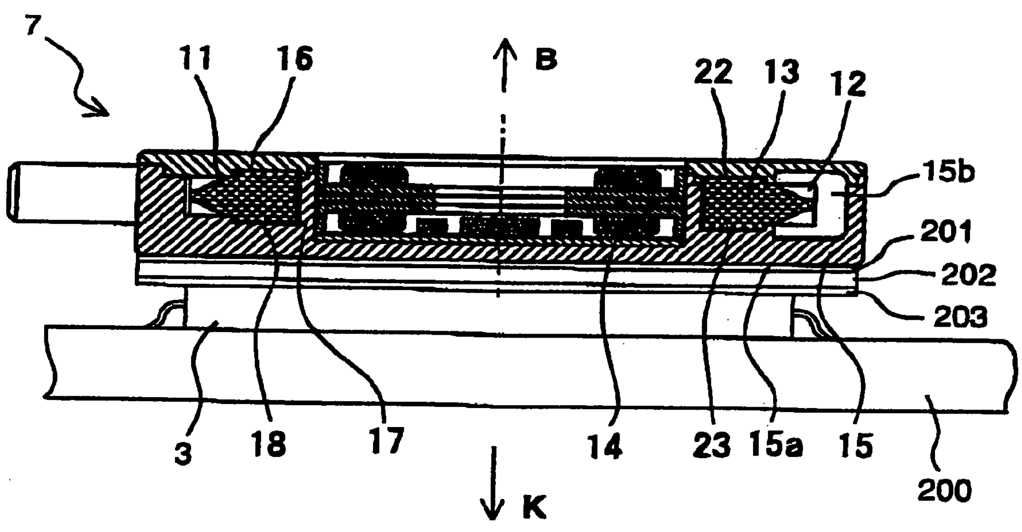
15a
15
200

FIG. 32



7
11
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B
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15b
201
202
203
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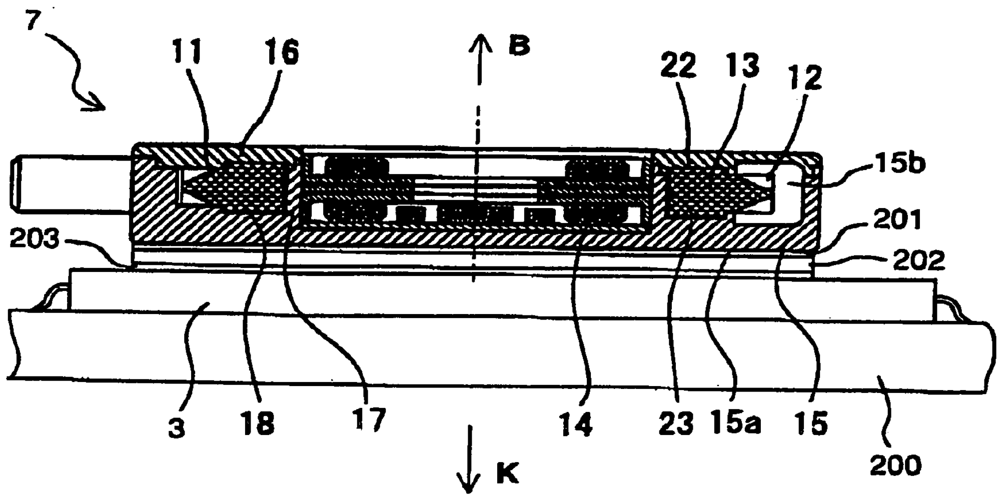
17
14
23
15a
15
200
K

FIG. 33


7
11
16
B
22
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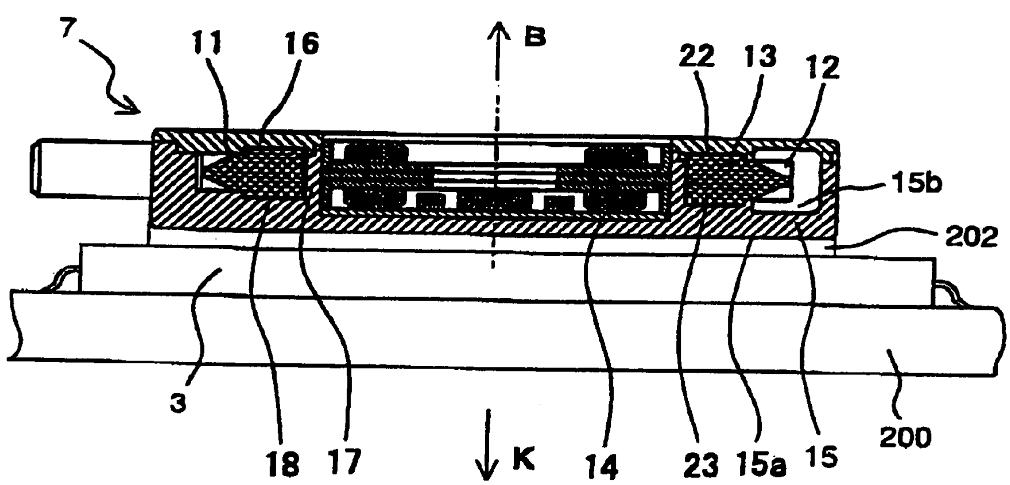
12
15b
201
203
202
3
18
17
14
23
15a
15
200
K

FIG. 34


7
11
16
B
22
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15b
202
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18
17
K
14
23
15a
15
200

FIG. 35

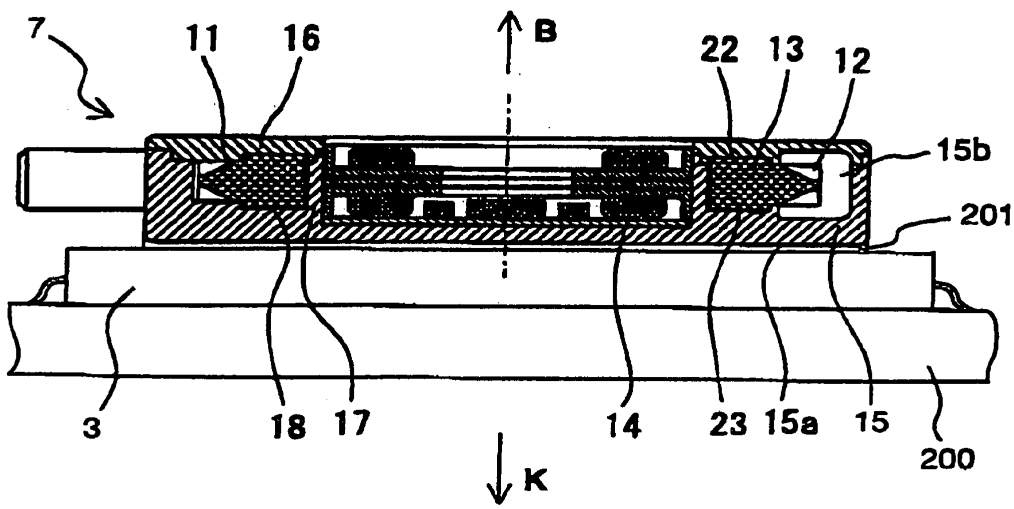

7
11
16
B
22
13
12
15b
201
3
18
17
14
23
15a
15
200
K

FIG. 36

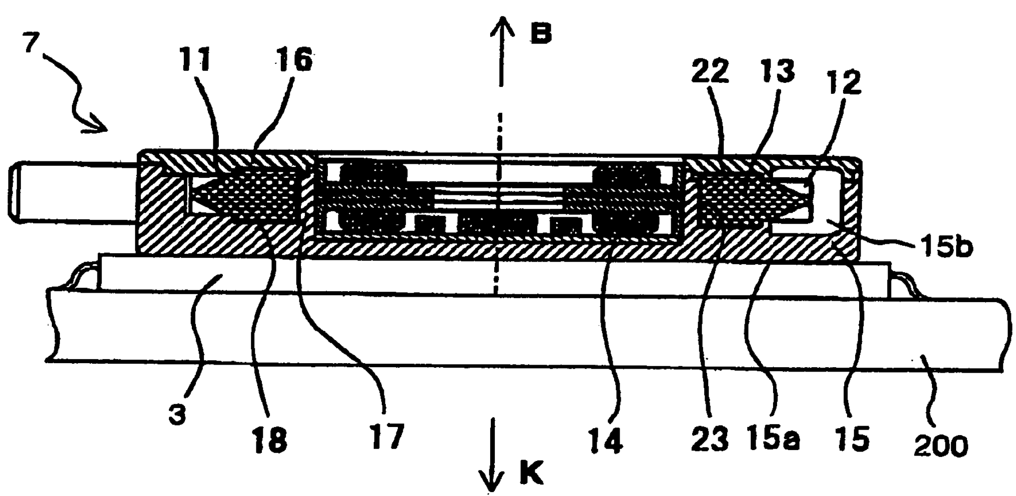

7
11
16
B
22
13
12
15b
3
18
17
14
23
15a
15
200
K

FIG. 37

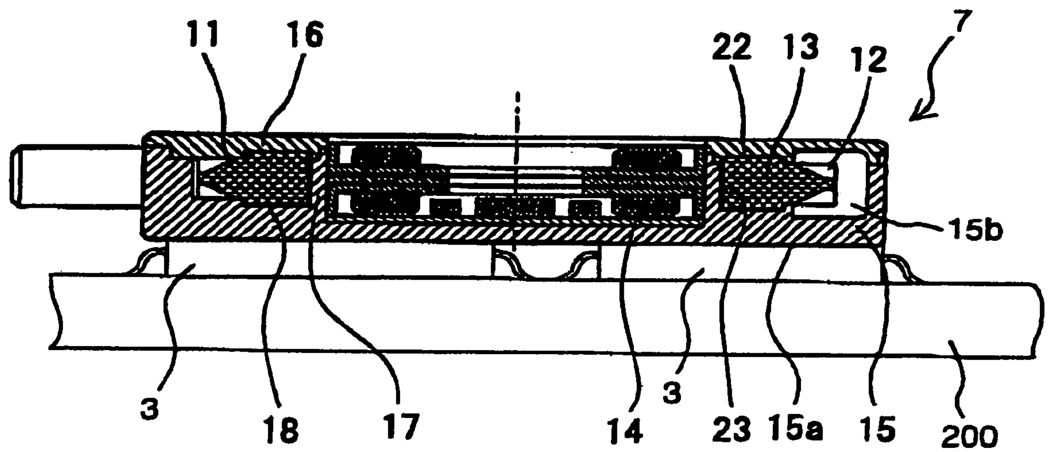
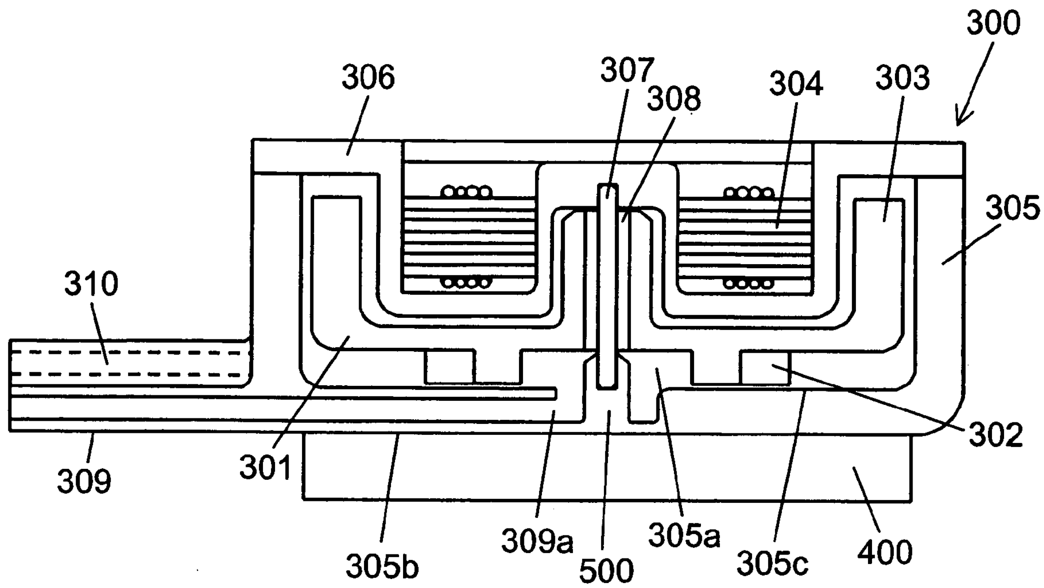


FIG. 38



300
306
307
308
304
303
305
310
302
309
301
305b
309a
500
305a
305c
400

FIG. 39

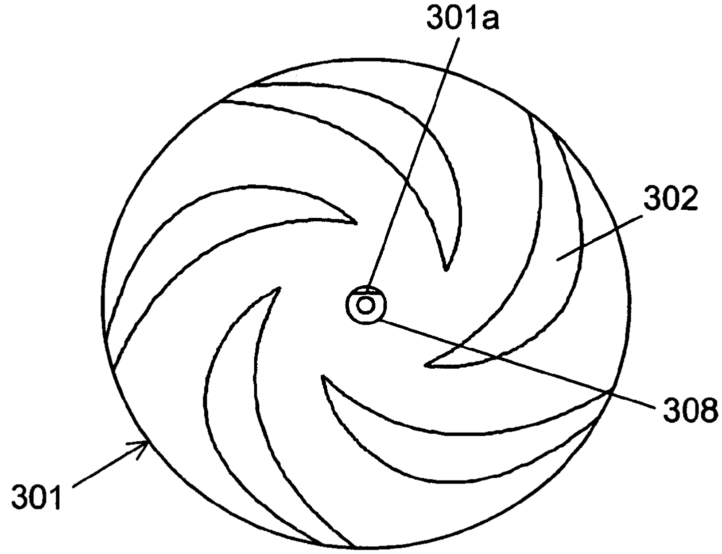


FIG. 40

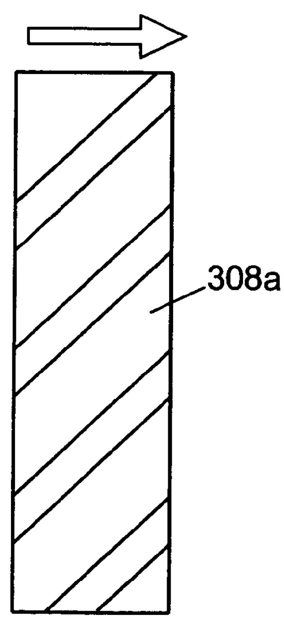


FIG. 41

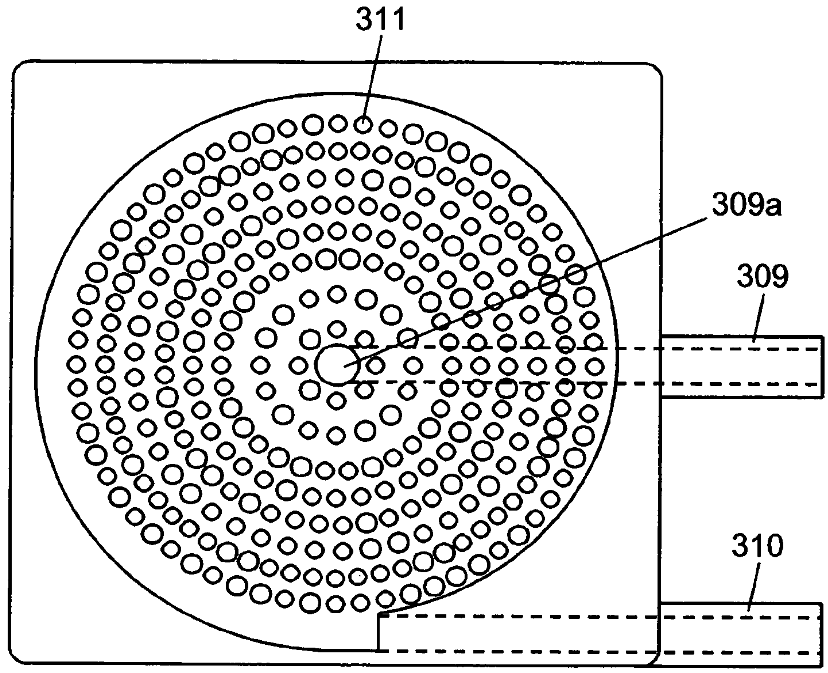


FIG. 42A

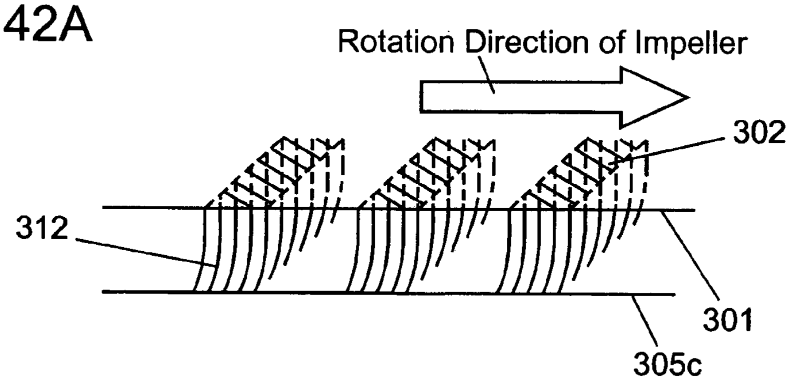


FIG. 42B

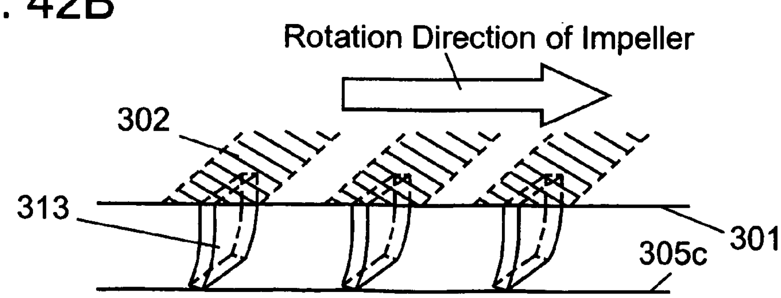
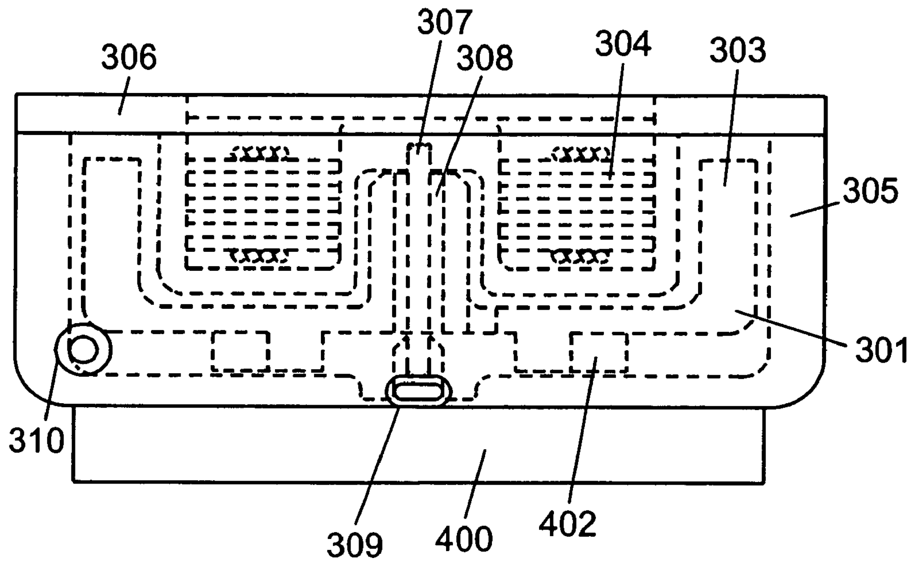


FIG. 43



307
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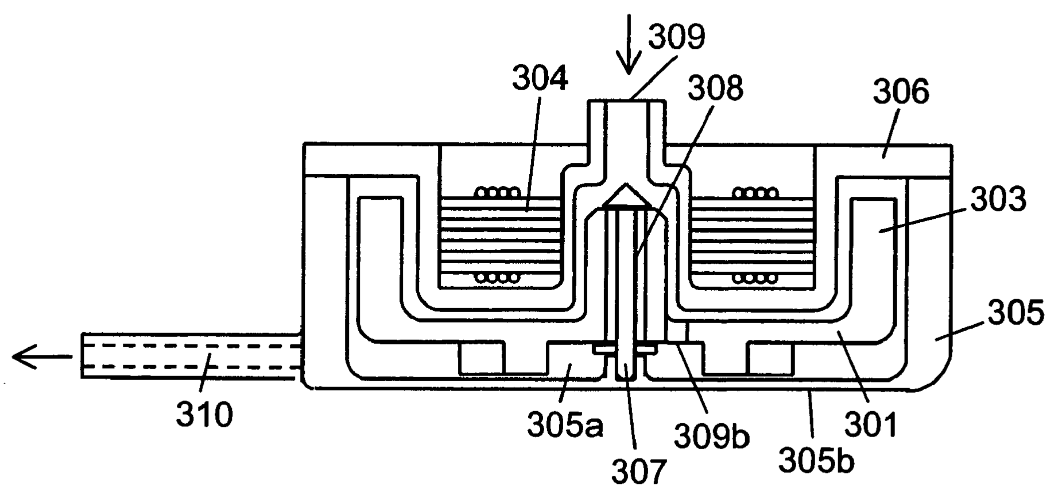
309
400
402

FIG. 44



309
304
308
306
303
305
310
305a
309b
301
307
305b

FIG. 45

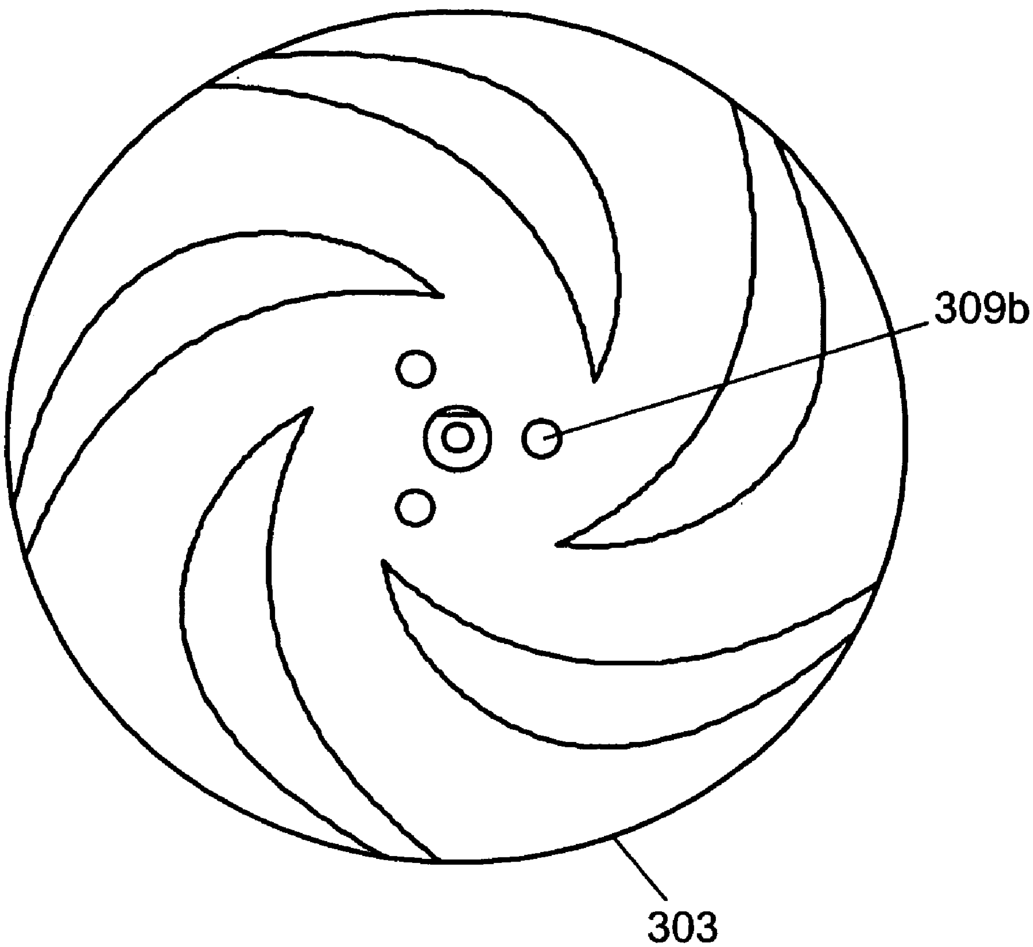


FIG. 46A

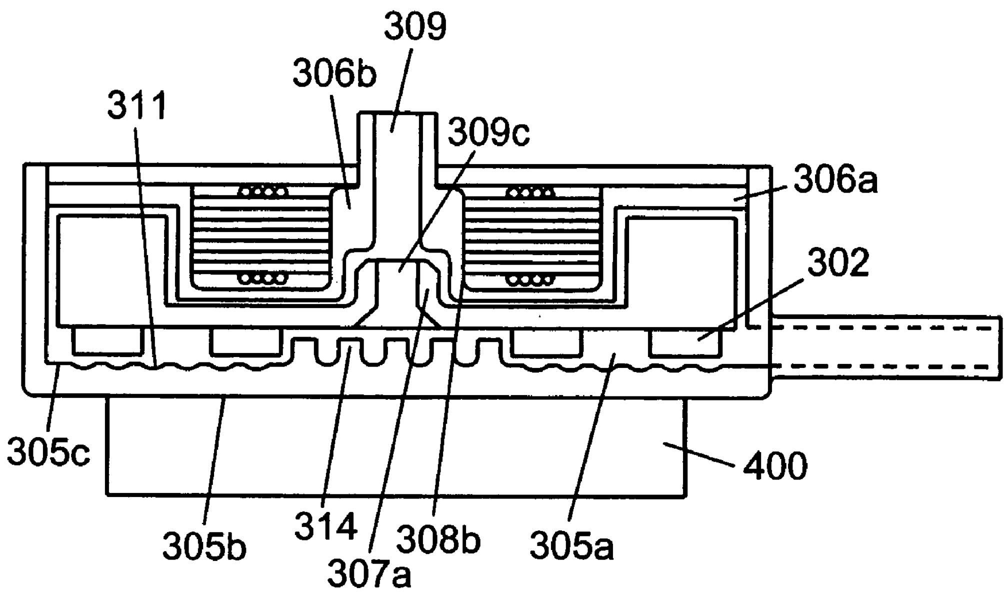


FIG. 46B

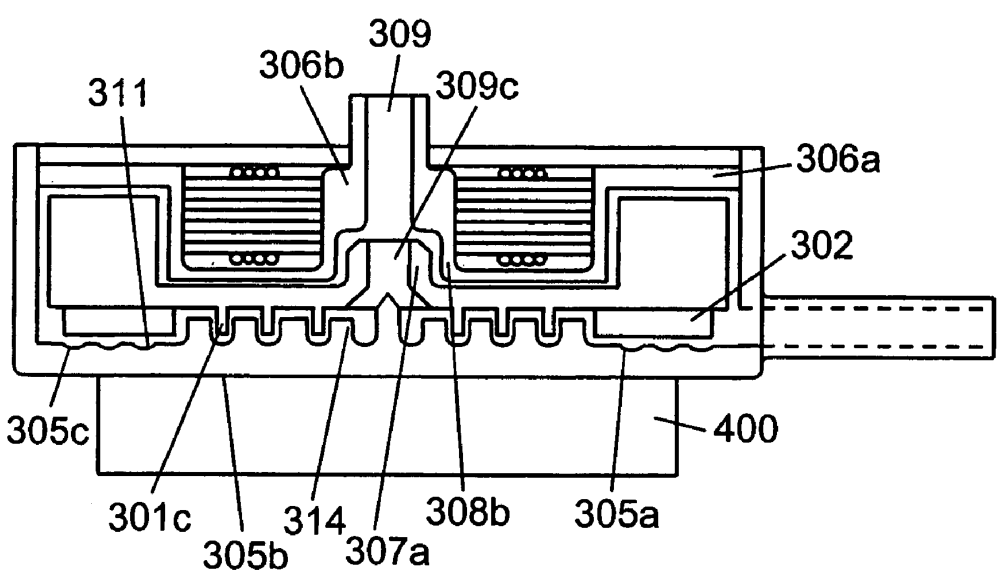


FIG. 47

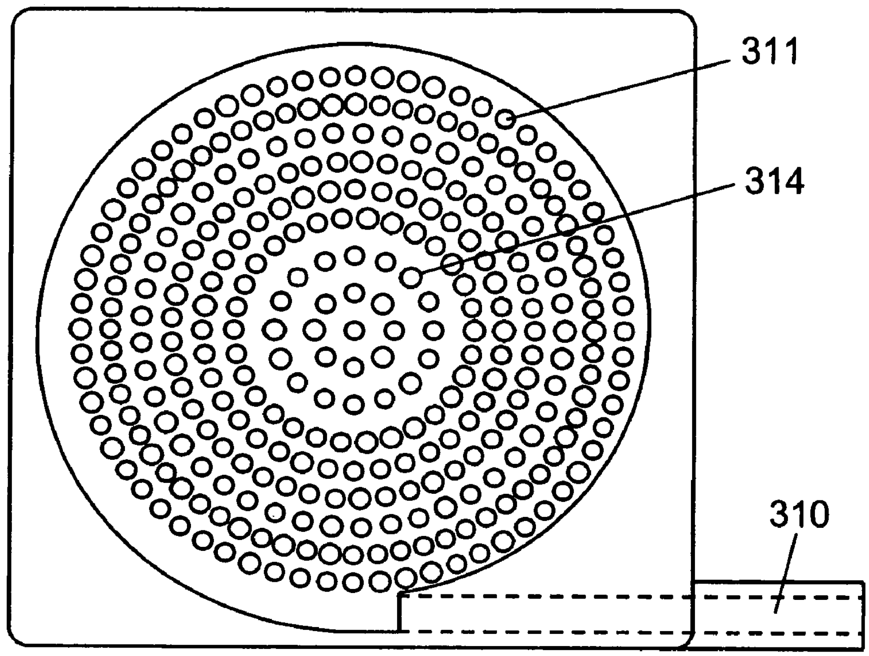


FIG. 48

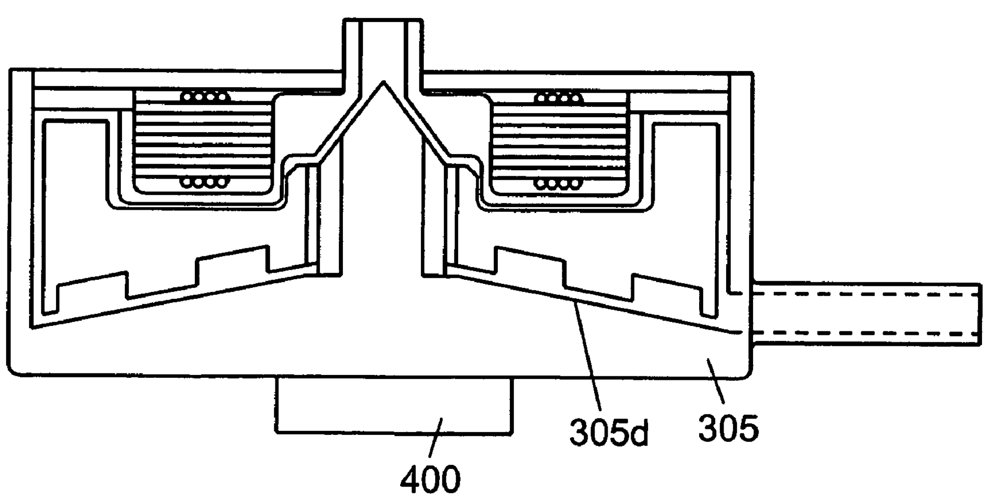


FIG. 49

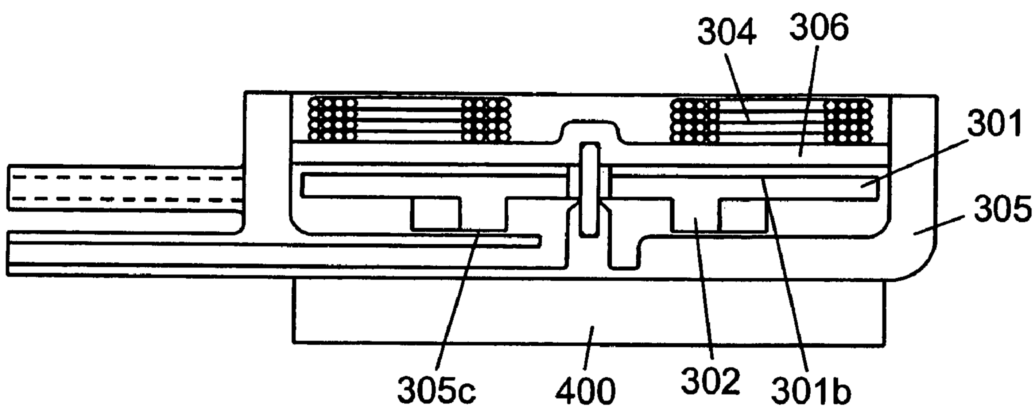
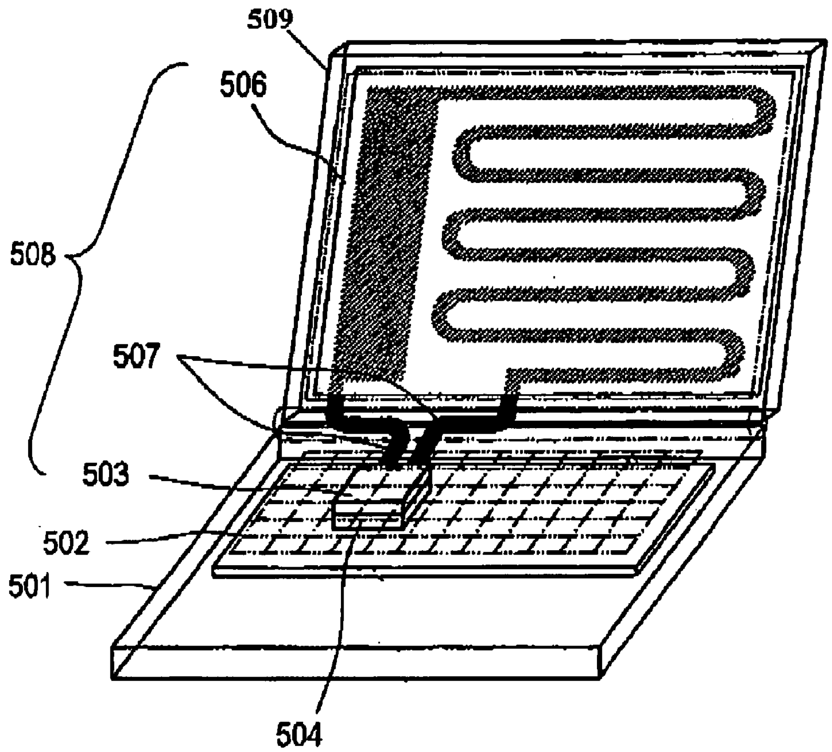


Fig. 50


509
506
508
507
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502
501
504

Fig. 51

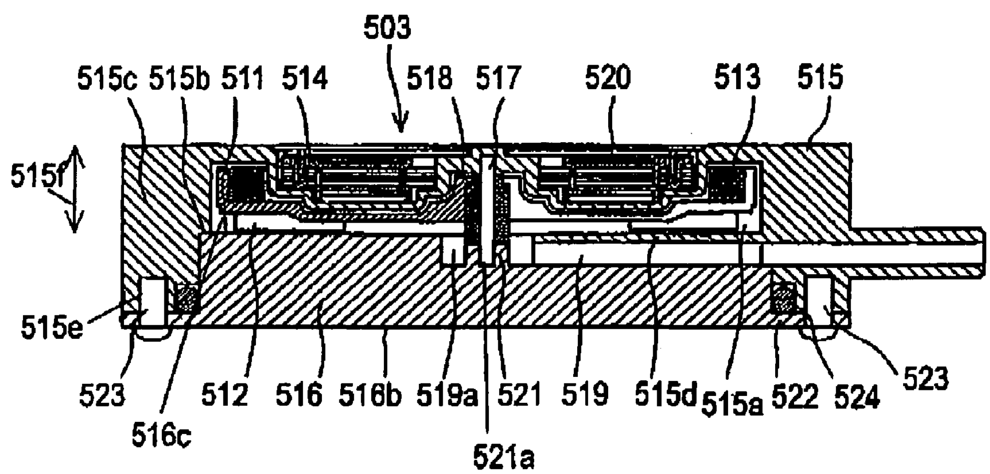

503
515c 515b 511 514
518 517
520
513 515
515f
515e
523
516c
512 516 516b 519a
521
521a
519 515d 515a 522 524
523

Fig. 52A

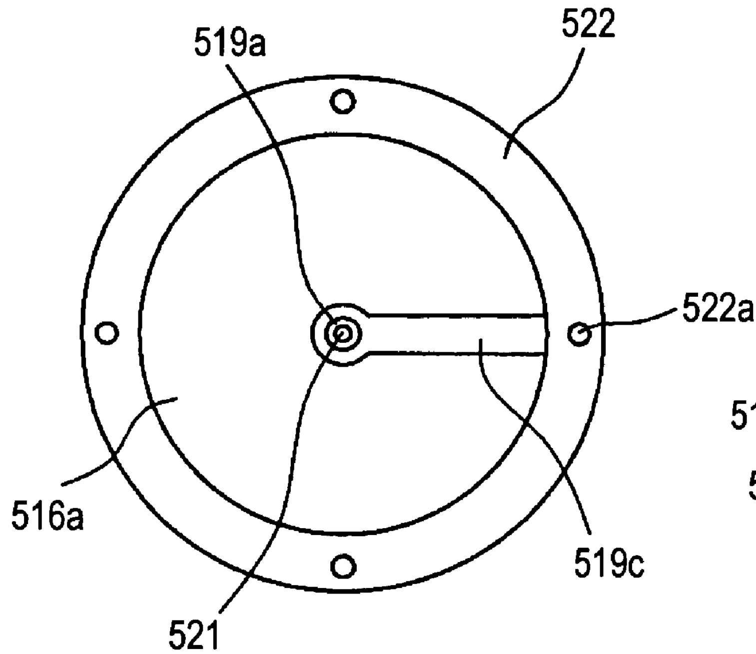


Fig. 52C

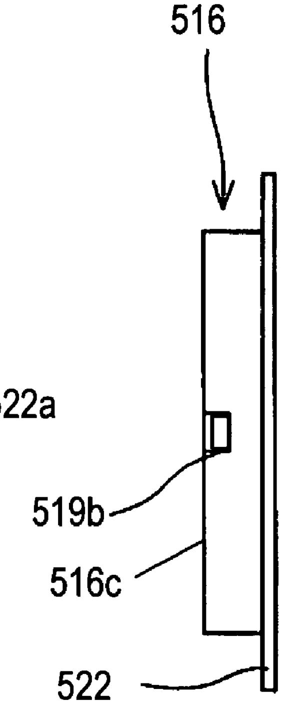


Fig. 52B

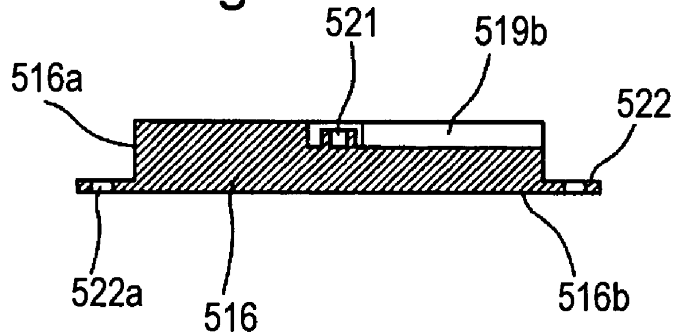


Fig. 53A

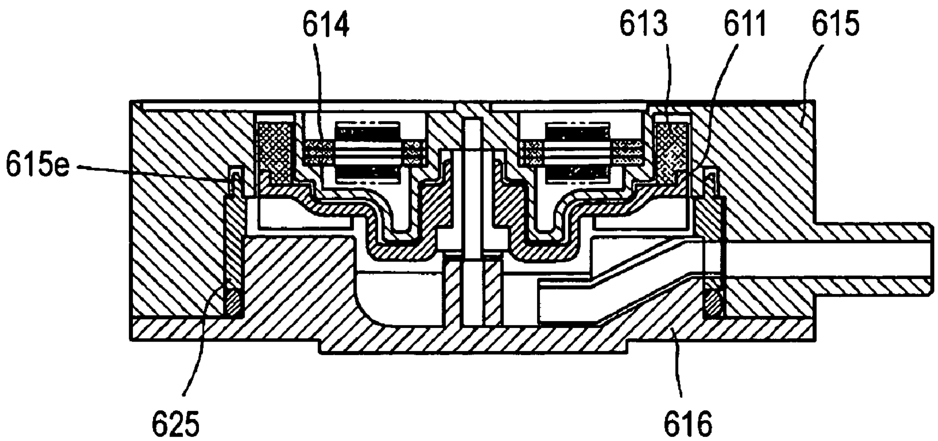


Fig. 53B

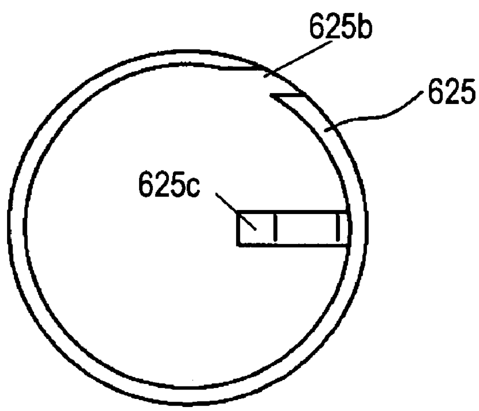
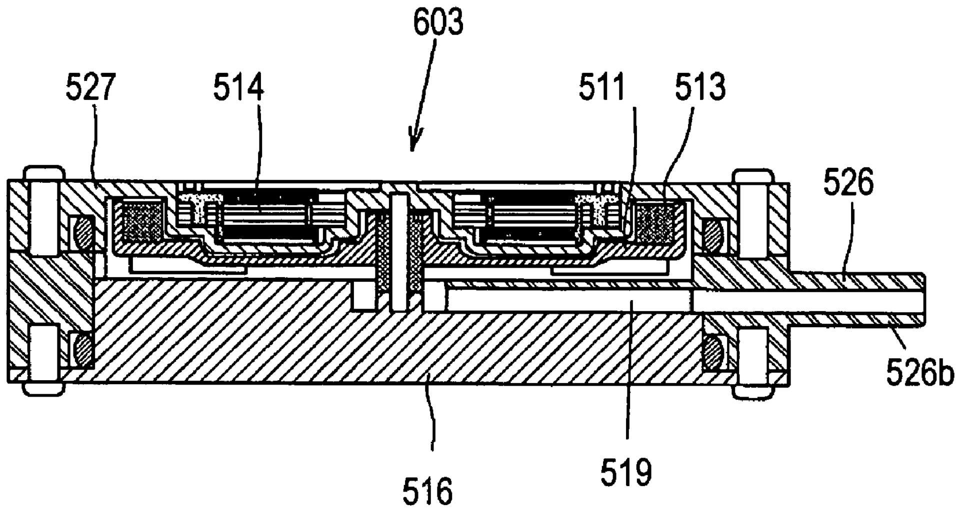


Fig. 54



COOLING DEVICE AND AN ELECTRONIC APPARATUS INCLUDING THE SAME

RELATED APPLICATIONS

This application is a continuation-in part of the U.S. patent application Ser. No. 10/446,152 filed May 28, 2003 now U.S. Pat. No. 6,839,234, which is a continuation-in part of the U.S. patent application Ser. No. 10/264,265 filed Oct. 4, 2002 now abandoned, entitled A COOLING DEVICE AND AN ELECTRONIC APPARATUS INCLUDING THE SAME, which relates to and claims priority from Japanese Patent Application No. 2002-139598 filed May 15, 2002, and Japanese Patent Application No. 2003-007168, filed Jan. 15, 2003, the disclosure of both which are hereby incorporated in their entirety by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a cooling device of an electronic apparatus for cooling a heat-generating electronic component, such as a microprocessor or a CPU, mounted in a case with coolant circulated.

2. Description of the Related Art

The recent years have seen a dramatic progress in the speed-up of computers while CPUs have much greater clock frequencies than before. As a result, heat generation of the CPU is increased so much that the conventional air cooling method solely dependent upon a heat-sink has become inadequate. In this context, a high-efficiency, high-power cooling device is absolutely required. Known as such a cooling device are those disclosed in Japanese Unexamined Patent Publication Nos. 264139/1993 and 32263/1996 wherein a coolant is circulated on a substrate for cooling the substrate with a heat generating electronic component mounted thereon.

The conventional cooling device for cooling the electronic apparatus by means of coolant circulation will be described as below. It is noted that the term "electronic apparatus" essentially means herein an apparatus adapted to perform processings based on a program loaded in the CPU or the like, or more particularly a portable compact apparatus such as a notebook computer. However, the term also includes other apparatuses equipped with a heat generating electronic component which generates heat when energized. A first conventional cooling device is schematically shown in FIG. **10**. Referring to FIG. **10**, a reference numeral **100** represents a housing; a numeral **101** representing a heat generating electronic component; a numeral **102** representing a substrate with the heat generating component **101** mounted thereon; a numeral **103** representing a cooler performing heat exchange between the heat generating component **101** and the coolant for cooling the heat generating component **101**. A reference numeral **104** represents a radiator for removing heat from the coolant; a numeral **105** representing a pump for circulating the coolant; a numeral **106** representing a pipe interconnecting these elements; a numeral **107** representing a fan for air cooling the radiator **104**.

Now, description is made on the operations of the first conventional cooling device. Discharged from the pump **105**, the coolant flows through the pipe **106** to reach the cooler **103**, where the coolant is raised in temperature by absorbing the heat of the heat generating electronic component **101**. Then, the coolant is delivered to the radiator **104**, where the coolant is lowered in temperature as air cooled by the fan **107**. Thus, the cooled coolant is returned to the pump **105**. The movement of the coolant is repeated in cycles. The cooling device is designed to cool the heat generating electronic component **101** by circulating the coolant in this manner.

Next, a second conventional cooling device for electronic apparatus is exemplified by that disclosed in Japanese Unexamined Patent Publication No. 142886/1995. FIG. **11** is a general view of the apparatus with the cooling device.

The second cooling device is designed to cool a heat generating member mounted in a narrow housing by efficiently transferring heat from the heat generating member to a wall of a metal housing which serves as a radiator portion. Referring to FIG. **11**, a reference numeral **108** represents a wiring board of an electronic apparatus; a numeral **109** representing a key board; a numeral **110** representing a semiconductor heat generating device; a numeral **111** representing a disc unit; a numeral **112** representing a display unit; a numeral **113** representing a heat absorber header involved in heat exchange with the semiconductor heat generating device **110**; a numeral **114** representing a radiator header for heat dissipation; a numeral **115** representing a flexible tube; a numeral **116** representing a metal housing of the electronic apparatus.

The second cooling device is adapted for thermal connection between the semiconductor heat generating device **110** as the heat generating member and the metal housing **116** by means of a thermal transfer device of a flexible structure. The thermal transfer device includes the flat heat absorber header **113** attached to the semiconductor heat generating device **110** and having a fluid passage; the radiator header **114** having a fluid passage and disposed in contact with a wall of the metal housing **116**; and the flexible tube **115** interconnecting the headers. The thermal transfer device is designed to drive or circulate a fluid sealed within the device between the heat absorber header **113** and the radiator header **114** by means of a fluid driving mechanism incorporated in the radiator header **114**. Thus, an easy connection between the semiconductor heat generating device **110** and the metal housing **116** is provided irrespective of component layout. Furthermore, a highly efficient heat transfer is accomplished by driving the fluid. Since the radiator header **114** is thermally connected with the metal housing **116**, the heat from the radiator header is diffused widely on the body of the metal housing **116** having a high heat conductivity.

On the other hand, there is known a pump with a heat exchange function for internal heat exchange, as disclosed in Japanese Unexamined Utility Model Publication No. 147900/1990. The pump with the heat exchange function is shown in a partially cut-away perspective view of FIG. **12**. Referring to FIG. **12**, a reference numeral **120** represents a motor; a numeral **121** representing a heat exchanger; a numeral **122** representing a cooling water passage; a numeral **122***a* representing an outlet port; a numeral **122***b* representing an inlet port; a numeral **123** representing a centrifugal pump; a numeral **124** representing a housing; a numeral **125** representing an impeller.

The centrifugal pump **123** is provided with an inlet port **124***b* centrally of the housing **124** of a volute type, and with an outlet port **124***a* tangentially of the housing. Disposed within the housing **124** is the impeller **125**, a shaft of which is coupled with the motor **120**. The cooling water passage **122** of the heat exchanger **121** is accommodated in the housing, as arranged on the whole outer periphery of the impeller **125** in a zigzag fashion.

Now, description is made on the operations of the conventional pump with the heat exchange function. When the impeller **125** is rotated by the motor **120**, a heated coolant A from the apparatus is introduced into the housing **124** via the inlet port **122***b* to be whirled in the housing **124** and then discharged from the outlet port **122***a* on the external side. In this process, turbulent flow is formed at an outer area of the interior of the housing **124** because of high pressure, thus violently bringing the coolant A into contact with the cooling water passage **122** so that the coolant A is cooled by a cooling water B flowing through the cooling water passage **122**. In this manner, the device delivers the coolant A to the apparatus under pressure while cooling the coolant A in the centrifugal pump **123**.

However, the first conventional cooling device described above requires the cooler **103** for cooling the heat generating electronic component **101** by way of heat exchange between the heat generating component **101** and the coolant, the radiator **104** for removing the heat from the coolant, and the pump **105** for circulating the coolant. Since the cooling device comprises the combination of these elements, the device has a large and complicated structure which cannot be downsized and also involves cost increase. In other words, the first conventional cooling device is basically suited for cooling large electronic apparatuses but is not adapted for the current high-performance portable notebook computers featuring a compact, lightweight and slim design and various modes of carriage and use.

Although the aforementioned second conventional cooling device can be adapted for use in the notebook computers, the flat heat absorber header **113** attached to the semiconductor heat generating device **110** and the radiator header **114** in contact with the wall of the metal housing **116** are both shaped like a box, having substantial thickness. That is, the headers are an impediment to a thinner design of the notebook computer. Specifically, the second conventional cooling device is arranged such that the radiator header **114** contains therein a reciprocating pump as the fluid driving machine which is smaller in transverse width than other pumps. Unfortunately, the thickness of the reciprocating pump defines a great thickness of the radiator header **114** as a whole, making the notebook computer of slim design impracticable.

Further, the slim notebook computer does not permit the heat absorber header **113** to accommodate the reciprocating pump of the second cooling device. That is, the thickness of the pump would add to that of the semiconductor heat generating device **110**, resulting in an increased thickness of the notebook computer. This is against the movement toward the thin design of the notebook computers. In addition, vibrations and noises produced by the reciprocating pump adversely affect the semiconductor heat generating device **110** on which the pump would be mounted. In some cases, the noises may grate on ear. On these accounts, it is difficult for the second cooling device to contribute the slim design.

The second conventional cooling device encounters a limited cooling capability because the radiator header **114** in contact with the wall of the metal housing **116** has a low heat transferability resulting from a small heat radiating area. It may be contemplated to increase the heat radiating area for enhancing the cooling capability. However, the further increase of the heat radiating area leads to the following contradiction. That is, the increased heat radiating area means an increased length of the flow passage and amount of circulation, thus requiring an increased output of the incorporated reciprocating pump, which results in an increased thickness of the radiator header **114**. If an arrangement is made such that the reciprocating pump is independently accommodated in the metal housing **116**, another space for the pump must be spared in the body of the notebook computer with dead space reduced to the limit. Furthermore, assembly work for the cooling device is complicated. Thus, the second conventional cooling device has limitations in the reduction of size and thickness of the notebook computers. The second conventional cooling device with such drawbacks falls short of meeting a demand for further increase of the cooling capability in conjunction with the recent progress of the CPUs.

On the other hand, the conventional pump with the heat exchange function has a large, complicated structure requiring the cooling water passage disposed therein because the coolant is cooled by the independent cooling water. The pump further requires a second pump for circulating the cooling water and a second heat exchanger for absorbing heat from the cooling water. Hence, the pump is a complicated system difficult to be downsized and also suffers a large number of components and low assembly efficiencies. Consequently, a good thermal efficiency or cost reduction cannot be expected from this pump.

In view of the foregoing, it is an object of the invention to provide a cooling device accomplishing both the improved cooling efficiency and the reduced size and thickness thereof, and featuring a simple construction.

It is another object of the invention to provide an electronic apparatus featuring a compact, slim design and a simplified construction.

SUMMARY OF THE INVENTION

A cooling device for cooling a heat-generating component includes a circulating passage arranged to have coolant circulate therein, a centrifugal pump including a first case made of metallic material, a second case made of resin material, and an impeller accommodated in the pump chamber, and a radiator provided at the circulating passage and being operable to release heat from the coolant. The first case has a surface arranged to contact the heat-generating component. The second case forms a pump chamber between the first case and the second case. The pump chamber stores the coolant therein. The impeller includes open-type vanes arranged to pressurize the coolant as to have the coolant flow through the circulating passage.

The cooling device has a high cooling efficiency as well as a high operating efficiency of the motor while having a simple construction and a small overall size and a small thickness.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram showing a general construction of an electronic apparatus incorporating a cooling device according to a first embodiment of the invention;

FIG. **2** is a sectional view showing a pump of contact heat exchanger type according to the first embodiment of the invention;

FIG. **3** is a disassembled perspective view showing the pump of contact heat exchanger type according to the first embodiment of the invention;

FIG. **4** is a sectional view of a principal part for illustrating the flow of a coolant in the pump of contact heat exchanger type according to the first embodiment of the invention;

FIG. **5**A is a table representing radial thrusts on a ring-like impeller according to the first embodiment of the invention;

FIG. **5**B is a diagram explaining of the radial thrust on the ring-like impeller according to the first embodiment of the invention;

FIG. **6** is a sectional view of a principal part for illustrating the flow of the coolant in the pump of contact heat exchanger type provided with a fin according to the first embodiment of the invention;

FIG. **7** is a diagram showing a general construction of an electronic apparatus incorporating a cooling device according to a second embodiment of the invention;

FIG. **8** is a sectional view showing a pivotal member according to the second embodiment of the invention;

FIG. **9** is a sectional view showing the pivotal member of the second embodiment of the invention integrated with a removable snap-in type connector;

FIG. **10** is a diagram showing a construction of a first conventional cooling device for electronic apparatus;

FIG. **11** is a diagram showing a construction of a second conventional cooling device for electronic apparatus;

FIG. **12** is a partially cut-away perspective view showing a conventional pump with heat exchange function;

FIG. **13** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **14** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **15** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **16** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **17** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **18** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **19** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **20** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **21** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **22** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **23** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **24** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **25** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **26** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **27** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **28** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **29** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **30** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **31** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **32** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **33** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **34** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **35** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention;

FIG. **36** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention; and

FIG. **37** is a diagram showing a mounting structure of the pump of contact heat exchanger type and the heat generating electronic component according to an embodiment of the invention.

FIG. **38** is a schematic diagram of an exemplary heat-exchange-type centrifugal pump of a cooling device in accordance with a third embodiment of the invention.

FIG. **39** is a front view of an impeller of the centrifugal pump in accordance with the third embodiment.

FIG. **40** shows an exemplary fluid bearing that can be utilized in the centrifugal pump in accordance with the third embodiment.

FIG. **41** is a perspective view of an inner surface of a pump chamber of the centrifugal pump in accordance with the third embodiment.

FIG. **42**A illustrates brushes attached to the impeller of the centrifugal pump in accordance with the third embodiment. FIG. **42**B illustrates blades attached to the impeller of the centrifugal pump in accordance with the third embodiment.

FIG. **43** is a side view of the centrifugal pump taken at line **43**—**43** of FIG. **38**.

FIG. **44** is a schematic diagram of an exemplary heat-exchange-type centrifugal pump of a cooling device in accordance with a fourth embodiment of the invention.

FIG. **45** is a front view of an impeller of the centrifugal pump in accordance with the fourth embodiment.

FIG. **46**A shows the centrifugal pump including an impeller having a short rotating shaft in accordance with the fourth embodiment.

FIG. **46**B shows another centrifugal pump including an impeller having a short rotating shaft in accordance with the fourth embodiment.

FIG. **47** is a front view of an inner wall of a pump chamber of the centrifugal pump in accordance with the fourth embodiment.

FIG. **48** is a schematic diagram of a housing of a further centrifugal pump in accordance with the fourth embodiment.

FIG. **49** is a schematic diagram of an exemplary heat-exchange-type centrifugal pump of a cooling device in accordance with a fifth embodiment of the invention.

FIG. **50** is a perspective view of an electronic apparatus including a cooling device according to a sixth embodiment of the present invention.

FIG. **51** is a cross sectional view of a centrifugal pump of the cooling device of the sixth embodiment.

FIG. **52**A is a front view of a lower case of the centrifugal pump according to the sixth embodiment.

FIG. **52**B is a cross sectional view of the lower case shown in FIG. **52**A.

FIG. **52**C is a side view of the lower case shown in FIG. **52**A.

FIG. **53**A is a cross sectional view of another centrifugal pump including a sealing member according to the sixth embodiment.

FIG. **53**B is a front view of the sealing member shown in FIG. **53**A.

FIG. **54** is a cross sectional view of a further centrifugal pump according the sixth embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the invention will be described in detail with reference to the accompanying drawings. In the following description of the embodiments, each of the parts represented by the same reference numerals in the drawings is substantially constructed the same way and hence, the explanation of like parts is omitted.

First Embodiment

A cooling device of a first embodiment and an electronic apparatus including the same is designed to interconnect a pump of contact heat exchanger type and a radiator by means of a flexible pipe permitting a second housing to rotate relative to a first housing. The electronic apparatus is a foldable apparatus such as a notebook computer. FIG. **1** is a diagram showing a general construction of the electronic apparatus incorporating the cooling device of the first embodiment, whereas FIG. **2** is a sectional view showing the pump of contact heat exchanger type according to the first embodiment. FIG. **3** is a disassembled perspective view showing the pump of contact heat exchanger type according to the first embodiment whereas FIG. **4** is a sectional view of a principal part showing a flow of a coolant in the pump according to the first embodiment.

Referring to FIG. **1**, a reference numeral **1** represents a first housing such as of a notebook computer; a numeral **2** representing a key board disposed on a top surface of the first housing **1**; a numeral **3** representing a heat generating electronic component such as a CPU accommodated in the first housing **1**; a numeral **4** representing a substrate with the heat generating electronic component **3** mounted thereon; a numeral **5** representing a second housing serving as a cover of the first housing **1**; a numeral **6** representing a display unit disposed on an inside surface of the second housing **5** for displaying operation results given by the CPU; a numeral **7** representing a pump of contact heat exchanger type disposed in intimate contact with the heat generating component **3** for heat exchange between the heat generating component **3** and a coolant X thereby cooling the heat generating component **3** and also serving to circulate the coolant X; a numeral **8** representing a radiator disposed on a back side of the display unit **6** for removing the heat from the coolant X; a numeral **8***a* representing a coolant passage arranged in a zigzag fashion; a numeral **8***b* representing a reserve tank for replenishing the coolant X; a numeral **9** representing a pipe for interconnecting these elements. Suitably used as the coolant X is an aqueous solution of propylene glycol which is safely used as a food additive or the like. In a case where aluminum or copper is used as a housing material as will be described herein later, the coolant may preferably be added with an anti-corrosive additive for improving the coolant in anti-corrosion characteristic with respect to such materials.

The radiator **8** comprises a sheet member of a material having a high heat conductivity and heat releasability, such as copper, aluminum, stainless steel or the like, because of the need for removing heat from the coolant X in a large space of a narrow width on the back side of the display unit **6**. As shown in FIG. **1**, the radiator includes therein the coolant passage **8***a* and the reserve tank **8***b*. A suitable radiator for use in the present invention is disclosed in a commonly owned and concurrently filed U.S. Patent application Ser. No. 10/976,324, which application is hereby incorporated by reference. In order to increase the cooling effect, the radiator **8** may be further provided a fan for forcibly cooling the coolant by blowing air against the radiator **8**. The pipe **9** comprises a rubber tube of a flexible, low gas-permeable rubber such as butyl rubber such that the freedom of pipe layout may be secured. The low gas-permeable rubber serves the purpose of preventing the invasion of air bubbles into the tube.

Next, the structure of the pump of contact heat exchanger type **7** is described. The pump of contact heat exchanger type **7** according to the first embodiment employs a vortex pump (also referred to as Wesco pump, regenerative pump or friction pump). Referring to FIGS. **2** and **3**, a reference numeral **11** represents a ring-like impeller of the vortex pump; a numeral **12** representing a plurality of grooved vanes formed on an outer periphery of the ring-like impeller **11**; a numeral **13** representing a rotor magnet disposed in an inside circumference of the ring-like impeller **11**. A reference numeral **14** represents a motor stator disposed in an inside circumference of the rotor magnet **13**; a numeral **15** representing a pump housing accommodating the ring-like impeller **11** and guiding the fluid to an outlet port as allowing the restoration of the pressure of kinetic energy applied to the fluid by the impeller **11**; a numeral **15***a* representing a heat absorbing surface contacting the heat generating electronic component **3** for absorbing the heat therefrom; a numeral **15***b* representing a pump chamber guiding the fluid to the outlet port as allowing the restoration of the pressure of the kinetic energy applied to the fluid by the vanes **12**; a numeral **16** representing a housing cover constituting a part of the pump housing **15** and accommodating the ring-like impeller **11** followed by sealing the pump chamber **15***b*; a numeral **17** representing a cylinder portion disposed in the pump housing **15** and rotatably supporting the ring-like impeller **11**. The pump **7** of the first embodiment has a thickness of 5–10 mm with respect to a direction of rotary axis; a characteristic radial length of 40–50 mm; a speed of rotation of 1200 rpm; a flow rate of 0.08–0.12 L/min.; and a head of the order of 0.35–0.45 m. Thus, the data of the pump according to the invention, including the values of the first embodiment, are defined as 3–15 mm in thickness; 10–70 mm in characteristic radial length; 0.01–0.5 L/min. in flow rate; and 0.1–2 m in head. That is, the pump is a slim, compact type having a specific rate of 24–28 (unit: m, m^3/min., rpm) and much smaller than the conventional pumps.

Because of the difficulty of forming a flat side surface of the pump, the application of a slim pump having thin and flat heat absorbing surface has been thought to be impracticable. However, the inventors focused attention on the vortex pump and found that the object of the invention can be achieved by making the following improvements to the pump. That is, an adequate heat exchange function can be attained by subjecting the heat from the heat generating electronic component **3** to turbulent heat exchange by way of turbulent flow formed at an outer periphery of the vortex pump. The flat heat absorbing surface can be realized by unifying a part of a driving portion with the impeller to form a flat plate-like arrangement as a whole. In terms of the area of the heat absorbing surface relative to the flow rate and the quantity of heat transfer relative to the flow rate, this compact, slim pump can achieve an adequate cooling capacity in contrast to the pump of a normal size.

Specifically, the fluid in the pump housing **15** of the pump of contact heat exchanger type **7** is agitated by the vanes **12** to form a spiral flow. In a macroscopic view, the fluid flows along the ring-like pump chamber **15***b*. The heat externally transferred from the heat source is absorbed by the fluid flow at the outer periphery of the ring-like impeller **11** (in a microscopic view as shown in FIG. **4**, the fluid flow partly counter-flows against the heat transfer direction). As a result, the pump can function as a heat exchanger without the provision of another cooling device. However, the pump may include an auxiliary cooling device for enhancing the cooling capacity. The rotor magnet **13** is unified with the ring-like impeller **11** to form a ring body which is rotatably supported by the cylinder portion **17**. Accordingly, the ring-like impeller **11** is decreased in inertial mass, so that heat generation by the driving portion is decreased while the pump of contact heat exchanger type **7** can be reduced in size, thickness and weight. In order to expedite the heat transfer, a material of high heat conductivity, such as copper, aluminum, stainless steel and the like, must be selected for forming the pump housing **15** and the housing cover **16**. In principle, it is proper to use a metal material of high heat conductivity including copper, aluminum and the like. Otherwise, as a material less susceptible to variations in heat conductivity, a resin or the like having a high heat conductivity may also be used. In a case where aluminum is selected as a material for forming the pump housing **15** in the light of weight reduction, a copper sheet having a greater heat conductivity than aluminum may preferably be attached to a lower surface of the pump housing **15**. Additionally, a heat pipe may be attached to the lower surface of the pump housing **15** (on the heat absorbing surface **15***a* side) or may be embedded in a part thereof so that the absorbed heat may be more effectively transferred to the outer periphery of the ring-like impeller **11** in the pump housing **15**. The copper sheet and heat pipe are equivalent to an auxiliary heat conductive member of the invention. In addition to the attached sheet member, the auxiliary heat conductive member may be formed by friction bonding a copper bar and cutting off an unrequired portion. It is also preferred that the pump housing **15** and housing cover **16** are formed with fin-like projections and depressions on outer surfaces thereof for active heat exchange with outside air.

In addition, the pump of contact heat exchanger type **7** can be designed to have the heat absorbing surface **15***a* of the pump housing **15** totally defined by a flat plane. Specifically, a side surface of the pump housing **15** is formed in correspondence with side surfaces of the pump chamber **15***b* and motor stator **14**, while the motor stator **14** is received in a cavity in the cylinder portion **17**, whereby the heat absorbing surface **15***a* of the pump **7** is formed flat. Thus, the heat absorbing surface **15***a* may come into tight contact with the heat generating electronic component **3** (a top surface thereof is normally formed flat). In a case where the top of the heat generating component **3** is formed uneven, the pump housing may be so varied in thickness as to conform with the top configuration of the heat generating component, thereby establishing the tight contact therewith. Similarly to the aforementioned copper sheet, a bonding resin or rubber having a high heat conductivity may preferably be interposed between the heat absorbing surface **15***a* and the top configuration of the heat generating electronic component **3** such that the pump housing may be secured to place with the minimum possible decrease of the heat conductivity. It is noted that to conform the heat absorbing surface **15***a* with the top configuration of the heat generating electronic component **3** is to impart the heat absorbing surface **15***a* with a complementary configuration to the three-dimensional configuration of the top surface of the heat generating component **3**. That is, the curvature of the heat absorbing surface matches that of the heat generating component **3**, so that the pump housing per se is mountable on the component. Further, such a conformity means that the curvatures of these elements match with each other at least at their fixing portions (contact portions), although the size and configuration of the heat generating electronic component **3** such as CPU often differ from those of the heat absorbing surface **15***a* (the pump of contact heat exchanger type **7** according to the invention is quite small whereas the heat generating component **3** normally has a greater size, and the pump **7** according to the invention can take various forms whereas the heat generating component normally has a square shape). For effective heat transfer, it is necessary to eliminate the formation of an air layer between the heat absorbing surface **15***a* and the heat generating electronic component **3**. Hence, the concept of conformity may include a case, for instance, where a minor depression is formed in either one of the heat absorbing surface and the heat generating component, although this approach is never recommended.

In the first embodiment, the motor stator **14** is received in the central cavity defined by the cylinder portion **17** of the pump housing **15** and transferred, one side of the motor stator transferring heat while the other side thereof dissipating the heat as exposed the outside air. Thus, the driving portion basically produces a small quantity of heat, which is dissipated in the atmosphere. Therefore, the pump of contact heat exchanger type **7** can be dedicated to the cooling of the heat generating electronic component **3**. In the light of the effective cooling of the heat generating electronic component **3**, however, it is recommendable not to locate the heat generating component **3** such as CPU near the motor stator **14** which also produces heat. Although varied depending upon the sizes of the heat generating component **3** and heat absorbing surface **15***a*, the rate of heat transfer depends upon the location of the heat generating component **3**. Because of the heat generation by the motor, areas of the heat absorbing surface **15***a* that correspond to lateral sides of the housing sandwiching the wall of the pump chamber **15***b* and an area near an inlet port **19** and an outlet port **20** present higher rate of heat absorption. In particular, the greatest heat dissipation effect may be obtained by positioning the center of the heat generating component **3** at the area of the heat absorbing surface **15***a* that is surrounded by the inlet port **19**, outlet port **20** and pump chamber **15***b*.

The cavity receiving the motor stator **14** may be molded of a silicone or urethane resin having a high heat conductivity such that the heat produced by the motor stator **14** may be transferred to the pump chamber **15***b* via this molded portion. Furthermore, the molded portion is effective to transfer the heat from the heat generating component **3**, absorbed by the heat absorbing surface **15***a*, to the coolant X in the pump chamber **15***b*. This results in a further increase in the heat transfer rate. If the motor stator **14** including winding is molded of a molding material, the molded stator not only expedites the dissipation of heat from the heat generating component **3** but also completely seals the electrically conductive winding portion against water. Thus, the motor stator **14** can be perfectly protected against fluid leakage.

The pump of contact heat exchanger type **7** according to the first embodiment is adapted for non-contact rotation while reducing hydrodynamically produced axial and radial thrusts in order to maintain smooth operation for a long period of time. Referring to FIGS. **2** and **3**, a reference numeral **18** represents a thrust plate; the **19** numeral representing the inlet port; the numeral **20** representing the outlet port. A reference numeral **22** represents a thrust dynamic pressure generating groove formed on opposite side surfaces of the ring-like impeller **11** and having a spiral groove pattern, whereas a numeral **23** represents a radial dynamic pressure generating groove formed on an inside circumference of the ring-like impeller **11** and having a herringbone groove pattern.

In the vortex pump, thrust balance is lost because a pressure at an area near the outlet port **20** is greater than a pressure at an area near the inlet port **19**. Hence, the spiral groove pattern of the thrust dynamic pressure generating groove **22** is so formed as to provide a pumping action for thrusting the fluid toward the inside circumference of the groove in conjunction with the rotation of the ring-like impeller **11**, thereby forming fluid films on the opposite sides of the impeller **11** for dynamically supporting an axial thrust. On the other hand, the herringbone groove pattern of the radial dynamic pressure generating groove **23** is so formed as to provide a pumping action for thrusting the fluid toward the axial center of the groove in conjunction with the rotation of the impeller **11**, thereby forming a fluid film for dynamically supporting a radial thrust on the ring-like impeller **11**. The thrust dynamic pressure generating groove **22** may be formed on the thrust plate **18** of the pump housing **15** or the housing cover rather than on the ring-like impeller **11**. On the other hand, the radial dynamic pressure generating groove **23** may be formed on the cylinder portion **17** of the pump housing **15**.

FIG. **5**A is a table listing radial thrusts on the ring-like impeller **11** according to the first embodiment of the invention, whereas FIG. **5**B is an explanatory diagram of the radial thrust on the ring-like impeller according to the first embodiment of the invention. In FIG. **5**B, the arrow F represents the direction of force acting on the ring-like impeller **11**. As shown in FIG. **5**B, the vortex pump has the higher pressure at the area near the outlet port **20** than the pressure at the area near the inlet port **19** and hence, the radial thrust acts in a θ-direction or a direction away from the outlet port **20**. Therefore, the radial thrust can be prevented from bringing the ring-like impeller **11** into contact with the cylinder portion **17** if the thrusting force of the fluid is intensified by forming the radial dynamic pressure generating groove **23** at an A-region (a portion of the cylinder portion **17** of the pump housing **15** that is represented by a thick line in the figure) in such a depth as to provide an increased dynamic pressure. In this case, the radial dynamic pressure generating groove **23** may be formed only on the A-region of the cylinder portion **17** near the outlet port **20** or on the overall circumference. In this manner, a stable operation of the pump is ensured. As apparent from the data listed in FIG. **5**A, the direction of the force on the ring-like impeller **11** varies depending upon the pressure difference between the outlet port **20** and the inlet port **19**. Hence, the range of the A-region may be defined based on the area used.

The pump of contact heat exchanger type **7** has the following advantages. Firstly, the driving portion of the vortex pump includes rotor magnet **13** and motor stator **14** which are separated. The rotor magnet **13** is unified with the ring-like impeller **11**, so that the unified body may be combined with the motor stator **14** to form a flat general structure of the pump. This permits the formation of a flat and wide heat absorbing surface **15***a* on the side surface of the pump. Secondly, the pump of contact heat exchanger type **7** can adequately function as the cooling device because the heat from the heat generating electronic component **3** is transferred to the heat absorbing surface **15***a* where the heat is subjected to turbulent heat exchange at the outer periphery of the pump by way of a spiral flow of the fluid including a local counter flow against the heat transfer direction. Thirdly, the ring-like impeller **11** is perfectly sealed in the fluid by providing the cylinder portion **17** and is maintained afloat within the pump housing **15** in a non-contact fashion thereby minimizing load thereupon. The minimum load leads to a reduced heat generation by the driving portion and an increased cooling capability. Fourthly, the pump of contact heat exchanger type **7** also serves as the cooling device, thus negating the need for the conventional cooling device or for the assembly work for the cooling device. In addition, the mounting of the pump **7** onto the heat generating component **3** does not require an additional cumbersome assembly work or a special structure. The pump **7** only need be securely seated on the heat generating component with its heat absorbing surface contacting the component. This is quite advantageous in terms of the assembly work for the cooling device and costs.

Next, description will be made on the operations of the cooling device of the first embodiment and of the electronic apparatus including the same. When power is supplied from an external power source, current controlled by a semiconductor switching circuit in the pump of contact heat exchanger type **7** flows through a coil of the motor stator **14**, so as to generate a rotating magnetic field. The rotating magnetic field acts on the rotor magnet **13** to produce a physical force therein. Since the rotor magnet **13** is unified with the ring-like impeller **11** rotatably supported by the cylinder portion **17** of the pump housing **15**, the ring-like impeller **11** is subjected to a torque, which causes the impeller **11** to rotate. In conjunction with the rotation of the impeller **11**, the vanes **12** on the outer periphery of the impeller **11** imparts a kinetic energy to the fluid thus introduced from the inlet port **19**. The kinetic energy progressively increases the fluid pressure in the pump housing **15**, so as to discharge the fluid from the outlet port **20**.

In this process, the pumping action of the thrust dynamic pressure generating groove **22** due to the rotation of the impeller **11** thrusts the fluid toward the inside circumference of the thrust dynamic pressure generating groove **22** thereby to produce a thrust dynamic pressure between the opposite sides of the impeller **11** and the thrust plates **18**. This permits the impeller **11** to rotate smoothly as prevented by the fluid film from contacting the thrust plates **18**. On the other hand, the pumping action of the radial dynamic pressure generating groove **23** due to the rotation of the impeller **11** thrusts the fluid toward the axial center of the radial dynamic pressure generating groove **23** thereby to produce a radial dynamic pressure between the inside circumference of the impeller **11** and the cylinder portion **17**. Therefore, the ring-like impeller **11** rotates smoothly as maintained afloat and out of contact with the cylinder portion **17**. The ring-like impeller **11** presents a small rotational inertia and quite favorable response. In addition, the pump itself is notably decreased in weight.

In this state, the pump of contact heat exchanger type **7** smoothly suck in the coolant X. The sucked coolant X is agitated by the impeller **11** in a space enclosed by the pump housing **15** and the housing cover **16**, as shown in FIG. **4**, thereby to form a flow typical of the vortex pump in the pump chamber **15***b* and then discharged as progressively increased in pressure. In this process, the coolant X is involved in a violent turbulent heat exchange with the pump housing **15** and housing cover **16** which are raised in temperature by the heat transferred from the heat generating electronic component **3**. The turbulent heat exchange may be promoted by increasing the surface roughness of an inside wall of the pump chamber **15** by shot blasting, shot peening or the like. This is because the heat transfer area is increased by increasing the surface roughness and because the heat transfer is enhanced by the more violent turbulent flow. For the same reasons, the quantity of heat exchange may be increased by providing a fin **15***c* projecting from the inside wall of the pump chamber **15***b* toward the impeller **11**, as shown in FIG. **6**. The fin **15***c* contributes to the smooth fluid flow in the pump chamber **15***b* as well as to the increased area of heat transfer from the pump housing **15** to the coolant X. FIG. **6** is a sectional view of a principal part for illustrating the flow of coolant in the pump of contact heat exchanger type provided with the fin according to the first embodiment of the invention.

Thus raised in temperature as absorbing the heat from the heat generating component **3** during the turbulent heat exchange, the coolant X is transported to the radiator **8** via the pipe **9**, and cooled by the radiator **8**. After lowered in temperature, the coolant X is returned to the pump **7** via the pipe **9**, repeating these movements in cycles.

The heat released from the radiator **8** is discharged from the second housing **5** whereas the temperature of the interior of the first housing **1** is kept at a constant level. Therefore, there is no fear that the surface temperature of the first housing **1** most frequently touched by a user is raised to cause user discomfort. In this manner, the pump of contact heat exchanger type **7** is capable of maintaining the temperature of the heat generating electronic component **3** within an allowable range by absorbing the heat from the heat generating component **3** by way of circulation of the coolant X.

By virtue of the pump of contact heat exchanger type **7** serving the dual purposes of pump and cooling device, the cooling device of the first embodiment and the electronic apparatus including the same do not require separate provisions of the pump and cooling device, or the pipe for interconnecting the pump and the cooling device, thus accomplishing the reduction of the size and cost of the cooling device. The assembly work for the cooling device is also obviated. Furthermore, the additional cumbersome assembly work or the specific structure is not required for mounting the pump **7** on the heat generating component **3**. The pump **7** can be adequately mounted to place simply by placing it on the component **3** in contacting relation. This is quite advantageous in terms of the assembly of the cooling device and costs.

The pump of contact heat exchanger type **7** is constructed as a ultra-thin vortex pump wherein the vanes **12**, the rotor magnet **13** and a rotary shaft are unified to form the ring-like impeller **11** which receives therein the motor stator **14**. The pump **7** is adapted to subject the coolant to the violent turbulent heat exchange therein, thus achieving the increased cooling efficiency of the cooling device and contributing to the further reduction of thickness and cost of the cooling device.

The pipe **9** is comprised of a tube of a low gas-permeable rubber, thereby maintaining the freedom of pipe layout and providing a long term prevention of the evaporation of the coolant X in the cooling device which will lead to the invasion of a large quantity of gas into the cooling device. In addition, the main body such as a notebook computer can be further downsized by providing the pump of contact heat exchanger type **7** in the first housing **1** and the radiator **8** in the second housing **5**.

Second Embodiment

A cooling device according to a second embodiment of the invention and an electronic apparatus including the same is designed to interconnect a pump of contact heat exchanger type and a radiator by means of a pipe and a pivotal member permitting the second housing to rotate relative to the first housing. The electronic apparatus is a foldable apparatus such as a notebook computer. The pump of contact heat exchanger type is constructed the same way as in the first embodiment. FIG. **7** is a diagram showing a general construction of the electronic apparatus incorporating the cooling device according to the second embodiment of the invention. FIG. **8** is a sectional view showing the pivotal member according to the second embodiment of the invention. FIG. **9** is a sectional view showing the pivotal member of the second embodiment of the invention integrated with a removable snap-in type connector.

Referring to FIG. **7**, the reference numeral **1** represents the first housing; the numeral **2** representing the key board; the numeral **3** representing the heat generating electronic component; the numeral **4** representing the substrate; the numeral **5** representing the second housing; the numeral **6** representing the display unit; the numeral **7** representing the pump of contact heat exchanger type; the numeral **8** representing the radiator; the numeral **8***a* representing the coolant passage; the numeral **8***b* representing the reserve tank; a numeral **9***a* representing a pipe from the pump of contact heat exchanger type; a numeral **9***b* representing a pipe from the radiator **8**. A reference numeral **30** represents the pivotal member disposed in a connection portion between the first housing **1** and the second housing **5** and adapted to pivot in conjunction with the rotation of the second housing **5**. The pivotal member **30** is connected with the pipe **9***a* from the pump of contact heat exchanger type **7** and with the pipe **9***b* from the radiator **8**, respectively.

Next, the pivotal member **30** is described. Referring to FIG. **8**, a reference numeral **31** represents a hollow outer cylinder having one end thereof connected with the pipe and the other end thereof connected with an inner cylinder **32** to be described herein later; a numeral **31***a* representing a notch for slip-off prevention; a numeral **32** representing the hollow inner cylinder inserted in the outer cylinder **31** to be connected therewith; a numeral **32***b* representing a projection inserted in the notch **31***a* for slip-off prevention. The hollow portion defines a passage for the coolant X. A reference numeral **32***a* represents a groove formed in an outer periphery of the inner cylinder **32** whereas a numeral **33** represents an O-ring shaped resilient member interposed between the outer cylinder **31** and the inner cylinder **32** and fitted in the groove **32***a*. The O-ring like resilient member **33** pivotally supports the outer cylinder **31** and the inner cylinder **32** and provides seal between the passages of the outer cylinder **31** and inner cylinder **32** and the outside portion thereby preventing the coolant X through the passages from leaking out. The O-ring like resilient members **33** are disposed in two rows thereby providing a long term prevention of the evaporation of the coolant X in the cooling device which will lead to the invasion of a large quantity of gas into the cooling device. For the purpose of preventing the slip-off of the outer cylinder **31** from the inner cylinder **32**, the projection **32***b* is provided on the inner cylinder **32** whereas the notch **31***a* is formed at the outer cylinder **31**.

Referring to FIG. **9**, a reference numeral **31***b* represents a valve disposed in the outer cylinder **31** of the pivotal member **30**; a numeral **31***c* representing a spring for biasing the valve **31***b*; a numeral **32***c* representing a valve disposed in the inner cylinder **32**; a numeral **32***d* representing a spring for biasing the valve **32***c*. In a state where the outer cylinder **31** and the inner cylinder **32** are separated from each other, the valves **31***b*, **32***b* seal the respective internal passages of the cylinders. When the outer cylinder **31** and the inner cylinder **32** are connected with each other, the respective internal passages thereof are communicated with each other.

Since the construction and operations of the pump of contact heat exchanger type **7** are the same as in the first embodiment, the description thereof is omitted.

Next, description is made on the cooling device according to the second embodiment and the electronic apparatus including the same. The coolant X sucked by the pump of contact heat exchanger type **7** is agitated by the ring-like impeller **11** in the pump **7** and subjected to a violent turbulent heat exchange with the pump housing **15** and housing cover **16** which are raised in temperature by the heat transferred from the heat generating electronic component **3**. As a result, the coolant is raised in temperature. The heated coolant X is transported to the radiator **8** via the pipe **9** and the passages through the pivotal member **30**, and cooled by the radiator **8**. After lowered in temperature, the coolant X is returned to the pump **7** via the pipe **9** and the passages through the pivotal member **30**, repeating these movements in cycles. In this manner, the temperature of the heat generating electronic component **3** is maintained in an allowable range by cooling the heat generating component **3** through circulation of the coolant X.

When the user opens or closes the second housing **5** of the electronic apparatus such as a notebook computer, the second housing **5** rotates about a hinge of the first housing **1** as shown in FIG. **7**. The rotation causes the outer cylinder **31** and inner cylinder **32** of the pivotal member **30** to pivot relative to each other, so that the second housing smoothly rotates. In addition, the pipe **9***a* from the pump **7** in the first housing **1** and the pipe **9***b* from the radiator **8** in the second housing **5** are connected by means of the pivotal member **30** so that the pipes are less susceptible to deformation. Accordingly, the pipes are prevented from obstructing the coolant flow therethrough.

In a case where the pivotal member is integrated with the connector as shown in FIG. **9**, a pump side section and a radiator side section can be separately assembled. The sections may be individually incorporated in the first housing **1** and the second housing **5** to form sub-assemblies for the first housing **1** and second housing **5**. Subsequently, the first and second housings **1**, **5** may be connected with each other. This results in reduced fabrication costs.

According to the second embodiment as described above, the pivotal member provided at the pipe between the first and second housings **1**, **5** provides the smooth rotation of the second housing **5** and also prevents the deformation of the pipe which will lead to the obstruction to the coolant flow through the pipe. The removable snap-in type connector provided at the pipe interconnecting the pump of contact heat exchanger type and the radiator permits the pump side section and the radiator side section to be separately assembled, resulting in the reduced fabrication costs. In addition, the unification of the pivotal member and the connector contributes to the further reduction of size and cost of the main body such as a notebook computer.

According to the cooling device of the embodiment described above, the pump of contact heat exchanger type also serves as the cooling device, thereby negating the need for the separate provisions of the pump and the cooling device and for the pipe interconnecting the pump and the cooling device. This results in the reduction of size and cost of the cooling device as well as in an easy assembly work.

Since the pump of contact heat exchanger type is a vortex pump, the impeller has a small thickness. On the other hand, a side surface extending along a pump flow defines the heat absorbing surface such that the heat transferred externally from the heat generating component may be subjected to the turbulent heat exchange by means of the fluid flow at the outer periphery of the impeller and hence, the component is effectively cooled. Thus, the cooling device can accomplish both the increase of cooling efficiency and the reduction of size and costs.

The pump of contact heat exchanger type is a vortex pump which includes the ring-like impeller with the rotor magnet disposed in its inside circumference, and the pump housing including the cylinder portion interposed between the motor stator and the rotor magnet, the cylinder portion rotatably supporting the impeller. Hence, the motor portion of the pump is free from a projection toward the heat absorbing surface, so that the pump can be formed as an ultra thin type. Furthermore, the transferred heat is subjected to the violent turbulent heat exchange with the coolant at the outer periphery of the impeller. Thus, the cooling device can accomplish both the increase of the cooling efficiency and the further reduction of thickness and costs thereof.

Since the heat absorbing surface is defined by the overall side surface of the pump housing, the heat absorbing surface can advantageously occupy the maximum available area of the pump housing. The flat heat absorbing surface permits the mounting of the pump on a substrate with a flat top surface. The motor stator may be molded of a molding material thereby promoting the heat transfer and making the motor stator watertight.

The electronic apparatus is constructed such that the second housing is rotatably attached to the first housing and is provided with the cooling device for cooling the heat generating electronic component including the CPU. Thus, the electronic apparatus including the first housing with the key board and the second housing with the display unit is adapted to for cooling, so that the main body of the electronic apparatus can be further downsized.

The pump of contact heat exchanger type is mounted on the top surface of the central processing unit with its heat absorbing surface contacting the top surface whereas the radiator is disposed on the back side of the display unit in the second housing. Thus, a further downsizing of the main body of the electronic apparatus is achieved by the arrangement wherein the first housing contains therein the pump of contact heat exchanger type and the second housing contains therein the radiator.

Next, a mounting structure of the heat generating electronic component **3** and pump of contact heat exchanger type **7** will be described with reference to FIGS. **13** to **37**. In FIGS. **13** to **36**, the arrow K represents the location of the key board **2**, and the arrow B represents the location of the bottom of the first housing **1**.

In a case where the heat generating component **3** is disposed on a key-board **2** side surface of a circuit board **200** as shown in FIG. **13**, the circuit board **200**, heat electronic generating component **3** and pump of contact heat exchanger type **7** are stacked on top of each other in the named order from a bottom of the first housing **1** toward the key board **2**. An embodiment of FIG. **13** illustrates a case where the heat generating component **3** and the pump **7** have substantially equal physical sizes. Therefore, the heat generating component **3** does not protrude from the pump **7** or vice versa. Such an arrangement ensures that the heat generating component **3** positively transfers the heat produced by the heat generating component **3** to the pump of contact heat exchanger type **7**. Incidentally, the pump **7** and the heat generating component **3** are secured to each other by means of a fixing jig or adhesive normally used.

A different embodiment from that of FIG. **13** is shown in FIG. **14**, wherein an adhesion member **201**, such as silicone grease, having fluidity and a good heat conductivity is applied between the heat generating component **3** and the pump **7**, thereby further increasing a heat dissipating effect. If the pump **7** is directly placed on the heat generating component **3** as shown in FIG. **13**, there is formed a minor air layer therebetween, which entails a problem such as interference of the heat transfer from the heat generating component **3** to the pump **7**. However, as shown in FIG. **14**, the provision of the adhesion member **201** prevents the formation of a low heat-conduction portion, such as the air layer, between the heat generating component **3** and the pump **7**.

Another different embodiment from that of FIG. **13** is shown in FIG. **15**, wherein a conductive member **202** of a high heat conductivity is interposed between the heat generating component **3** and the pump **7**, for smoothly transferring the heat produced by the heat generating component **3** to the overall area of the heat absorbing surface of the pump **7**. This results in an increased cooling capability. In a case where the heat generating component **3** is a semiconductor device such as an IC, in particular, the semiconductor device is raised in temperature particularly at its center. The conductive member **202** expedites the transfer of a large quantity of heat produced at the center of the semiconductor device to the overall area of the heat absorbing surface of the pump **7**. Specific examples of the conductive member **202** include a plate member and a sheet member such as formed of copper or copper alloy, and a thin film of copper or copper alloy which is formed on the heat absorbing surface of the pump **7** by sputtering, vapor deposition, plating or the like. Examples of the material for the conductive member include copper, copper alloy and other materials having good heat conductivities. Alternatively, a heat pipe or the like may be used as the conductive member **202**.

Furthermore, the conductive member **202** serves to transfer the heat at least to place or its vicinity corresponding to an area of the pump **7**, such as the pump chamber **15***b*, where the coolant flows, thereby dramatically increasing the cooling efficiency.

Yet another different embodiment from that shown in FIG. **13** is shown in FIG. **16**, wherein an adhesion member **203** (the same material as that of the adhesion member **201**), the conductive member **202** and the adhesion member **201**, in the named order from the heat generating component **3**, are disposed between the heat generating component **3** and the pump of contact heat exchanger type **7**. Such an arrangement can achieve an extremely high cooling efficiency because the conductive member **202** efficiently propagates the heat from the heat generating component **3** while the adhesion members **203**, **201** between the respective pairs of the conductive member **202** and heat generating component **3** and of the conductive member **203** and pump **7** prevent the formation of the low heat-conduction portion such as the air layer. It is noted that a high cooling capability can be achieved if either one of the adhesion members **201**, **203** is omitted.

FIGS. **17** to **20** show respective modifications of the embodiments of FIGS. **13** to **16**. The embodiments of FIGS. **17** to **20** differ from those of FIGS. **13** to **16** in that the pump of contact heat exchanger type **7** protrudes from an outer edge of the heat generating component **3**. According to the embodiments of FIGS. **17** to **20**, the pump **7** can assuredly cover the substantially entire contact surface of the heat generating component **3** if the pump is more or less shifted from the mounting position. This negates the need for setting high mounting precisions for the pump **7** and hence, a decreased mounting time and an increased productivity result.

FIGS. **21** to **24** show respective modifications of the embodiments of FIGS. **13** to **16**. The embodiments of FIGS. **21** to **24** differ from those of FIGS. **13** to **16** in that the electronic component **3** protrudes from an outer edge of the pump **7**. These embodiments permit the pump **7** to be selectively mounted to a particular place of the heat generating component **3** that produces a particularly large quantity of heat. The embodiments have another advantage that the pump **7** can assuredly bring the substantially entire heat absorbing surface thereof into contact with the heat generating component **3** if the pump is more or less shifted from the mounting position. This negates the need for setting high mounting precisions for the pump **7** and hence, a decreased mounting time and an increased productivity result.

FIGS. **25** to **36** show respective modifications of the embodiments of FIGS. **13** to **24** and differ therefrom in that at least the heat generating component **3** and the pump **7** are disposed on a side of the circuit board **200** opposite from the key board **2**. Since the embodiments of FIGS. **25** to **36** have the same constructions and effects as the embodiments of FIGS. **13** to **24** except for the mounting surface of the circuit board **200** and hence, the description thereof is omitted.

FIG. **37** shows another embodiment. Although the embodiments of FIGS. **13** to **36** have the arrangement wherein the pump **7** is adapted to cool only one electronic component, the pump may be designed to cool a plurality of electronic components as shown in FIG. **37**. In this case, the key board **2** may be located on either side.

As shown in FIG. **1**, the coolant passage is extended in an area other than a space between the pump **7** and the heat generating component **3**, thereby negating the need for providing a wide space between the pump **7** and the heat generating component **3**. This permits the slim design of the apparatus. Where the coolant passage is extended between the pump **7** and the heat generating component **3**, the reduction of flow resistance dictates the need for the wide space between the pump **7** and the heat generating component **3** and hence, the realization of the slim design is impracticable.

Third Embodiment

The internal configuration of a centrifugal pump **300** of the third exemplary embodiment is now described with reference to FIGS. **38** through **42**B. An open-type impeller **301** of the centrifugal pump has a through-hole **301***a* formed therein and open vanes **302**. A magnet rotor **303** is provided along an outer periphery of the impeller **301**. A stator **304** is provided inside of the magnet rotor **303**. A housing **305** of the pump accommodates the impeller **301**, and restores a pressure of kinetic energy given by the impeller **301** to fluid, thus guiding the fluid to an outlet port linked to an outlet passage **310**. The housing **305** has a heat-generating electronic component **400** attached thereto, such as an IC, an LSI, or an MPU.

A pump chamber **305***a* restores a pressure of kinetic energy given by the vanes **302**, thus guiding the fluid to the outlet port. A heat-absorbing surface **305***b* is provided on a side face of the housing **305** along the pump chamber **305***a*. The heat-absorbing surface deprives the heat-generating electronic component **400** of heat through direct or indirect contact. The pump chamber **305***a* has a inner surface **305***c*. The housing **305** accommodates the impeller **301**, and a housing cover **306** seals the pump chamber **305***a*. A fixed shaft **307** provided in the housing **305** rotatably supports the impeller **301**. A bearing **308** is provided at the center of the impeller **301** installed over the fixed shaft **307**. The bearing **308**, when embodied as a fluid bearing, has dynamic pressure generating grooves **308***a* (see, FIG. **40**). The pump **300** includes a water inlet **309***a* through which coolant is put in the pump chamber **305***a*, and an inlet passage **309** for introducing the coolant to the inlet port **305***a*. Plural recesses **311** are formed on the inner surface **305***c* of the pump chamber. Elastic strip-like brushes **312** scrape a boundary area of laminar flow on the inner surface **305***c* of the pump chamber. Similarly, elastic strip-like blades **313** scrape a boundary area of laminar flow on the inner surface **305***c* of the pump chamber.

The housing cover **306** and the housing **305** form a pump housing of the centrifugal pump **300**. The housing **305** is made of highly heat-conductive and heat-dissipating material, i.e., at least one of copper, copper alloys, aluminum, aluminum alloys. The housing cover **306** may be made of the same material. Alternatively, the housing **305** may have a hybrid structure in which its central portion is made of copper or copper alloys, and the other portion is made of other materials, such as aluminum of aluminum alloys. The centrifugal pump of the third embodiment has a thickness of 8 to 12 mm in a direction of a rotary axis, a characteristic radial length of 25 to 60 mm, a speed of rotation of 2,000 to 3,500 rpm, a flow rate of 0.1 to 0.5 L/min, and a head of 0.2 to 0.8 m. The pump is specified as a thickness of 5 to 20 mm in thickness, a characteristic radial length of 10 to 70 mm in, a flow rate of 0.05 to 1 L/min; a head of 0.1 to 2 m. Thus the pump has a specific rate of 40 to 100 (m, m^3/min., rpm) and is much smaller than a conventional pump.

In the centrifugal pump **300**, the impeller **301** and vanes **302** face a heat-generating electronic component **400**. The heat-absorbing surface **305***b* has a shape corresponding to a shape of the top surface of the heat-generating electronic component **400**. This construction allows the pump chamber **305***a* to directly receive heat via the heat-absorbing surface **305***b*. The stator **304** is mounted by press-fitting to the housing cover **306**. The inner surface of the magnet rotor faces the outer peripheral portion of the stator **304**.

The housing cover **306** is disposed between the stator **304** and the magnet rotor **303** as a separator for separating the stator and the rotor. Thus, the stator **304** is completely separated from a flow of coolant in the pump chamber **305***a*. According to the third embodiment, the impeller **301** and the magnet rotor **303** are unitarily formed by magnetizing a cylinder portion of the impeller forming the magnet rotor **303**, however, the impeller may be separated from the magnet rotor. The rotating magnetic field generated by the stator **304** rotates the magnet rotor **303**, thereby rotating the impeller **301**. The rotation of the impeller **301** generates a negative pressure near the center of the impeller **301**. The negative pressure causes the coolant to be sucked through the inlet passage **309** communicating with the impeller. The impeller **301** gives a kinetic momentum to the coolant for discharging it to the outside. The coolant is discharged into a coolant circuit provided at the outside of the pump **300** through the outlet port (not shown) provided in the outer peripheral portion of the impeller **301** through the outlet passage **310**.

A bearing **308** made of low-frictional and wear-resistant ceramics is press-fitted to the center of the impeller **301**. In the bearing **308**, a fixed shaft **307** made of ceramics has one end fixed to the housing **305** and the other end fixed to the housing cover **306**. As shown in FIG. **38**, a portion of the peripheral surface of the bearing **308** is cut to provide a gap between the shaft and a hole in which the bearing of the impeller **301** is press-fitted. The gap serves as the through-hole **301***a* displaced from the center of the shaft, and links one side of the impeller **301** at which vanes **302** are provided to another side of the impeller oppose to the one side. The through-hole **301***a* causes a portion of the coolant subjected to the centrifugal force given by the impeller **301** to enter into the back side of the impeller **301**. The coolant at the back side of the impeller flows into the inlet **309***a* in the impeller under negative pressure through the through-hole **301***a*. In other words, a portion of the coolant is circulated in the centrifugal pump **300**. The circulated coolant is mixed at the inlet **309***a* and is interchanged.

The centrifugal force caused by the impeller **301** provides a negative pressure in the vicinity of the center of the impeller **301**, and thus, cavitation is likely to occur there in which a bubble is generated. However, the centrifugal pump **300** of the third embodiment has a specific rate of approximately 40 to 100 (m, m^3/min., rpm), thus hardly generating a bubble. Even if being generated, the bubble is discharged since the coolant is mixed by the circulation. The bubble does not stay near the center of the impeller **301** since circulating coolant is interchanged between another side of the impeller **301** and a side to the inlet **309***a*. Even when air is mixed in the cooling device and is sucked into the centrifugal pump **300**, the circulating coolant prevents air near the center of the impeller **301** and discharges the bubbles gradually. As a result, in the pump of the third embodiment, the cavitation causes little noise, and no air layers are formed. Moreover, because of the formation of turbulent flow, the coolant transfers a large amount of heat.

It is noted that instead of the bearing **308**, a fluid bearing as shown in FIG. **40** may be used. The fluid bearing may have dynamic-pressure-generating grooves **308***a* formed spirally thereon for promoting the circulation, and the grooves improve the performance of discharging a bubble. The dynamic-pressure-generating grooves **308***a* may have a herringbone or other shapes. The impeller may have grooves formed on the back face thereof for adjusting the circulation quantity and the pressure from the back face. These grooves create a thrust in the axial direction of the impeller **301**.

Additionally, as shown in FIG. **41**, plural recesses **311** are formed in at least a portion of the pump chamber inner wall **305***c* on the back face of the heat-absorbing surface **305***b* where impeller **301** slide. The recesses separate the boundary layer of flow where the coolant moved by the rotation of the impeller **301** forms along the pump chamber inner wall **305***c*, thus making the coolant turbulent. This turbulent flow increases the amount of heat transferred from the heat-absorbing surface **305***b* to the coolant. Similarly, the pump chamber inner wall **305***c* may have asperities or roughing at its surface formed by shot peening, sand blasting, or other method can improve heat-absorbing efficiency according to a similar principle. Further, as shown in FIG. **42**, brushes **312** or thin plate-like blades **313** attached not only to vanes **302** but also to the impeller in sliding contact with the pump chamber inner wall **305***c* break the boundary layer of flow with a rotating force of the impeller **301**, thus improving the heat-absorbing efficiency. Although not shown, spiral grooves formed on the pump chamber inner wall **305***c* makes the coolant form turbulent flow and increases the amount of heat transferred.

In cases that a heat transfer factor from the housing to the coolant is sufficiently large in comparison with heat generated, and that a large amount of heat can be transferred, the heat does not have to be spread along the pump chamber **305***a*. In such cases, the thickness of the heat-absorbing surface **305***b* of the housing **305** may be reduced for improve the heat-absorbing efficiency, and thus the pump can be thinner. For this purpose, the inlet passage **309** preferably has a section shaped like an ellipse having a minor axis in the direction of the thickness of the housing, as shown in FIG. **43**. In order to increase a heat transferring area and to not prevent the impeller **301** from rotating, the pump chamber inner wall **305***c* may be provided with protrusions, such as protruding small columns and ribs, in at least a portion of the wall **305***c* where the side faces of the impeller **301** slide. The protrusions increase the heat transferring area, and allows the coolant to form more turbulent flow, thus increasing the amount of absorbed heat. The protrusions formed near the center of a heat-generating electronic component **400** increase the heat-absorbing efficiency. If the center of the heat-generating electronic component is disposed at the center of the shaft of the impeller **301**, the protrusions may be provided near the center of the shaft of the impeller **301**.

According to the third embodiment, coolant having a relatively low temperature that has been cooled in the coolant circuit at the outside of the pump **300** is supplied substantially to the central portion of the centrifugal pump **300** through the inlet passage **309**. This arrangement provides the pump chamber **305***a* with a large area of the heat-absorbing surface **305***b*. Further, since the coolant is supplied to the pump chamber **305***a* as described above, the heat absorbed through the large area of the heat-absorbing surface **305***b* is transferred to the coolant. Thus, the resulting cooling efficiency is extremely high.

Further, the inlet passage **309** communicates substantially to the central portion of the centrifugal pump **300**. The cooled coolant is first supplied substantially to the central portion of the centrifugal pump **300**. Therefore, the centrifugal pump **300**, upon being mounted on a heat-generating electronic component **400**, the central portion of the centrifugal pump **300** to which the coolant is supplied is opposed substantially to the central portion of the heat-generating electronic component **400** having a temperature relatively higher than other portions. This arrangement improves the efficiency of cooling the heat-generating electronic component **400**.

As described above, according to the third embodiment, the inlet passage **309** is provided between the pump chamber **305***a* and the heat-absorbing surface **305***b*. This construction allows the coolant to absorb the heat received by the heat-absorbing surface **305** even when the coolant flows through the inlet passage **309**, thus further improving the cooling efficiency.

As described above, the centrifugal pump **300** of a cooling device of the third embodiment includes a housing **305** made of highly-heat-conductive material, and an open type impeller **301** having open vanes **302** formed thereon. Respective shapes of a heat-absorbing surface **305***b* and the top surface of a heat-generating electronic component **400** are three-dimensionally complementary to each other. Disposed between the heat-absorbing surface **305***b* and a pump chamber inner wall **305***c* (thick portion of the housing **305**) is an inlet passage **309** having a section of an ellipse having a minor axis in the direction of the thickness. This configuration reduces the thickness of the housing near the passage, thus decreasing the temperature at the heat-absorbing surface **305***b* near the inlet passage **309**. The inlet passage **309** does not protrude towards the heat-generating electronic component **400**, and thus the shape of the heat-absorbing surface **305***b* is not influenced by the shape of the centrifugal pump **300**. Intimate contact between the heat-absorbing surface **305***b* and the top surface of the heat-generating electronic component **400** enables the heat-absorbing surface **305***b* to effectively absorb heat.

Fourth Embodiment

A centrifugal pump according to a fourth exemplary embodiment is characterized in that a water inlet thereof is disposed on a back face of an impeller. Elements similar to those in the third embodiment are denoted by the same reference numerals, and the detailed descriptions of these elements are omitted.

With reference to FIG. **44**, a water inlet **309***b* in communication with an inlet passage **309** is provided near the center of an impeller **301** for providing communication between the back face and the side of a pump chamber **305***a*. The water inlet **309***b* consists of three through-holes located at the same radial from the center of the impeller by an equal interval, as shown in FIG. **45**. The inlet passage **309** is provided at the center of a stator **304** in the housing cover **306** and in communication with water inlet **309***b*. A fixed shaft **307** and a bearing **308** are provided in a manner of the third embodiment.

The water inlet **309***b* of this embodiment consists of the three through-holes having circular cross-sections disposed at regular intervals. However, the number of the holes is not limited to three, and each of the holes may have a circular or square cross-section or can be shaped like a slot having an arc cross-section. The number of the through-holes is preferably thirty or less in consideration of production of the impeller. Too many through-holes or large slots weakens the impeller itself. For this reason, the number of the through-holes are preferable thirty or less. The holes, upon having slot shapes, is preferably placed around the shaft at an angle of 180° or less.

Since the inlet passage **309** is placed on the side opposite to a heat-absorbing surface **305***b*, the thickness of a pump housing **305** at the side of the heat-absorbing surface **305***b* can be reduced. Thus, the heat transfer factor from the housing **305** to the coolant is sufficiently large in comparison with an amount of the heat generated. If a large amount of heat can be transferred, the heat is not necessarily transferred along the pump chamber **305***a*, and thus, the heat-absorbing efficiency can be increased. Additionally, the water inlet **309***b* provided near the center of the impeller **301** allows the coolant to be sucked from the back face of the impeller **301**.

As shown in FIGS. **46**A and **46**B, the pump may include no fixed shaft and suck coolant from the back face of an impeller **301**. In FIG. **46**A, a cylinder portion **306***b* is provided at the center of a housing cover **306***a*, and an inlet passage **309** is provided in this portion. A short rotating shaft **307***a* is provided at the center of the impeller **301**. A bearing **308***b* is provided in the cylinder portion **306***b*. The short rotating shaft **307***b* is inserted into the bearing for supporting the shaft. An inlet **309***c* consists of a through-hole formed around the center of the shaft of the impeller **301**. Protrusions **314**, such as columns and ribs, are provided on the center of a pump chamber inner wall **305***c* opposed to the inlet **309***c* (see FIG. **47**).

According to the fourth embodiment, the protrusions **314** are shaped like columns. However, the shapes of the protrusions are not limited to the column, and may be shaped in a prism, cone, pyramid, truncated cone or pyramid, hemisphere, and semi-ellipse. In FIG. **46**B, protrusions **301***c* are provided on the inlet side of vanes **302** or between the vanes **302**.

As described above, the inlet **309***c* provides communication between an inlet passage **309** on the back face and a pump chamber **305***a*. This arrangement allows the coolant to be sucked from the back face of the impeller **301**. In addition to the suction of the coolant from the side opposite to a heat-generating electronic component **400**, a jet effect of directly jetting the coolant onto a pump chamber inner wall **305***c* provides high-efficient heat absorption.

Additionally, the protrusions **314** provided on the pump chamber inner wall **305***c* increase the heat-absorbing area, thus drastically increasing the amount of absorbed heat. The protrusions **314** can generate turbulent flow at the pump chamber inner wall **305***c*, thus further increasing the heat-absorbing efficiency. Since the vanes **302** do not exist in the central portion of the impeller **301**, the protrusions **314** can be provided easily in this portion. The center of a heat-generating electronic component **400** is often placed at the center of the impeller **301** in consideration of balance. For this reason, the protrusions **314** provided in this portion locally improve the heat-absorbing efficiency. In other words, a portion of the heat-generating electronic component **400** near the center of the impeller **301** for sucking the coolant has the highest temperature, and a difference between respective temperatures of the component and the coolant is largest; and thus, the amount of heat transfer can be increased. Additionally, the protrusions **314** provided in this portion increases the heat transfer area and reduces the heat resistance, thus transferring the heat. Further, the jet effect of the coolant improves the heat-absorbing efficiency. The protrusions **314** allow the coolant to generate turbulent flow, thereby further improving the heat-absorbing efficiency. Instead of the protrusions **314**, grooves formed in the same portion provides the similar effects.

Further, as shown in FIG. **46**B, the protrusions **314** are preferably provided at the inlet side of the vanes **302** in the pump chamber **305***a*, and the protrusions **301***c* may preferably be provided on the impeller **301** in positions that allows radial engagement of the protrusions **314** and **301***c*. It is desirable to dispose the protrusions **301***c* spirally. In order to avoid actual contact between the protrusions **314** and **301***c*, the protrusions **314** must be radially displaced from the protrusions **301***c* so that they are opposed but are not placed on the same concentric circles. An agitation action caused by the protrusions **301***c* on the impeller **301** and the protrusions **314** generates the turbulent flow of the coolant on the inlet side of the vanes **302**. Further, the heat dissipation area increased by the protrusions **314** remarkably improves the heat-absorption efficiency. According to experiments, a heat transfer coefficient obtained at a speed of rotation of 3,000 rpm is approx. 6,000 W/m^2K, at which the largest amount of heat can be dissipated from the heat-absorbing surface **305***b* to the coolant.

If an area where the heat-generating electronic component **400** contacts the pump housing is smaller than the area where the vanes **302** rotate and the received heat must be spread throughout the side face along the pump chamber **305***a*, a pump chamber inner wall **305***c* having a raised central portion shown FIG. **48** contributes to improvement in the heat-absorbing efficiency more than a thin housing. In FIG. **48**, as for a pump chamber inner wall **305***d*, the thickness of the housing **305** radially decreases from the center of the shaft of an impeller **301**. Heat flux is likely to flow in portions having a smaller heat resistance. For example, such portions have a large sectional area through which the heat flux passes, or larger heat conductivity. Therefore, on the pump chamber inner wall **305***d* having a radially decreasing thickness, heat can be spread to the side face along the pump chamber **305***a*.

In each pump shown in FIGS. **46**A and **46**B, the grooves of herringbone or other shapes formed on the inner and outer peripheral surfaces of the magnet rotor **303**, and the surface of the impeller **301**, allow the dynamic pressure of the fluid to hold the impeller **301**. Further, the impeller **301** is rotatably supported between the bearing **308***b* of the cylinder portion **306***b* in the housing cover **306***a* and the short rotating shaft **307***a* provided at the center of the impeller **301**. Therefore, such simple construction can ensure smooth and stable rotation of the impeller **301** and promote heat transfer.

Fifth Embodiment

A centrifugal pump of a fifth exemplary embodiment includes a disk-like impeller **301**, and the impeller **301** is magnetized. Specifically, with reference to FIG. **49**, the back face of the impeller **301** is magnetized to provide a magnet **301***b*. The magnet **301***b* may be independent of the impeller **301** and formed by attaching a plate-like magnet to the impeller. Further, similarly to the third and fourth embodiments, in order to improve heat-absorbing efficiency, recesses and columns are formed at a pump chamber wall **305***c*. Additionally, brushes and blades can be provided on the impeller **301**, or the thickness of the central portion of the housing can be increased.

As described above, the centrifugal pump **300** of the fifth embodiment is thin in the axial direction. Thus, the centrifugal pump can be mounted in small portable electronic equipment, such as a notebook computer, so as to allow a heat-generating electronic component **400** to be effectively cooled.

According to the third through fifth embodiments, the centrifugal pump **300** is preferably used. However, an axial flow type impeller can be used. As long as the above effects can be obtained, an impeller of another shape can be used.

The pumps according to the third through fifth embodiments are installed as shown in FIGS. **13** through **37**. In other words, the pumps shown in FIGS. **13** through **37** can be replaced with those shown in the third through fifth embodiments.

According to the third through fifth embodiments, the area of the bearing portion, for example, a bearing portion **500** of FIG. **38**, i.e. the center of rotation of the impeller **301** is preferably no more than 100 mm^2. If the area of the bearing portion **500** exceeds 100 mm^2, the pump chamber **305***a* is not placed in the central portion of the centrifugal pump **300**, at which absorption of the heat is most desirable. This deteriorates cooling efficiency. Further, the pump does not need to include the bearing portion **500** most preferably. However, if the pump needs the bearing portion **500**, the area of the bearing portion **500** is preferably at least 0.5 mm^2 because of the strength thereof. In this case, the pump chamber **305***a* exists around the bearing portion **500**.

Sixth Embodiment

FIG. **50** is a perspective view of an electronic apparatus including a cooling device according to a sixth embodiment of the present invention. FIG. **51** is a cross sectional view of a centrifugal pump of the cooling device of the embodiment. FIG. **52**A is a front view of a lower case of the centrifugal pump. FIG. **52**B is a cross sectional view of the lower case shown in FIG. **52**A. FIG. **52**C is a side view of the lower case shown in FIG. **52**A.

A notebook computer, the electronic apparatus, includes a case **501**, a keyboard **502**, a heat-generating electronic component **504**, such as a CPU, which is a chip component having a flat upper side, a cooling device **508**, and a display **509**. The cooling device **508** includes a centrifugal pump **503** of contact-heat-exchanging type for exchanging heat while contacting the heat-generating electronic component **504**, a radiator **506** mounted beyond the display **509** for radiating the heat received through coolant from the heat-generating electronic component **504**, and a circulating passage **507** for circulating the coolant between the centrifugal pump **503** and the radiator **506**. The coolant may be propylene glycol water solution and preferably doped with anti-corrosion agent since material of cases contains copper as will be described later.

The radiator **506** is made of thin sheet of highly-radiative, thermally-conductive material, such as copper or aluminum, and includes a reservoir tank and a passage provided therein for the coolant. The cooling device **508** may include a fan for forcibly air-cooling the radiator **506**. The circulating passage **507** is made of flexible, less gas-permeable rubber tube, such as butyl rubber tube, for being arranged flexibly.

Internal arrangement of the centrifugal pump **503** will be described, referring to FIG. **51**. The centrifugal pump **503** includes an open-type impeller **511** having vanes **512** thereon and a magnet rotor **513** provided at an inner surface along the circumference of the impeller **511**. The impeller **511** may be separated from the magnet rotor **513**, and arranged integral with the magnet rotor **513** to have a portion of the impeller **511** magnetized. The centrifugal pump according to the sixth embodiment has an overall thickness ranging from 3 mm to 20 mm, a typical radial width raging from 10 mm to 70 mm, a number of revolutions ranging from 600 rpm to 4000 rpm, a flow ranging from 0.01 L/min to 1.5 L/min, a pressure head of 0.1 m to 2 m, and a specific velocity of 12 to 200 (m, m^3/min, rpm).

A stator **514** is provided at an inner side of the magnetic rotor **513**. The impeller **511** is accommodated in an upper case **515** which has an outlet port provided therein for discharging the coolant which has a pressure recovered and kinetically energized by the impeller **511**. More particularly, the coolant kinetically energized, i.e., pressurized by the vanes **512** of the impeller **511** in a pump chamber **515***a* is discharged from the outlet port. The upper case **515** has a step portion **515***b* thereof engaging and positioning the upper and side surfaces at a cylindrical portion **516***a* of the lower case **516** (See FIGS. **52**A–**52**C). An annular fitting portion **515***c* is engaged to a side surface of the cylindrical thick portion **516***a* and has its lower end contacting an upper surface of a flange **522**. The upper case **515** has a sealing portion **515***d* thereof for covering a groove **519***b* provided in the lower case **516** from above to define an inlet passage **519**. The upper case **515** of the pump chamber **515***a* having the impeller **511** accommodated therein seals the lower case **516**. A lower surface **516***b* of the lower case **516** opposite to the pump chamber **515***a* contacts the heat-generating electronic component **504**. The impeller **511** is pivotably mounted to the upper case **515** with a stationary shaft **517**. More specifically, the impeller **511** is fitted at the center by a bearing **518** to the stationary shaft **517**. This arrangement allows the coolant introduced from an inlet port **519***a* to flow to the pump chamber **515***a* from the inlet passage **519** extending in a radial direction of the impeller **511**. An outlet passage for discharging the coolant from the pump chamber **151***a* extends from the pump chamber **515***a* in parallel with the inlet passage **519** and in the radial direction of the impeller **511**. According to the sixth embodiment, the outlet passage is provided in parallel with the inlet passage **519** for reducing the overall size of the cooling device and allowing the characteristics of the pump to remain not declined. The location and arrangement of the outlet passage is not limited to that of the sixth embodiment. The lower surface (contact surface) **516***a* of the lower case **516** preferably has a shape matching with a shape of the upper surface of the heat-generating electronic component **4** so as to assure that the surfaces contact each other sufficiently. A CPU, the heat-generating electronic component **4**, often has a flat upper surface which contacts the flat lower contact surface **516***a* according to the sixth embodiment.

A control circuit board **520** drives the magnetic rotor **513** in relation to the stator **514** which both compose a DC brushless motor. The lower case **516** has a shaft supporter **521** thereof provided upright in the inlet port **519***a* and has a pit **521***a* for accepting the stationary shaft **517**. The flange portion **522** is provided at an annular shape along the circumference of the lower case **516** and has a uniform thickness. The upper case **515** and the lower case **516** may be joined and tightened to each other by tightening members **523**, such as screws. A sealing member **524** seals between the upper case **515** and the lower case **516**.

FIGS. **52**A to **52**C illustrate details of the lower case **516**. The pump chamber **515***b* is defined by the cylindrical thick portion **516***a* of the lower case **516** together with the flange **522** and the inner surfaces of the upper case **515**. The lower case **516** has a diameter slightly greater than that of the impeller **511** and is fitted into the fitting portion **515***c* of the upper case **515**. The groove **519***b* provided in the lower case **516** is covered with the sealing portion **515***b* of the upper case **515** to define the inlet passage **519**. The tightening members **523** are inserted into holes **522***a* provided in the flange **522** for tightening. The sealing portion **515***d* of the upper case **515** shuts a portion of the groove **519***b* so as to serve as a partition between the pump chamber **515***a* and the inlet passage **519**.

According to the sixth embodiment, the upper surface **516***c* of the cylindrical thick portion **516***a* engages directly with the step portion **515***b* of the upper case **515** to determine a depth at which the lower case **516** is inserted and positioned. The positioning of the lower case **516** is not limited to this. The position of the lower case **516** may be determined by the flange **522** engaging directly the lower surface **515***e* of the fitting portion **515***c* of the upper case **515** which does not have the step portion **515***b*. The lower case **516** is made entirely of metallic material according to the sixth embodiment, however may have partly a metallic portion located and sized to match the heat-generating electronic component **4** for optimum transfer of heat.

A method for assembling the centrifugal pump **503** according to the sixth embodiment will be described. The stator **514** and the stationary shaft **517** are mounted to the upper case **515**. The bearing **518** is mounted to the stationary shaft **517**, and then, the impeller **511** having the magnet rotor **513** mounted thereon is fitted into the bearing **518**. The cylindrical thick portion **516***a* of the lower case **516** is fitted to the upper case **515** so that the sealing portion **515***d* covers the groove **519***b* at a predetermined position to define the inlet passage **519**. The upper case **515** and the lower case **516** are then joined and tightened to each other with the tightening members **523**.

The centrifugal pump **503** is mounted so that the contact surface **516***b* of the lower case **516** contacts the heat-generating electronic component **4**. Heat from the heat-generating electronic component **4** is transferred to the lower case **516** and is transferred to the coolant in the pump chamber **515***a*. Coolant having temperature raised with the heat is discharged from the centrifugal pump **503** by the impeller **511** rotating, and the heat is released from the radiator **6** to air. The coolant cooled down returns back along the inlet passage **519** to the pump **503**.

According to the sixth embodiment, thc lower case **516** is made of highly radiative, thermally conductive metallic material while the upper pump case **515** is made of resin material, such as poly-phenylene sulfide (PPS) or poly-phenylene ether (PPE), as a single piece. The metallic material of the lower case **516** may preferably be copper. The resin material of the upper case **515** may preferably be poly-phenylene sulfide because of its physical strength and its resistance to heat. Upon the lower case **516** being made of copper, the coolant may preferably be doped with anti-corrosive agent. Both the upper case **515** and the lower case **516** may be made of metallic material to have simply large transfer and radiation of heat. However, the metallic material allows an eddy current to be generated across both the cases **515** and **516** due to an operation of the magnet rotor **513**, and decreases an operating efficiency of the motor. For avoiding the above drawback, the upper case **515** of the pump **503** according to the sixth embodiment, not affecting the transfer of heat, is made of resin material. More particularly, a rotation of the magnet rotor **513** across a magnetic field of the stator **514** generates a magnetic flux passing through the cases **515** and **516** and changing with time. The eddy current is thus developed in a direction to interrupt the change in the magnetic flux throughout the cases **515** and **516**, thus creating a resultant eddy current loss. The upper case **515** of the pump **503** according to the sixth embodiment is made of resin material in order to suppress declination of the operating efficiency of the motor even when the eddy cunent is generated in the lower ease **516** made of copper to provide an inevitable resultant loss. The resin material prevents heat from being radiated and prevents drop of operating efficiency of the motor.

The upper case **515** and the lower case **516** of the pump **503** are made of the resin material and the metallic material, respectively, and produce a difference between thermal expansion coefficients of the cases during the transfer of heat. Metallic material generally has a thermal expansion coefficient greater than that of resin material. If the upper case **515** does not have the fitting portion **515***c*, stresses caused by the difference of thermal expansion is applied intensively to the tightening members **523** and loosens the members **523**. This reduces effect of the sealing between the cases **515** and **516**. The upper case **515** according to the sixth embodiment has the fitting portion **515***c* thereof located at a side of the cylindrical thick portion **516***a* of the lower case **516**. This arrangement allows the fitting portion **515***c* to be close to the cylindrical thick portion **516***a* while being urged by the cylindrical thick portion **516***a* which thermally expands when a temperature increases. Accordingly, the tightening members **523** remain free from any unwanted stress, hence permitting no leakage of the coolant. The fitting portion **515***c* has an inner surface receiving a thermal expansion stress substantially uniformly along a height direction from the cylindrical thick portion **516***a*. This prevents the tightening members **523** from being loosened to develop an air gap, and thus reduce an area where the contact surface **516***b* contact the heat-generating electronic component **4**, hence ensuring the transfer of heat.

The upper case **515** has an intricate shape, providing the pump chamber **515***a* and the sealing portion **515***d* provided in its interior, and it is difficult to process the metallic material to provide the case **515**. The upper case **515** according to the sixth embodiment is made of the resin material and can thus be processed easily. Since the centrifugal pump **503** intakes the coolant from below the pump chamber **515***a*, the inlet passage **519** is provided towards the lower case **516**. Further, connection ports are necessary for connecting with external conduits, its difficult to process the upper case **515**. According to the sixth embodiment, the inlet passage **519** is defined by the groove **519***b* in the lower case **516** and the sealing portion **515***b* of the upper case **515**. This structure allows the upper case **515** and the lower case **516** to be fabricated separately as two pieces. In order to reduce a size or a thickness of the pump **503**, the inlet passage **519** and the pump chamber **515***a* are processed precisely. The upper case **515** is made of resin material and can be processed easily and accurately by a known molding technique. Including a case is formed of a combination of the upper case **515** and the lower case **516**, the pump **503** has a simple structure and can be assembled easily.

According to the sixth embodiment, the sealing portion **515***d* of the upper case **515** constructs a sealing arrangement together with the groove **519***b* for sealing between the pump chamber **515***a* and the inlet passage **519** to allow no leakage of the coolant. The sealing arrangement is not limited to the above construction. FIG. **53**A is a cross sectional view of another centrifugal pump according to the sixth embodiment. FIG. **53**B is a front view of a sealing member used in the centrifugal pump shown in FIG. **53**A. The upper case **615** has a holder portion **615***e* thereof. The sealing member, a cylindrical member **625**, has a sealing strip **625***c* thereof for covering a groove **619***b*. The cylindrical member **625** has a notch **625***b* provided in an upper end thereof for providing as an opening communicating between the pump chamber

615*a* and the discharge passage. The cylindrical member **625** for sealing is fitted on the holder portion **615***e* and the fitting portion **615***c* of the upper case **615** and the side surface of cylindrical thick portion **616***a* of the lower case **615**. The groove **619***b* is sealed with the sealing strip **625***c* of the cylindrical member **625** to form inlet passage **619**. This allows the upper case **615** to have the holding portion **615***e* but not the sealing portion **515***d* shown in FIG. **51** which is replaced by the sealing strip **625***c* of the cylindrical member **625** for developing the inlet passage **619**. The sealing member **625** functions as a partition to define the inlet passage **619**.

According to the sixth embodiment **6**, the upper case **515** and the lower case **516** are fabricated separately as two pieces for being assembled easily for the transfer of heat. However, the upper case **515** and/or the lower case **516** is composed of plural segments. This can particularly increase the freedom of designing. In particular, the upper case **515** may be composed of two separate segments since including connecting ports having intricate shapes. FIG. **54** is a cross sectional view of a centrifugal pump **603** composed of three separated segments.

As shown in FIG. **54**, a connection case **526** is coupled with the lower case **516** and has connecting ports **526***a* to communicate circulating passage with an external inlet tube and an external outlet tube (not shown). An upper case **527** is coupled with the connection case **526** for covering the back side of the impeller **511** at the opposite end of the inlet port **519***a*. The upper case **527**, the lower case **516**, and the connection case **526** are assembled to construct the case of the centrifugal pump **603**. The connection case **526** may be made of resin material for forming the inlet passage **519** and the connecting ports **526***a*. The upper case **527** is made of resin material and can thus be shaped and assembled more easily than the single-piece upper case **515** shown in FIG. **51**.

Although certain specific embodiments of the present invention have been disclosed, it is noted that the present invention may be embodied in other forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims, and all changes that come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

We claim:

1. A cooling device for cooling a heat-generating component, said cooling device comprising:

a circulating passage arranged to have coolant circulate therein;

a centrifugal pump, which connects to said circulating passage, for absorbing heat from said heat-generating component and for causing said coolant to move in said circulating passage; and

a radiator, which is disposed on the circulating passage, for radiating heat from the coolant, wherein

said centrifugal pump comprises a first case made of metallic material, a second case made of resin material, and a motor,

a first face of said first case and a second face of said second case forms a pressure chamber therebetween,

a third face of said first case has a portion to contact said heat-generating component, and

said motor is arranged on a fourth surface of said second case.

2. The cooling device according to claim **1**,

wherein the first case made of the metallic material is formed integrally with a portion of an inlet passage arranged to introduce the coolant into the pump chamber, and

wherein the second case made of the resin material is shaped integrally with another portion of the inlet passage and an outlet port, the outlet port being arranged to discharge the coolant from the pump chamber.

3. The cooling device according to claim **2**,

wherein the portion of the inlet passage comprises a side of the inlet passage, and the first case has a groove provided therein to define the side, and

wherein the another portion of the inlet passage shuts the groove and seals between the pump chamber and the inlet passage.

4. The cooling device according to claim **3**, wherein the another portion of the inlet passage is included in the second case.

5. The cooling device according to claim **3**, further comprising a sealing member provided separately from the second case and shutting the groove, wherein the second case has a holding portion for holding the sealing member.

6. The cooling device according to claim **1**, further comprising a tightening member,

wherein the first case has a cylindrical thick portion defining an inner wall of the pump chamber and has a flange portion provided along a circumference of the cylindrical thick portion,

wherein the second case has a fitting portion engaging with the cylindrical thick portion of the first case, and

wherein the tightening member tightens the flange portion to the fitting portion.

7. The cooling device according to claim **6**, wherein the second case has a step portion provided at the fitting portion, the step portion engaging with the cylindrical thick portion of the first case and positioning the cylindrical thick portion.

8. The cooling device according to claim **1**, wherein the first case is composed of a plurality of segments separate from each other.

9. The cooling device according to claim **1**, wherein the second case is composed of a plurality of segments separate from each other.

10. A cooling device for cooling a heat-generating component said cooling device comprising:

a circulating passage arranged to circulate coolant therein; and

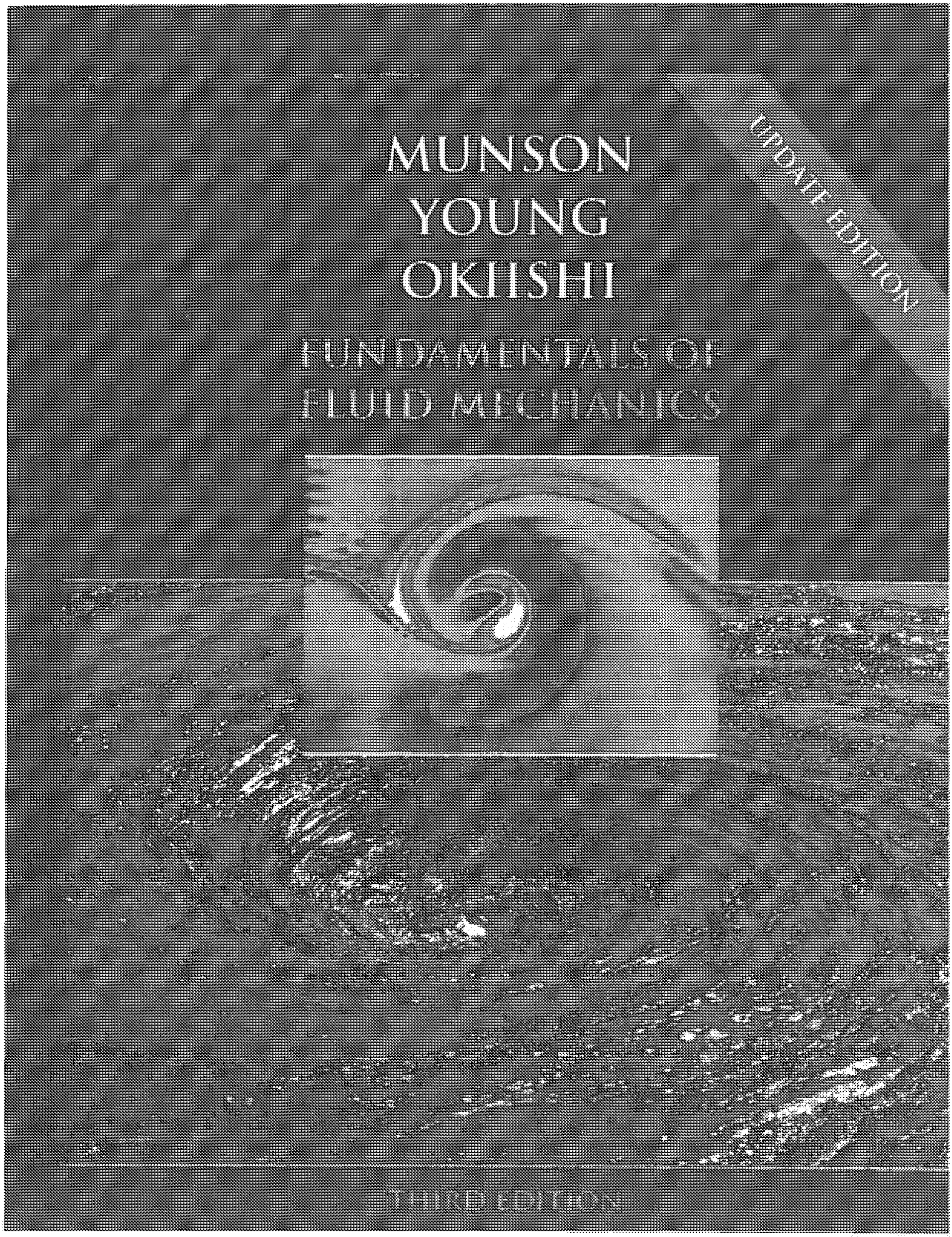
a centrifugal pump, which connects to said circulating passage, for absorbing heat from said heat-generating component and for causing said coolant to move in said circulating passage,

wherein said centrifugal pump comprises a first case made of metallic material, a second case made of resin material, and a motor,

said first case and said second case cooperate to form a pressure chamber therebetween, and

said first case has a portion to contact said heat-generating component and said second case holds said motor.

* * * * *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2.3 Pressure Variation in a Fluid at Rest

For a fluid at rest $\mathbf{a} = 0$ and Eq. 2.2 reduces to

$$\nabla p + \gamma \hat{\mathbf{k}} = 0$$

or in component form

$$\frac{\partial p}{\partial x} = 0 \qquad \frac{\partial p}{\partial y} = 0 \qquad \frac{\partial p}{\partial z} = -\gamma \tag{2.3}$$

For liquids or gases at rest the pressure gradient in the vertical direction at any point in a fluid depends only on the specific weight of the fluid at that point.

These equations show that the pressure does not depend on x or y. Thus, as we move from point to point in a horizontal plane (any plane parallel to the x–y plane), the pressure does not change. Since p depends only on z, the last of Eqs. 2.3 can be written as the ordinary differential equation

$$\boxed{\frac{dp}{dz} = -\gamma} \tag{2.4}$$

Equation 2.4 is the fundamental equation for fluids at rest and can be used to determine how pressure changes with elevation. This equation indicates that the pressure gradient in the vertical direction is negative; that is, the pressure decreases as we move upward in a fluid at rest. There is no requirement that γ be a constant. Thus, it is valid for fluids with constant specific weight, such as liquids, as well as fluids whose specific weight may vary with elevation, such as air or other gases. However, to proceed with the integration of Eq. 2.4 it is necessary to stipulate how the specific weight varies with z.

2.3.1 Incompressible Fluid

Since the specific weight is equal to the product of fluid density and acceleration of gravity ($\gamma = \rho g$), changes in γ are caused either by a change in ρ or g. For most engineering applications the variation in g is negligible, so our main concern is with the possible variation in the fluid density. For liquids the variation in density is usually negligible, even over large vertical distances, so that the assumption of constant specific weight when dealing with liquids is a good one. For this instance, Eq. 2.4 can be directly integrated

$$\int_{p_1}^{p_2} dp = -\gamma \int_{z_1}^{z_2} dz$$

to yield

$$p_2 - p_1 = -\gamma(z_2 - z_1)$$

or

$$p_1 - p_2 = \gamma(z_2 - z_1) \tag{2.5}$$

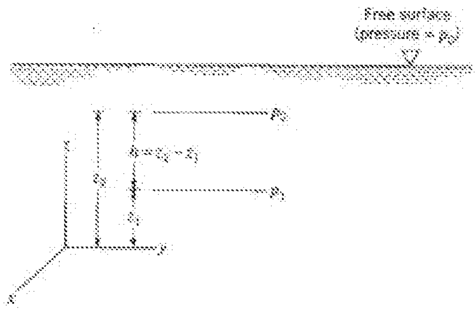
where p_1 and p_2 are pressures at the vertical elevations z_1 and z_2, as is illustrated in Fig. 2.3.

Equation 2.5 can be written in the compact form

$$p_1 - p_2 = \gamma h \tag{2.6}$$

or

$$p_1 = \gamma h + p_2 \tag{2.7}$$



■ FIGURE 2.3 Notation for pressure variation in a fluid at rest with a free surface.

where h is the distance, $z_2 - z_1$, which is the depth of fluid measured downward from the location of p_2. This type of pressure distribution is commonly called a *hydrostatic distribution*, and Eq. 2.7 shows that in an incompressible fluid at rest the pressure varies linearly with depth. The pressure must increase with depth to "hold up" the fluid above it.

It can also be observed from Eq. 2.6 that the pressure difference between two points can be specified by the distance h since

$$h = \frac{p_1 - p_2}{\gamma}$$

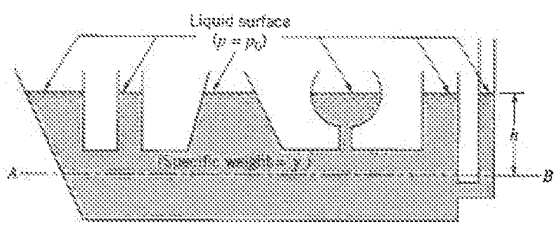
The pressure head is the height of a column of fluid that would give the specified pressure difference.

In this case h is called the *pressure head* and is interpreted as the height of a column of fluid of specific weight γ required to give a pressure difference $p_1 - p_2$. For example, a pressure difference of 10 psi can be specified in terms of pressure head as 23.1 ft of water ($\gamma = 62.4$ lb/ft^3), or 518 mm of Hg ($\gamma = 133$ kN/m^3).

When one works with liquids there is often a free surface, as is illustrated in Fig. 2.3, and it is convenient to use this surface as a reference plane. The reference pressure p_0 would correspond to the pressure acting on the free surface (which would frequently be atmospheric pressure), and thus if we let $p_2 = p_0$ in Eq. 2.7 it follows that the pressure p at any depth h below the free surface is given by the equation:

$$p = \gamma h + p_0 \qquad (2.8)$$

As is demonstrated by Eq. 2.7 or 2.8, the pressure in a homogeneous, incompressible fluid at rest depends on the depth of the fluid relative to some reference plane, and it is *not* influenced by the *size* or *shape* of the tank or container in which the fluid is held. Thus, in Fig. 2.4 the pressure is the same at all points along the line AB even though the container may have the very irregular shape shown in the figure. The actual value of the pressure along AB depends only on the depth, h, the surface pressure, p_0, and the specific weight, γ, of the liquid in the container.



■ FIGURE 2.4 Fluid equilibrium in a container of arbitrary shape.

EXAMPLE 2.1

Because of a leak in a buried gasoline storage tank, water has seeped in to the depth shown in Fig. E2.1. If the specific gravity of the gasoline is $SG = 0.68$, determine the pressure at the gasoline-water interface and at the bottom of the tank. Express the pressure in units of lb/ft^2, $lb/in.^2$, and as a pressure head in feet of water.

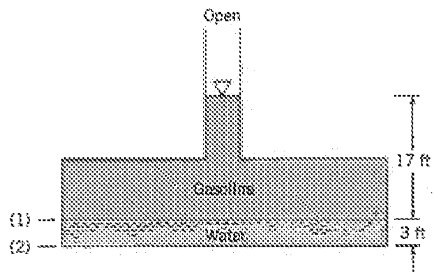


FIGURE E2.1

SOLUTION

Since we are dealing with liquids at rest, the pressure distribution will be hydrostatic, and therefore the pressure variation can be found from the equation:

$$p = \gamma h + p_0$$

With p_0 corresponding to the pressure at the free surface of the gasoline, then the pressure at the interface is

$$\begin{aligned} p_1 &= SG\,\gamma_{H_2O} h + p_0 \\ &= (0.68)(62.4\ \text{lb/ft}^3)(17\ \text{ft}) + p_0 \\ &= 721 + p_0\ (\text{lb/ft}^2) \end{aligned}$$

If we measure the pressure relative to atmospheric pressure (gage pressure), it follows that $p_0 = 0$, and therefore

$$p_1 = 721\ \text{lb/ft}^2 \qquad \textbf{(Ans)}$$

$$p_1 = \frac{721\ \text{lb/ft}^2}{144\ \text{in.}^2/\text{ft}^2} = 5.01\ \text{lb/in.}^2 \qquad \textbf{(Ans)}$$

$$\frac{p_1}{\gamma_{H_2O}} = \frac{721\ \text{lb/ft}^2}{62.4\ \text{lb/ft}^3} = 11.6\ \text{ft} \qquad \textbf{(Ans)}$$

It is noted that a rectangular column of water 11.6 ft tall and 1 ft^2 in cross section weighs 721 lb. A similar column with a 1-$in.^2$ cross section weighs 5.01 lb.

We can now apply the same relationship to determine the pressure at the tank bottom; that is,

$$\begin{aligned} p_2 &= \gamma_{H_2O} h_{H_2O} + p_1 \\ &= (62.4\ \text{lb/ft}^3)(3\ \text{ft}) + 721\ \text{lb/ft}^2 \qquad \textbf{(Ans)} \\ &= 908\ \text{lb/ft}^2 \end{aligned}$$

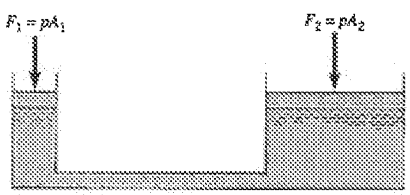
$$p_2 = \frac{908\ \text{lb/ft}^2}{144\ \text{in.}^2/\text{ft}^2} = 6.31\ \text{lb/in.}^2 \qquad \text{(Ans)}$$

$$\frac{p_2}{\gamma_{H_2O}} = \frac{908\ \text{lb/ft}^2}{62.4\ \text{lb/ft}^3} = 14.6\ \text{ft} \qquad \text{(Ans)}$$

Observe that if we wish to express these pressures in terms of *absolute* pressure, we would have to add the local atmospheric pressure (in appropriate units) to the previous results. A further discussion of gage and absolute pressure is given in Section 2.5.

The transmission of pressure throughout a stationary fluid is the principle upon which many hydraulic devices are based.

The required equality of pressures at equal elevations throughout a system is important for the operation of hydraulic jacks, lifts, and presses, as well as hydraulic controls on aircraft and other types of heavy machinery. The fundamental idea behind such devices and systems is demonstrated in Fig. 2.5. A piston located at one end of a closed system filled with a liquid, such as oil, can be used to change the pressure throughout the system, and thus transmit an applied force F_1 to a second piston where the resulting force is F_2. Since the pressure p acting on the faces of both pistons is the same (the effect of elevation changes is usually negligible for this type of hydraulic device), it follows that $F_2 = (A_2/A_1)F_1$. The piston area A_2 can be made much larger than A_1 and therefore a large mechanical advantage can be developed; that is, a small force applied at the smaller piston can be used to develop a large force at the larger piston. The applied force could be created manually through some type of mechanical device, such as a hydraulic jack, or through compressed air acting directly on the surface of the liquid, as is done in hydraulic lifts commonly found in service stations.



■ FIGURE 2.5 Transmission of fluid pressure.

2.3.2 Compressible Fluid

We normally think of gases such as air, oxygen, and nitrogen as being compressible fluids since the density of the gas can change significantly with changes in pressure and temperature. Thus, although Eq. 2.4 applies at a point in a gas, it is necessary to consider the possible variation in γ before the equation can be integrated. However, as was discussed in Chapter 1, the specific weights of common gases are small when compared with those of liquids. For example, the specific weight of air at sea level and 60 °F is 0.0763 lb/ft^3, whereas the specific weight of water under the same conditions is 62.4 lb/ft^3. Since the specific weights of gases are comparatively small, it follows from Eq. 2.4 that the pressure gradient in the vertical direction is correspondingly small, and even over distances of several hundred feet the pressure will remain essentially constant for a gas. This means we can neglect the effect of elevation changes on the pressure in gases in tanks, pipes, and so forth in which the distances involved are small.

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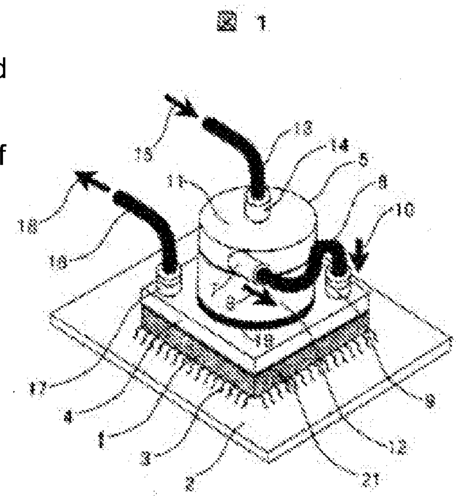
(54) COOLER FOR ELECTRONIC EQUIPMENT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a cooling structure for mounting in compact manner a liquid-cooled heat sink and a pump in a housing.

SOLUTION: The pump 5 is mounted on the upper part of the liquid-cooled heat sink 4. The structure in which the pump 5 is integrated with the heat sink 4, to be handled as an integral structure. A liquid cooling system can be mounted compactly in an electronic equipment housing. Thus, the liquid cooling system having a high cooling performance, low noise and high reliability can be realized, without greatly changing the present air-cooled type electronic equipment housing structure.



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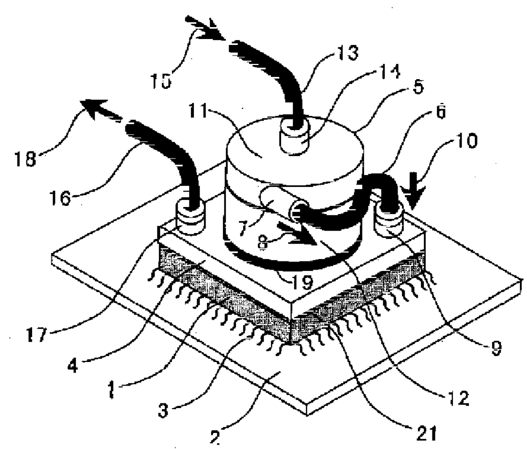
(54)【発明の名称】　電子機器の冷却装置

(57)【要約】　（修正有）

【課題】液体冷却ヒートシンクとポンプとを筐体内にコンパクトに実装するための冷却構造。

【解決手段】ポンプ５が液体冷却ヒートシンク４の上部に搭載され、ポンプ５と液体冷却ヒートシンク４とを一体構造として取扱える構造にし、液体冷却システムを電子機器筐体内にコンパクトに搭載でき、現状の空冷方式の電子機器筐体構造を大きく変えることなく、冷却性能が高く、かつ低騒音で、信頼性の高い液体冷却システムを実現できる。

図　１



【特許請求の範囲】

【請求項１】配線基板と、該配線基板上に搭載されたＬＳＩ等の電子回路部品を含む発熱体と、該発熱体上に熱的に接触して搭載された液体冷却ヒートシンクと、液体冷媒を加圧して循環させるポンプとからなる電子機器の冷却装置であって、該ポンプが該液体冷却ヒートシンクの上部に搭載されることを特徴とする電子機器の冷却装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、配線基板上に搭載されたＬＳＩ等の発熱電子回路部品を、液体冷却するための冷却構造に係り、特に液体冷却ヒートシンクとポンプとをコンパクトに実装するための冷却構造に関する。

【０００２】

【従来の技術】近年、コンピュータや通信機器、マルチメディア機器等に代表される電子機器の発熱量は著しく増加する傾向にあり、特に演算処理を集中して行うＣＰＵや、画像処理用ＬＳＩ、パワーアンプ等の冷却は非常に重要な課題となってきた。

【０００３】また、冷却方式としては、従来から、空冷フィンとファンを組合せた空冷方式が数多く用いられてきた。しかしながら、空冷方式は、液冷方式に比較して冷却限界が低いため、最近、ＣＰＵ等の高発熱ＬＳＩのみを水等の液体冷媒により液冷する方式が検討されている。

【０００４】例えば、特開平8−32262号公報には、図４に示すような液冷方式が開示されている。発熱量の大きくない空冷可能なＬＳＩ５１と、発熱量が大きいため水冷ヒートシンク４０で冷却されるＬＳＩとが、同じ配線基板５０上に搭載されている。空冷可能なＬＳＩ５１は２つのファン４７により空冷される。冷却空気は４８に示すように外部から供給され、４９に示すように排気される。発熱量の大きいＬＳＩに搭載された水冷ヒートシンク４０はホース４１でを介して出口配管４２に連結され、４０で温められた冷却水は熱交換器４３においてファン４７の空気により冷却される。冷却された冷却水は冷媒配管４４を経由してポンプ４５に流れ、加圧された後に入口配管４６を通って再び水冷ヒートシンク４０に供給される。

【０００５】

【発明が解決しようとする課題】特開平8−32262号公報に開示された冷却構造では、ポンプ４５が配線基板５０や水冷ヒートシンク４０と離れて設置されているため、ポンプ４５を実装するスペースとポンプ４５に接続する配管スペースが筐体内に別途必要となり、電子機器筐体をコンパクトにすることができないという問題点があった。

【０００６】本発明の目的は、コンパクトで、低騒音で、冷却性能に優れ、かつ信頼性の高い電子機器の冷却構造を提供することである。

【０００７】

【課題を解決するための手段】上記目的を達成するため、本発明では、配線基板と、配線基板上に搭載されたＬＳＩ等の電子回路部品を含む発熱体と、発熱体上に熱的に接触して搭載された液体冷却ヒートシンクと、液体冷媒を加圧して循環させるポンプとからなる電子機器の冷却装置を前提とし、ポンプが液体冷却ヒートシンクの上部に搭載される構造とした。

【０００８】また、ポンプが液体冷却ヒートシンクの上部に固定され、さらにポンプと液体冷却ヒートシンクとを一体構造として取扱える構造とした。

【０００９】また、ポンプの液体冷媒吐出し部が液体冷却ヒートシンクに配管等で直接連結された構造とした。

【００１０】さらに、ポンプが直流電源で動作する構成とした。

【００１１】さらに、ポンプが振動吸収部材等を介して液体冷却ヒートシンクに固定される構造とした。

【００１２】

【発明の実施の形態】本発明の第一の実施例について図１を用いて説明する。ＬＳＩ等の電子回路部品を含む発熱体１は、配線基板２上に配線用ピン３や半田ボール等を介して電気的に接続されて搭載されている。発熱体１は、例えばコンピュータ用のＣＰＵや、画像処理用ＬＳＩ、ＦＥＴパワーアンプ等である。発熱体１上には、発熱体１を液冷するための液体冷却ヒートシンク４が、熱伝導コンパウンド２１や熱伝導グリース、または熱伝導シート等を介して熱的に接続されて搭載されている。さらに、液体冷却ヒートシンク４の上部には、液体冷媒を加圧して循環させるポンプ５が搭載されている。

【００１３】本実施例では、ポンプ５が振動吸収部材１９を介して液体冷却ヒートシンク４に固定される構造を採っている。そのためポンプ５の振動が直接ＣＰＵ等の電子部品に影響を及ぼし難い構造となっている。ポンプ５はフレキシブルなホース６により液体冷却ヒートシンク４と接続されている。ホース６は一端がポンプ５の冷媒吐出し部カプラ７に接続され、他端が液体冷却ヒートシンク４の給水カプラ９に接続されており、加圧された液体冷媒は８のように流れた後に１０のように直接液体冷却ヒートシンク４に流入する。液体冷媒は、液体冷却ヒートシンク４内に流入した後に、ヒートシンク内に構成された複数の流路に別れて蛇行状に流れ、発熱体１の熱を吸収する。加熱された液体冷媒は排水カプラ１７、ホース１６を経て、液体冷媒を冷却する熱交換部（図示せず）に１８に示すように流れる。熱交換部で冷却された液体冷媒は、１５のように戻ってきて、ホース１３、冷媒吸込み部カプラ１４を介してポンプ５に吸込まれ、再び加圧されて液体冷却ヒートシンク４に供給される。

【００１４】なお、前述したカプラ７，９，１４，１７によってホース６，１３，１６は脱着が容易になってい

るため、組立て性やメンテナンス性が良い構造を実現している。

【００１５】上記のように、ポンプ５が液体冷却ヒートシンク４の上部に搭載される構造とすることにより、ポンプ５を別途設置するスペースを電子機器筐体内に用意する必要が無くなり、またポンプから液体冷却ヒートシンク４までのホースを短くできるので、液体冷却システムを電子機器筐体内にコンパクトに搭載できる。そのため、現状の空冷方式の電子機器筐体構造を大きく変えることなく、冷却性能が高く、かつ低騒音の液体冷却システムを搭載することが可能となる。

【００１６】また、ポンプ５が液体冷却ヒートシンク４の上部に固定され、ポンプと液冷ヒートシンクとを一体構造として取扱えるようにすると、組立て時の部品点数が低減し、さらに、現状パソコン等で多用されているファン付き空冷ヒートシンクの代わりに、このポンプと液冷ヒートシンクの一体部品キットを組付けることができるため、液体冷却システムを無理なく電子機器に導入可能である。

【００１７】また、ポンプ５の冷媒吐出し部７が液体冷却ヒートシンク４の給水カプラ９に配管等で直接連結された構造とした。そのため、ポンプ５から液体冷却ヒートシンク４までのホースを非常に短くできるので、ホースでの液体冷媒の流動損失を小さくでき、その結果ポンプ５の揚程能力を小さくでき、最終的にモータの能力をより小さくし、ポンプを小型化することができる。

【００１８】ポンプ５は羽根車ケース１１とモータ１２から構成される。本実施例において、ポンプ５は羽根車ケース１１内に設置された羽根車を回転させて液体冷媒を加圧する遠心型の例を示したが、ダイヤフラムなどを用いて機械的容積変化により液体冷媒を加圧する容積型ポンプであっても良い。また、本実施例においては、モータと羽根車の軸が液体冷却ヒートシンク４の上面にほぼ垂直になるように搭載されており、よって、モータの底面が液体冷却ヒートシンク４の上面に振動吸収部材１９を介して面同士で接合されるため、モータの座りが良い構造を実現できる。

【００１９】モータ１２は直流電源で駆動するＤＣモータである。ＤＣモータとすることにより、ＤＣ電圧を変化させて容易にモータの回転数を変えられるので、冷却能力の制御も可能になる。さらに、モータをＤＣブラシレスモータとすることにより、低騒音でかつ高寿命のポンプを実現することができる。

【００２０】液体冷媒の流量が ０.１（リットル／分）のオーダーのように比較的小さい場合には、駆動電圧を例えば １〜１.５（Ｖ）程度の乾電池でも駆動可能なものとすれば、ポンプのバッテリー駆動が可能となり、信頼性の高い液体冷却システムを構築できる。また、液体冷媒の流量が１（リットル／分）のオーダーのように比較的大きい場合には、駆動電圧を例えば２〜１２（Ｖ）程度の電子機器のＤＣ電源で供給可能な電圧とすると、ポンプ用の専用電源を用意する必要がないためコンパクトで安価に液体冷却システムを構築できる。ただし、本発明は、モータ１２を必ずしもＤＣモータに限定するものではなく、例えば１００（Ｖ）や 200（Ｖ）の交流電源で駆動するＡＣモータであっても構わない。

【００２１】液体冷媒は入手が容易な水が良く、特に純水であると熱容量が大きいので冷却性能を高くでき、さらに腐食に強く、不純物が流路内に堆積し難いので信頼性の高い液体冷却システムを実現することができる。また、液体冷媒として、水にエチレングリコール等を添加した不凍液を使えば、寒冷時の液体冷媒凍結による流路部破損を防止できる。また、液体冷媒にパーフルオロカーボン等の非電導性冷媒を使えば、万一の液漏れ時にも電子回路のショート等の事故を防ぐことができる。

【００２２】本発明の第二の実施例について図２を用いて説明する。本実施例においては、モータ５と羽根車の軸が液体冷却ヒートシンク４の上面にほぼ平行になるように搭載されている。それにより、モータ出力が高く、そのためモータの軸方向長さが長い高出力ポンプでも、液体冷却ヒートシンク４上にコンパクトに搭載できる。本実施例では、ポンプ５は液体冷却ヒートシンク４上にブラケット２０で固定されている。ブラケット２０は、材質が振動吸収部材であるか、その一部に振動吸収部材を用いることにより、ポンプ５の振動が直接ＣＰＵ等の電子部品に影響を及ぼし難い構造とすることができる。第二の実施例は、上記以外は第一の実施例と同様である。

【００２３】本発明の第三の実施例について図３を用いて説明する。本実施例は、第一の実施例で示したポンプと液冷ヒートシンク一体型の液体冷却システムを、実際の電子機器筐体内に搭載した例を示している。

【００２４】ＬＳＩ等の発熱体１は、マザーボードである配線基板２上に搭載されている。発熱体１上には、発熱体１を液冷するための液体冷却ヒートシンク４が搭載されている。さらに、液体冷却ヒートシンク４の上部には、ポンプ５が搭載されている。配線基板２上には、発熱体１以外に、メモリＬＳＩやドライバＬＳＩなどの空冷で冷却可能な発熱体２２ａ，２２ｂ，２２ｃや、ＩＯカード、メモリカード、ハードディスク等のカード実装基板２３等が搭載されている。配線基板２は、電子機器筐体のケース２４内に収められている。ケース２４には空冷用のファン３４が取付けられており、前記多数の空冷部品を冷却風２５で空冷している。

【００２５】液体冷却ヒートシンク４で加熱された液体冷媒は、ホース１６で１８に示すように流れ、筐体ケースの側板３２に取付けられた熱交換器２７に接続カプラ２６を介して接続される。本実施例では、熱交換器２７の配管が側板３２に熱的に接触して取付けられており、液体冷媒は熱交換器内で２８や２９のように蛇行しなが

ら上方へ流れる。液体冷媒の熱は側板３２全体に熱伝導により広げられた後に、電子機器筐体周囲の自然対流による空気流３３やファン３４による冷却風２５により放熱される。

【００２６】冷却された液体冷媒は、３０のように流れ、接続カプラ３１を介して戻り側のホース１３に接続され、１５のようにポンプ５に戻り、再び加圧されて液体冷却ヒートシンク４に供給される。

【００２７】側板３２と熱交換器２７の構成方法の一例として、側板３２をアルミニウムやマグネシウムや銅等の金属材料で構成し、さらに熱交換器の配管を金属材料で構成し、両者をろう付けや半田付け等の金属接合や熱伝導性接着剤等で接続する方法がある。この場合、熱伝導を良好にできるので、液体冷却システムの冷却性能を向上させることができる。また、２枚の金属板を熱交換器の蛇行流路を空けた状態で接合させて、側板と熱交換器を一体成形するロールボンド等の製法を用いれば、より安価に熱交換器を製造できる。ただし、側板３２が樹脂製等の非金属材料であったり、熱交換器２７の配管が非金属材料であっても、本発明の効果は実現できるものである。

【００２８】以上から、本実施例の構成とすることにより、ポンプ５を別途設置するスペースを電子機器筐体内に用意する必要が無くなり、またポンプから液体冷却ヒートシンク４までのホースを短くできるので、液体冷却システムを電子機器筐体内にコンパクトに搭載できる。

【００２９】さらに、現状の空冷方式の電子機器筐体構造を大きく変えることなく、熱交換器２７を備えた側板３２と、ポンプ一体型液冷ヒートシンクと、２本の接続ホース１３，１６を追加するだけで、冷却性能が高く、かつ低騒音の液体冷却システムを実現することが可能となる。

【００３０】また、現状パソコン等で多用されているファン付き空冷ヒートシンクの代わりに、このポンプと液冷ヒートシンクの一体部品キットを組付けることができるため、液体冷却システムを無理なく電子機器に導入可能である。ポンプの電源がファン付き空冷ヒートシンクのファン用電源と互換性があれば、さらに導入が容易となることは言うまでもない。

【００３１】

【発明の効果】以上説明したように、本発明によれば、第一に、液体冷却システムを電子機器筐体内にコンパクトに搭載できる。

【００３２】第二に、現状の空冷方式の電子機器筐体構造を大きく変えることなく、冷却性能が高く、かつ低騒音で、信頼性の高い液体冷却システムを搭載することができる。

【００３３】第三に、組立て時の部品点数が低減し、かつ、ファン付き空冷ヒートシンクの代わりに、ポンプと液冷ヒートシンクの一体部品キットを組付けることができるため、液体冷却システムを無理なく電子機器に導入できる。

【００３４】第四に、ポンプの揚程能力を小さくでき、モータの能力をより小さくし、小型化できる。

【００３５】第五に、ポンプの回転数を変化させて冷却能力を制御可能な液体冷却システムとすることができる。

【図面の簡単な説明】

【図１】本発明の第一の実施例である電子機器の冷却装置の斜視図。

【図２】本発明の第二の実施例である電子機器の冷却装置の斜視図。

【図３】本発明の第三の実施例である電子機器の冷却装置の斜視図。

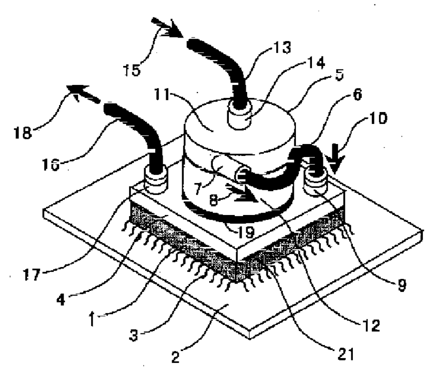
【図４】従来例の電子機器の冷却装置を示す斜視図。

【符号の説明】

１…発熱体、２…配線基板、３…配線用ピン、４…液体冷却ヒートシンク、５…ポンプ、６…ホース、７…冷媒吐出し部カプラ、８…液体冷媒の流れ、９…給水カプラ、１０…液体冷媒の流れ、１１…羽根車ケース、１２…モータ、１３…ホース、１４…冷媒吸込み部カプラ、１５…液体冷媒の流れ、１６…ホース、１７…排水カプラ、１８…液体冷媒の流れ、１９…振動吸収部材、２０…ブラケット、２１…熱伝導性コンパウンド、２２ａ…空冷で冷却可能な発熱体、２２ｂ…空冷で冷却可能な発熱体、２２ｃ…空冷で冷却可能な発熱体、２３…カード実装基板、２４…電子機器筐体のケース、２５…冷却風、２６…接続カプラ、２７…熱交換器、２８…蛇行する液体冷媒の流れ、２９…蛇行する液体冷媒の流れ、３０…液体冷媒の流れ、３１…接続カプラ、３２…側板、３３…空気流、３４…ファン、４０…水冷ヒートシンク、４１…ホース、４２…出口配管、４３…熱交換器、４４…冷媒配管、４５…ポンプ、４６…入口配管、４７…ファン、４８…冷却空気、４９…冷却空気、５０…配線基板、５１…空冷可能なＬＳＩ。

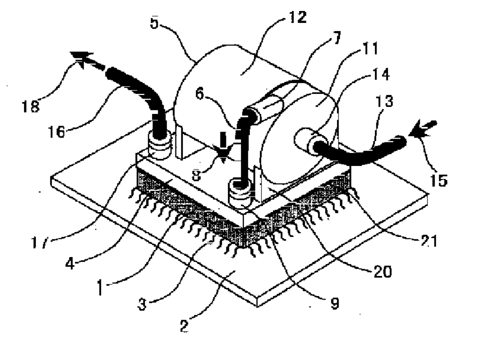
【図1】

図 1



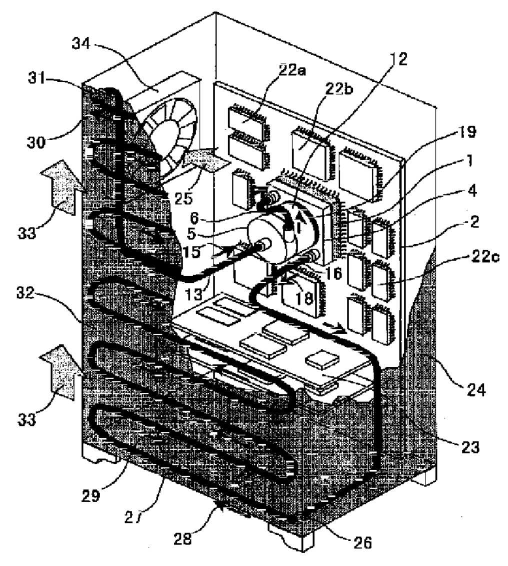
【図2】

図 2



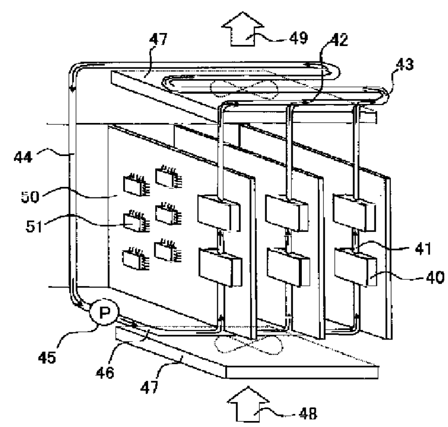
【図3】

図 3



【図4】

図 4



JP2002-151638

[Detailed Description of the Invention]
[0001] [Field of the Invention]The present invention relates to the cooling structure for starting the cooling structure for carrying out liquid cooling of the exothermic electronic circuit part articles, such as LSI carried on the wiring board, especially mounting a liquid cooling heat sink and a pump compactly.
[Brief Description of the Drawings]
[Drawing 1]The perspective view of the cooling system of the electronic device which is a first working example of the present invention.
[Drawing 2]The perspective view of the cooling system of the electronic device which is a second working example of the present invention.
[Drawing 3]The perspective view of the cooling system of the electronic device which is a third working example of the present invention.
[Drawing 4]The perspective view showing the cooling system of the electronic device of a conventional example.
[Explanations of letters or numerals]
1 -- heating element, 2 -- wiring board, 3 -- pin for wiring, 4 -- liquid cooling heat sink, 5 -- a pump and 6 -- a hose -- carrying out 7 -- refrigerant discharge -- A part coupler and 8 -- the flow of a liquid refrigerant -- 9 -- feed water coupler, 10 -- flow of a liquid refrigerant, 11 -- impeller case, 12 -- motor, 13 -- hose, 14 -- refrigerant sink part coupler, 15 -- flow of a liquid refrigerant, 16 -- hose, 17 -- wastewater coupler, 18 -- flow of a liquid refrigerant, 19 -- oscillation absorbing member, 20 -- bracket, 21 -- thermally conductive compound, 22 a -- heating element which can be cooled with air cooling, 22 b -- heating element which can be cooled with air cooling, 22 c -- heating element which can be cooled with air cooling, 23 -- card mounting board, 24 -- case of electronic equipment casing, 25 -- cooling wind blows, 26 -- connecting coupler, 27 -- heat exchanger, 28 -- flow of the liquid refrigerant which moves in a zigzag direction, 29 -- flow of the liquid refrigerant which moves in a zigzag direction, 30 -- flow of a liquid refrigerant, 31 -- connecting coupler, 32 -- side board, 33 -- airstream, 34 -- fan, 40 -- watercooling heat sink, 41 -- hose, 42 -- outlet piping, 43 -- heat exchanger, 44 -- refrigerant piping, 45 -- pump, 46 -- entrance line, 47 -- fan, 48 -- cooling air, 49 -- cooling air, 50 -- wiring board, 51 -- LSI in which air cooling is possible.
[0002]
[Description of the Prior Art]The calorific value of the electronic device represented by a computer, communication equipment, multimedia apparatus, etc. tends to increase remarkably in recent years, and cooling of CPU which concentrates and performs especially data processing, image processing LSI, power amplification, etc., etc. has been very important problem.
[0003]As cooling system, many air systems which combined the air-cooling fin and the fan have been used from the former. However, since the cooling limit of an air system is low as compared with a liquid cooling system, the system which carries out liquid cooling only of the high exothermic LSI, such as CPU, with liquid refrigerants, such as water, is examined these days.
[0004]For example, JP,H8-32262,A has disclosed a liquid cooling system as shown in Fig.4. LSI51 which does not have calorific value largely and in which air cooling is possible, and LSI

cooled with the watercooling heat sink 40 since calorific value is large are carried on the same wiring board 50. Air cooling of the LSI51 in which air cooling is possible is carried out by the two fans 47. Cooling air is supplied from the outside, as shown in 48, and as shown in 49, it is exhausted. The watercooling heat sink 40 carried in LSI with large calorific value is connected with the outlet piping 42 via hose 41 **, and the cooling water which was able to be warmed by 40 is cooled by the air of the fan 47 in the heat exchanger 43. The cooled cooling water flows into the pump 45 via the refrigerant piping 44, and after being pressurized, it is again supplied to the watercooling heat sink 40 through the entrance line 46.
[0005]
[Problem to be solved by the invention]In the cooling structure disclosed in JP,H8-32262,A, Since the pump 45 separated with the wiring board 50 and the watercooling heat sink 40 and was installed, the piping space linked to the space which mounts the pump 45, and the pump 45 was needed separately in the housing, and there was a problem that electronic equipment casing could not be downsized.
[0006]The object of this invention is compact, is a low noise, and is excelling in a cooling capability and providing the cooling structure of a reliable electronic device.
[0007]

[Means for solving problem]The heating element which contains electronic circuit part articles, such as LSI carried on the wiring board and the wiring board, in the present invention in order to attain the above-mentioned purpose, It was considered as the structure where a pump is carried in the upper part of a liquid cooling heat sink on the assumption that the cooling system of the electronic device which consists of a liquid cooling heat sink carried by contacting thermally on the heating element, and a pump made to pressurize and circulate through a liquid refrigerant.
[0008]The pump was fixed to the upper part of the liquid cooling heat sink, and considered it as the structure where a pump and a liquid cooling heat sink can be further dealt with as integral construction.
[0009]It was considered as the structure where the pump carried out liquid refrigerant discharge and the part was directly connected with the liquid cooling heat sink for piping etc.
[0010]The pump had composition which operates by DC power supply.
[0011]It was considered as the structure where a pump is fixed to a liquid cooling heat sink via an oscillation absorbing member etc.
[0012]
[Mode for carrying out the invention]It describes using Fig.1 about the first working example of the present invention. On the wiring board 2, via the pin 3 for wiring, the solder ball, etc., it is electrically connected and the heating element 1 containing electronic circuit part articles, such as LSI, is carried. The heating elements 1 are CPU for computers, image processing LSI, FET power amplification, etc., for example. On the heating element 1, via the heat-conduction compound 21, heat-conduction grease or a heat conduction sheet, etc., it is connected thermally and the liquid cooling heat sink 4 for carrying out liquid cooling of the heating element 1 is carried. The pump 5 made to pressurize and circulate through a liquid refrigerant is carried in the upper part of the liquid cooling heat sink 4.
[0013]In this example, the structure where the pump 5 is fixed to the liquid cooling heat sink 4 via the oscillation absorbing member 19 is taken. Therefore, it has the structure where vibration

of the pump 5 cannot affect electronic parts, such as direct CPU, easily. The pump 5 is connected with the liquid cooling heat sink 4 by the flexible hose 6. After the liquid refrigerant in which the pump 5 carries out refrigerant discharge, one end is connected to the part coupler 7, the other end is connected to the feed water coupler 9 of the liquid cooling heat sink 4, and the hose 6 was pressurized flows like 8, it flows into the liquid cooling heat sink 4 directly like ten. After a liquid refrigerant flows in the liquid cooling heat sink 4, it separates to two or more flow paths constituted in the heat sink, flows into meandering state, and absorbs the heat of the heating element 1. The heated liquid refrigerant flows, as shown in the heat exchanging part (not shown) which cools a liquid refrigerant through the wastewater coupler 17 and the hose 16 18. The liquid refrigerant cooled by the heat exchanging part returns like 15, is absorbed by the pump 5 via the hose 13 and the refrigerant sink part coupler 14, is pressurized again, and is supplied to the liquid cooling heat sink 4.

[0014]With the couplers 7, 9, 14, and 17 mentioned above, since desorption is easy, the hose 6, 13, and 16 have realized structure with sufficient assembly nature and maintainability.

[0015]As mentioned above, by considering it as the structure where the pump 5 is carried in the upper part of the liquid cooling heat sink 4, Since the necessity of preparing the space in which the pump 5 is installed separately in electronic equipment casing is lost and the hose from a pump to the liquid cooling heat sink 4 can be shortened, a liquid cooling system can be compactly carried in electronic equipment casing. Therefore, a cooling capability turns into that it is high and it is possible to carry the liquid cooling system of a low noise, without changing largely the electronic equipment casing structure of the present air system.

[0016]If the pump 5 is fixed to the upper part of the liquid cooling heat sink 4 and it enables it to deal with a pump and a liquid cooling heat sink as integral construction, The number of parts at the time of an assembly decreases, and since the integral-part kit of this pump and a liquid cooling heat sink can be further attached instead of the air cooling heat sink with a fan currently used abundantly with the actual condition personal computer etc., a liquid cooling system can be introduced into an electronic device reasonable.

[0017]It was considered as the structure where the pump 5 carried out refrigerant discharge and the part 7 was directly connected with the feed water coupler 9 of the liquid cooling heat sink 4 for piping etc. Therefore, since the hose from the pump 5 to the liquid cooling heat sink 4 can be shortened dramatically, the flow loss of the liquid refrigerant in a hose can be made small, as a result, head capability of the pump 5 can be made small, capability of a motor can be eventually made smaller, and a pump can be miniaturized.

[0018]The pump 5 comprises the impeller case 11 and the motor 12. In this example, although the pump 5 showed the example of the centrifugal type which rotates the impeller installed in the impeller case 11, and pressurizes a liquid refrigerant, it may be a positive displacement pump which pressurizes a liquid refrigerant by mechanical volume change using diaphragm etc. In this example, it is carried so that the axis of a motor and an impeller may become substantially vertical to the upper surface of the liquid cooling heat sink 4, and therefore, since the bottom surface of a motor is joined to the upper surface of the liquid cooling heat sink 4 in surfaces via the oscillation absorbing member 19, structure with the sufficient stability of a motor is realizable.

[0019]The motor 12 is a DC motor driven by DC power supply. Since DC voltage is changed and the rotational speed of a motor can be easily changed by considering it as a DC motor, control of refrigeration capacity is also attained. By using a motor as a DC brushless motor, it is a low noise and the pump of a high lifetime can be realized.

[0020]The flow rate of a liquid refrigerant can build the liquid cooling system of 0.1 (a part for the liter /) reliable if it makes driver voltage into what can be driven also by the dry cell of a 1 - 1.5(V) degree like an order in being comparatively small battery-operated [whose / of a pump] becomes possible. The flow rate of a liquid refrigerant like the order of 1 (a part for the liter /) in being comparatively large, If driver voltage is made into the voltage which can be supplied by the DC power supply of the electronic device of 2 - 12(V) degree, since it is not necessary to prepare the exclusive power supply for pumps, a liquid cooling system can be built compactly and inexpensive. It is ** and the present invention may be an AC motor which does not necessarily limit the motor 12 to a DC motor, and is driven, for example by the AC power supply of 100(V)s or 200(V).

[0021]Since calorific capacity is large in water with easy acquisition being good and being especially pure water, the liquid refrigerant can make a cooling capability high, it is still stronger to corrosion, and since it is hard to deposit an impurity in a flow path, a reliable liquid cooling system is realizable. If the antifreeze solution which added ethylene glycol etc. is used for water as a liquid refrigerant, the passage part damage by liquid refrigerant freezing at the time of chill can be prevented. If non-conductivity refrigerants, such as perfluorocarbon, are used for a liquid refrigerant, accidents, such as a short circuit of an electronic circuit, can be prevented also at the time of emergency liquid leakage.

[0022]It describes using Fig.2 about the second working example of the present invention. In this example, it is carried so that the axis of the motor 5 and an impeller may become substantially parallel to the upper surface of the liquid cooling heat sink 4. Thereby, it can carry compactly on the liquid cooling heat sink 4 also with a high-output pump with the long axial direction length of a motor highly [a motor output] therefore. In this example, the pump 5 is fixed with the bracket 20 on the liquid cooling heat sink 4. The bracket 20 can be made into the structure where construction material is an oscillation absorbing member, or vibration of the pump 5 cannot affect electronic parts, such as direct CPU, easily by using an oscillation absorbing member for the part. The second working example is the same as a first working example except the above.

[0023]It describes using Fig.3 about the third working example of the present invention. This example shows the example which carries the pump and the liquid cooling system of a liquid cooling heat sink integral type which were shown in the first working example in actual electronic equipment casing.

[0024]The heating elements 1, such as LSI, are carried on the wiring board 2 which is a mother board. On the heating element 1, the liquid cooling heat sink 4 for carrying out liquid cooling of the heating element 1 is carried. The pump 5 is carried in the upper part of the liquid cooling heat sink 4. On the wiring board 2, the card mounting boards 23, such as the heating elements 22a, 22b, and 22c which can be cooled with air cooling, such as memory LSI and driver LSI, in addition to heating element 1, an IO card and a memory card, and a hard disk, etc. are carried. The wiring board 2 is stored in the case 24 of electronic equipment casing. The fan 34 for air cooling is attached to the case 24, and air cooling of the above-mentioned many air cooling part article is carried out by the cooling wind blows 25.

[0025]The liquid refrigerant heated with the liquid cooling heat sink 4 flows, as the hose 16

shows to 18, and it is connected to the heat exchanger 27 attached to the side board 32 of a housing case via the connecting coupler 26. In this example, piping of the heat exchanger 27 contacts the side board 32 thermally, and is attached to it, and a liquid refrigerant flows upwards, moving in a zigzag direction like 28 or 29 within a heat exchanger. After being able to extend the heat of a liquid refrigerant by heat conduction to the side-board 32 whole, it radiates heat by the cooling wind blows 25 by the airstream 33 by a free convection and the fan 34 of the circumference of electronic equipment casing.
[0026]It flows like 30, and is connected to the hose 13 of a return end via the connecting coupler 31, and the cooled liquid refrigerant returns to the pump 5 like 15, is pressurized again, and is supplied to the liquid cooling heat sink 4.
[0027]There is the method of constituting the side board 32 from metallic materials, such as aluminum, magnesium, and copper, constituting piping of a heat exchanger from a metallic material further as an example of the constitution method of the side board 32 and the heat exchanger 27, and connecting both with metal junction, thermally conductive adhesives, etc., such as brazing and soldering. In this case, since heat conduction can be made good, the cooling capability of a liquid cooling system can be improved. The metal plate of two sheets is joined where the meandering passages of a heat exchanger are vacated, and if processes, such as a roll bond which forms a side board and a heat exchanger integrally, are used, a heat exchanger can be manufactured more inexpensive. However, even if the side boards 32 are nonmetal materials, such as a product made of resin, or piping of the heat exchanger 27 is a nonmetal material, the effect of the present invention is realizable.
[0028]As mentioned above, since the necessity of preparing the space in which the pump 5 is separately installed by having composition of this example in electronic equipment casing is lost and the hose from a pump to the liquid cooling heat sink 4 can be shortened, a liquid cooling system can be compactly carried in electronic equipment casing.
[0029]Without changing largely the electronic equipment casing structure of the present air system, only by adding the side board 32 provided with the heat exchanger 27, a pump integral-type liquid cooling heat sink, and the two connection hose 13 and 16, a cooling capability is high and it becomes possible to realize the liquid cooling system of a low noise.
[0030]Since the integral-part kit of this pump and a liquid cooling heat sink can be attached instead of the air cooling heat sink with a fan currently used abundantly with the actual condition personal computer etc., a liquid cooling system can be introduced into an electronic device reasonable. If the power supply of a pump has the power supply for fans and compatibility of an air cooling heat sink with a fan, it cannot be overemphasized that introducing becomes still easier.
[0031]
[Effect of the Invention]As described above, according to the present invention, a liquid cooling system can be compactly carried in electronic equipment casing in the first place.
[0032]Without changing largely the electronic equipment casing structure of the present air system, a cooling capability can be high and a reliable liquid cooling system can be carried [second] with a low noise.
[0033]Since the number of parts at the time of an assembly decreases, and the integral-part kit of a pump and a liquid cooling heat sink can be attached to the third instead of being an air cooling heat sink with a fan, a liquid cooling system can be introduced into an electronic device

reasonable.
[0034]Head capability of a pump can be made small, capability of a motor is made smaller, and it can miniaturize [fourth].
[0035]The rotational speed of a pump can be changed and refrigeration capacity can be used [fifth] as a controllable liquid cooling system.

[Claim(s)]
[Claim 1]A wiring board.
A heating element containing electronic circuit part articles, such as LSI carried on this wiring board.
A liquid cooling heat sink carried by contacting thermally on this heating element.
A pump made to pressurize and circulate through a liquid refrigerant.
In a cooling system of an electronic device provided with the above,
A cooling system of an electronic device, wherein this pump is carried in the upper part of this liquid cooling heat sink.

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[Publication date]Heisei 17(2005) May 26 (2005.5.26)

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[The 7th edition of International Patent Classification]
H01L 23/473

H05K 7/20

[FI]
H01L 23/46 Z

H05K 7/20 N

[Written Amendment]
[Filing date]Heisei 16(2004) July 30 (2004.7.30)
[Amendment 1]
[Document to be Amended]Description
[Item(s) to be Amended]Claims
[Method of Amendment]Change
[The contents of correction]
[Claim(s)]
[Claim 1]

In a cooling system of electronic parts stored by electronic device,
It has a heat sink for heat-receiving, a heat exchanger for heat dissipation, a liquid circulation flow passage of a cooling medium, and a liquid driving part of the aforementioned cooling medium,
A cooling system of electronic parts having connected integrally the aforementioned heat sink and the aforementioned liquid driving part, and connecting the aforementioned electronic parts with the aforementioned heat sink thermally.
[Claim 2]
In a cooling system of the electronic parts according to claim 1,
A cooling system of electronic parts, wherein the aforementioned liquid driving part is attached to a surface where the aforementioned heat sink linked to the aforementioned electronic parts opposes.
[Claim 3]
In a cooling system of the electronic parts according to claim 1,
A cooling system of characterizing [it]-by making it become connection plane [of a heat sink which connects a driving shaft of the aforementioned liquid driving part to the aforementioned electronic parts], and parallel electronic parts.

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Wei et al.

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(45) **Date of Patent: May 29, 2007**

(54) **COOLING MODULE**

(75) Inventors: **Jie Wei**, Kawasaki (JP); **Masahiro Suzuki**, Kawasaki (JP)

(73) Assignee: **Fujitsu Limited**, Kanagawa (JP)

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H05K 7/20 (2006.01)

(52) **U.S. Cl.** **165/80.4**; 165/104.33; 361/699

(58) **Field of Classification Search** 165/104.14, 165/104.28, 104.31, 104.33; 361/697, 699
See application file for complete search history.

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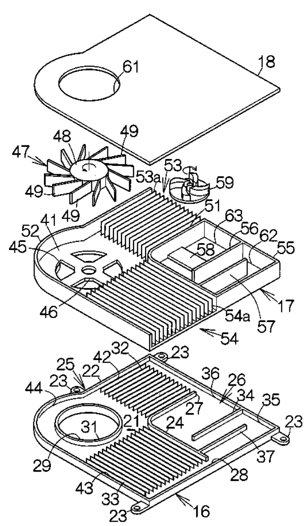
(74) *Attorney, Agent, or Firm*—Armstrong, Kratz, Quintos, Hanson & Brooks LLP

(57) **ABSTRACT**

A cooling module includes a thermal conductive member. An endoergic chamber, a radiative chamber and a circulation pump chamber are defined along the thermal conductive member. The thermal conductive member contacts a heat generating object outside the endoergic chamber. The thermal energy is transferred to the coolant in the endoergic chamber. The coolant then flows into the radiative chamber. The thermal energy of the coolant is taken away in the radiative chamber. The thermal energy is radiated from the outer wall surface of the radiative chamber. This cooling cycle is repeated so that an efficient cooling operation can be realized in the cooling module. Arrangement of the endoergic, radiative and circulation pump chambers along the thermal conductive member leads to a minimized height of the cooling module.

13 Claims, 3 Drawing Sheets



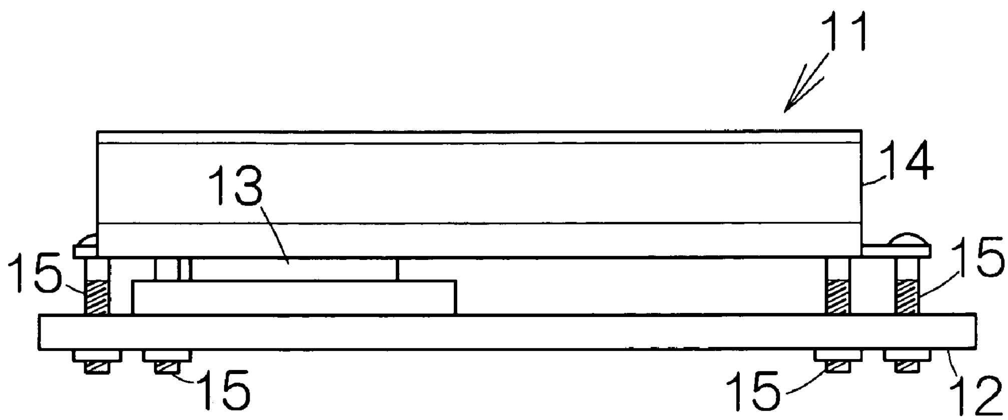


FIG.1

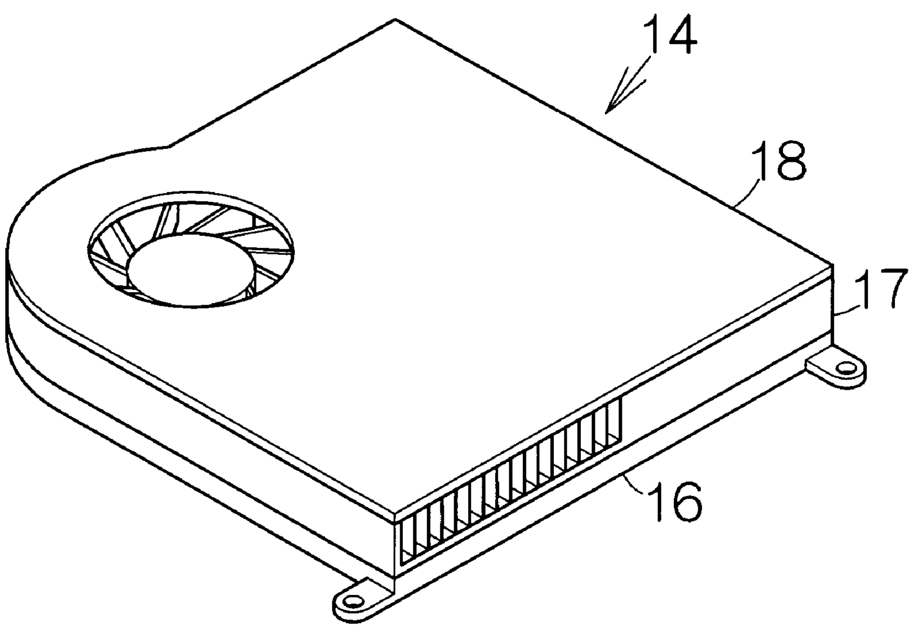


FIG.2

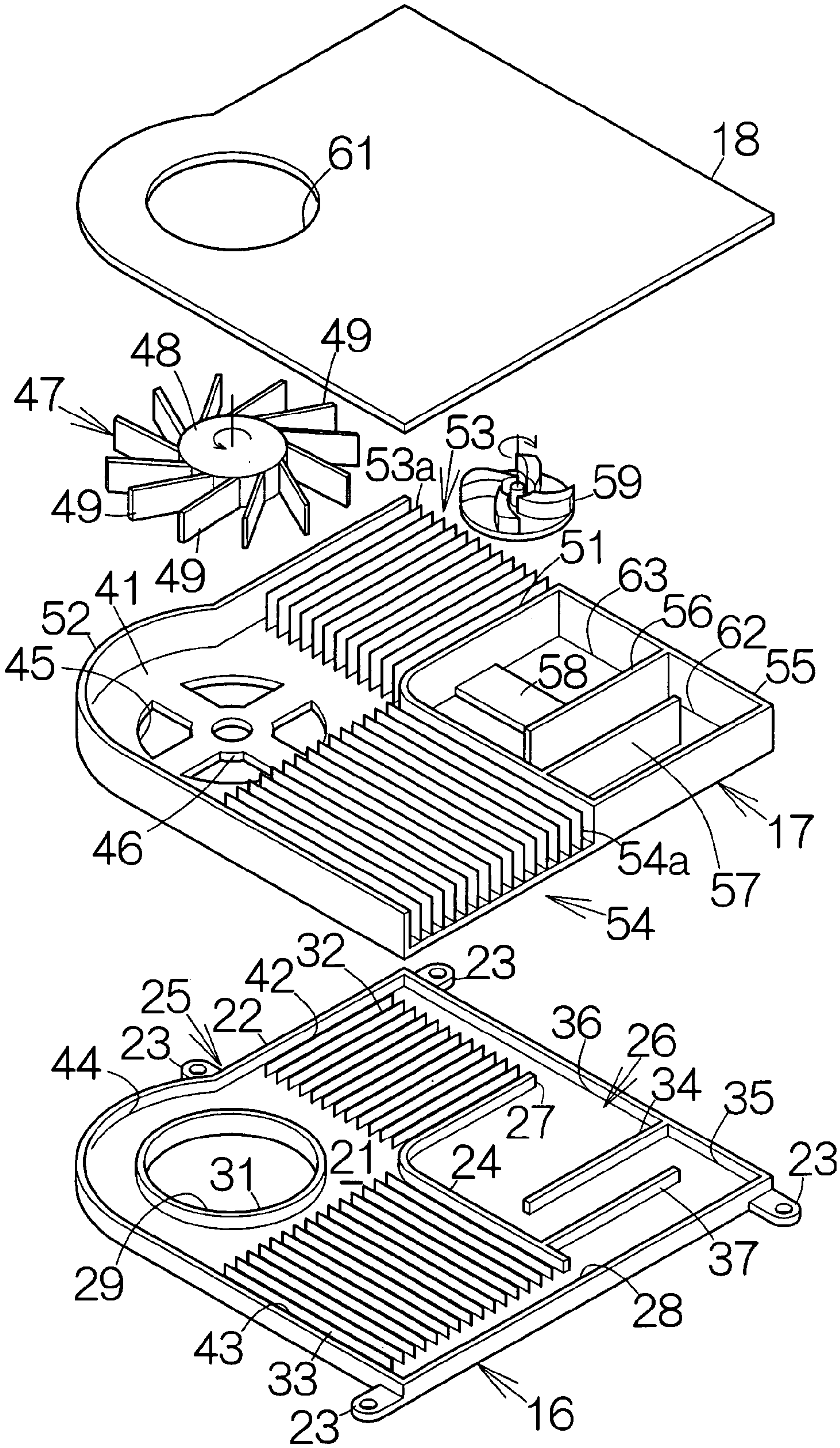

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FIG.3

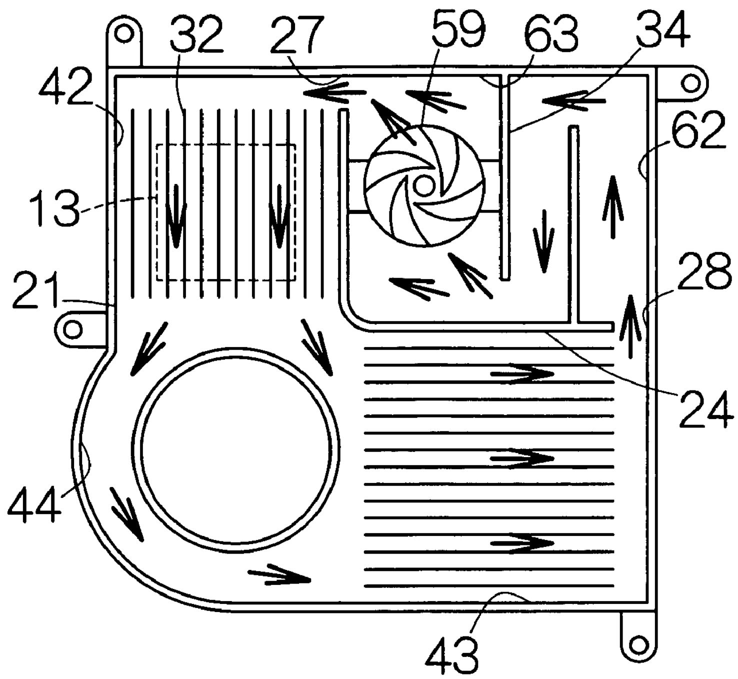

FIG.4

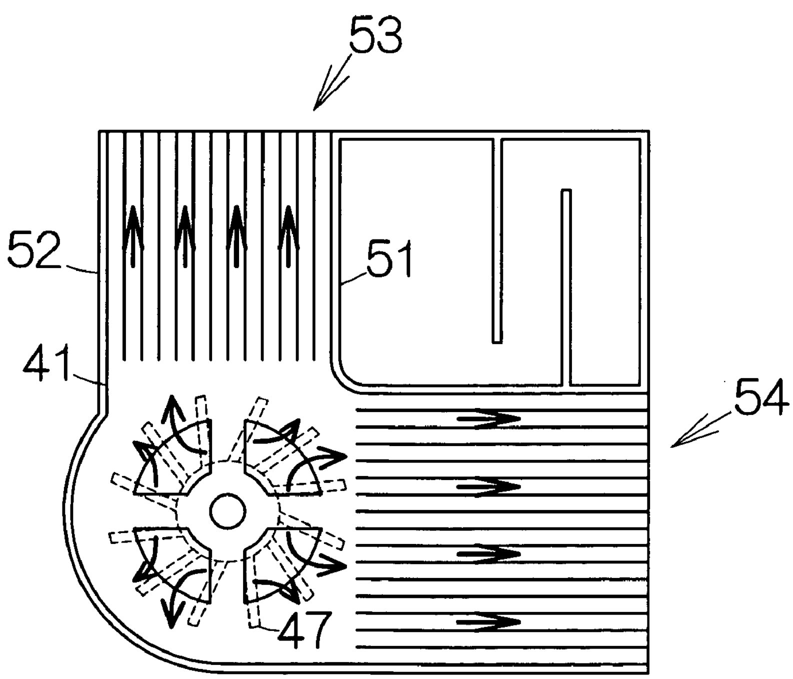

FIG.5

COOLING MODULE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a cooling module comprising an endoergic chamber designed to transfer thermal energy to a coolant, and a radiative chamber connected to the endoergic chamber so as to absorb the thermal energy from the coolant.

2. Description of the Prior Art

A cooling module often includes radiation fins. The cooling module of the type usually includes a thermal conductive plate contacting a heat generating object such as a large-scale integrated circuit (LSI) chip, as disclosed in Japanese Patent Application Publication No. 8-32263. The radiation fins are fixed to the thermal conductive plate. The thermal energy of the LSI chip is transferred to the coolant through the thermal conductive plate. The coolant flows within the radiation fins. The thermal energy of the LSI chip is in this manner transferred to the radiation fins. The thermal energy of the coolant is then radiated into the air through the radiation fins.

The aforementioned publication discloses the radiation fins standing from the thermal conductive plate in the cooling device. Unless the radiation fins are formed sufficiently higher, a efficient radiation of heat cannot be achieved. A larger space is required above the LSI chip, for example. In addition, a flow passage of the coolant must be formed within the individual one of the radiation fins in the cooling module of the type. The production of the cooling module gets complicated. This leads to an increased production cost.

SUMMARY OF THE INVENTION

It is accordingly an object of the present invention to provide a cooling module contributing to a reduced space required above a target object and to an efficient cooling of the target object.

According to a first aspect of the present invention, there is provided a cooling module comprising: a thermal conductive member at least partly having a thermal conductivity; an endoergic chamber defined along the thermal conductive member and designed to transfer thermal energy to a coolant; a radiative chamber defined along the thermal conductive member off the endoergic chamber and designed to absorb thermal energy from the coolant; a circulation pump chamber defined along the thermal conductive chamber off the endoergic chamber; and a circulation pump placed within the circulation pump chamber and designed to circulate the coolant through the endoergic and radiative chambers.

A circulation channel is established through the endoergic, radiative and circulation pump chambers in the cooling module. A closed circulation channel can be established. When the circulation pump operates, the coolant circulate through the endoergic, radiative and circulation pump chambers in this sequence. The coolant absorbs thermal energy from the thermal conductive member in the endoergic chamber. The coolant is then allowed to flow along the thermal conductive member into the radiative chamber. The thermal energy of the coolant is taken away in the radiative chamber. The coolant gets cooled. The cooled coolant is led to the endoergic chamber through the circulation pump chamber. This cooling cycle is repeated so that an efficient cooling operation can be realized in the cooling module.

In addition, the cooling module enables arrangement of the endoergic, radiative and circulation pump chambers along the thermal conductive member. The height of the cooling module can be minimized. The cooling module requires only a smaller space on a target object.

The cooling module may further comprise an auxiliary member opposed to the thermal conductive member between the endoergic and radiative chambers, for example. The auxiliary member thus serves to define a flow passage for bringing the coolant to the radiative chamber from the endoergic chamber. The flow passage connects the endoergic chamber to the radiative chamber. Leakage of the coolant is reliably prevented in the cooling module as compared with the case where piping is employed to connect the endoergic chamber to the radiative chamber. The cooling module is allowed to have an improved durability and reliability.

The cooling module may further comprise a reservoir defined along the thermal conductive member off the radiative chamber. The reservoir is designed to reserve the coolant discharged from the radiative chamber. This enables arrangement of the endoergic chamber, the radiative chamber, the reservoir and the circulation pump chamber along the thermal conductive member. The height of the cooling module can be minimized.

A partition may be placed between the radiative chamber and the reservoir so as to isolate the radiative chamber from the reservoir. The reservoir can be formed in a facilitated manner. Moreover, the break of the partition can be utilized to connect the radiative chamber to the reservoir. Leakage of the coolant can reliably be prevented in the cooling module as compared with the case where piping is employed to connect the radiative chamber to the reservoir.

Likewise, a partition may be placed between the reservoir and the circulation pump chamber so as to isolate the reservoir from the circulation pump chamber. The reservoir can be formed in a facilitated manner. Moreover, the break of the partition can be utilized to connect the reservoir to the circulation pump chamber. Leakage of the coolant can reliably be prevented in the cooling module as compared with the case where piping is employed to connect the reservoir to the circulation pump chamber.

The cooling module may further comprise: a first fin standing from the outer wall surface of the endoergic chamber; a second fin standing from the outer wall surface of the radiative chamber; and a ventilation fan placed within a space adjacent the first and second fins. The first fin serves to absorb the thermal energy from the coolant within the endoergic chamber. The second fin likewise serves to absorb the thermal energy from the coolant within the radiative chamber. The cooling of the coolant can be promoted in this manner. Moreover, air is introduced into the first and second fins from the ventilation fan. The first and second fins are allowed to realize an efficient radiation of heat.

According to a second aspect of the present invention, there is provided a cooling module comprising: a plate-shaped upper thermal conductive member; a plate-shaped lower thermal conductive member opposed to the upper thermal conductive member; an endoergic chamber defined between the upper and lower thermal conductive members and designed to transfer thermal energy to a coolant; and a radiative chamber defined between the upper and lower thermal conductive members at a location off the endoergic chamber and designed to absorb thermal energy from the coolant.

A circulation channel is established through the endoergic and radiative chambers in the cooling module. A closed circulation channel can be established. When the coolant circulates through the endoergic and radiative chambers, the coolant serves to transfer the thermal energy from the endoergic chamber to the radiative chamber. The thermal energy is radiated from the radiative chamber into the air. This cooling cycle is repeated so that an efficient cooling operation can be realized in the cooling module.

The cooling module enables establishment of the endoergic and radiative chambers between the plate-shaped upper and lower thermal conductive plates. The endoergic and radiative chambers can be included within a flat space. The height of the cooling module can be minimized.

The upper and lower thermal conductive members may cooperate to define between the radiative and endoergic chambers a flow passage for bringing the coolant to the radiative chamber from the endoergic chamber. The flow passage connects the endoergic chamber to the radiative chamber. Leakage of the coolant can reliably be prevented in the cooling module as compared with the case where piping is employed to connect the endoergic chamber to the radiative chamber. The cooling module is allowed to have an improved durability and reliability.

The cooling module may further comprise: a plate-shaped auxiliary member opposed to the upper surface of the upper thermal conductive member so as to define an airflow passage outside the endoergic and radiative chambers; a first fin standing from the upper surface of the upper thermal conductive member outside the endoergic chamber; and a second fin standing from the upper surface of the upper thermal conductive member outside the radiative chamber. The first and second fins serve to promote the cooling of the coolant in the same manner as described above. Here, a ventilation fan may be placed within the airflow passage. The ventilation fan serves to bring air into the first and second fins. This still promotes the cooling of the coolant.

The auxiliary member and lower thermal conductive member may cooperate to define a reservoir designed to reserve the coolant discharged from the radiative chamber. The reservoir is defined between the plate-shaped upper and lower thermal conductive members in the same manner as described above. The reservoir can be included within a flat space. The height of the cooing module can be minimized. The cooling module requires only a smaller space on a target object.

Otherwise, the auxiliary member and lower thermal conductive member may cooperate to define a circulation pump chamber designed to receive the coolant discharged from the reservoir. The circulation pump chamber is defined between the plate-shaped upper and lower thermal conductive members in the same manner as described above. The circulation pump chamber can be included within a flat space. The height of the cooing module can be minimized. A circulation pump may be placed within the circulation pump chamber so as to discharge the coolant to the endoergic chamber.

According to a third aspect of the present invention, there is provided a cooling module comprising: an endoergic chamber defined at least partly with a wall exposed to a first passage, said endoergic chamber designed to transfer thermal energy to a coolant; a radiative chamber defined at least partly with a wall exposed to a second passage, said radiative chamber designed to absorb thermal energy from the coolant; and a ventilation fan placed within a space connecting the first passage to the second passage.

The cooling module enables airflow from the ventilation fan to flow along the wall of the endoergic chamber in the first passage. The cooling module also enables airflow from the ventilation fan to flow along the wall of the radiative chamber in the second passage. The thermal energy is efficiently taken away from the coolant within the endoergic and radiative chambers. The airflow from the single ventilation fan is in this manner efficiently utilized in the cooling of the coolant.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become apparent from the following description of the preferred embodiment in conjunction with the accompanying drawings, wherein:

FIG. **1** is a side view schematically illustrating the structure of a printed circuit board unit;

FIG. **2** is a perspective view schematically illustrating a cooling module in the printed circuit board unit;

FIG. **3** is an exploded view of the cooling module;

FIG. **4** is a plan view schematically illustrating the circulation of a coolant along a lower thermal conductive plate; and

FIG. **5** is a plan view schematically illustrating airflow generated along the upper thermal conductive plate.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** illustrates a schematic view of a printed circuit board unit **11**. The printed circuit board unit **11** includes a printed circuit board **12** and a central processing unit (CPU) **13** mounted on the printed circuit board **12**, for example. The CPU **13** is allowed to operate based on software programs temporarily stored in a memory, not shown, for example. The CPU **13** generates heat during the operation. A cooling module **14** is placed on the CPU **13**. The cooling module **14** serves to cool the CPU **13**. Screws **15** may be employed to couple the cooling module **14** to the printed circuit board **12**.

As shown in FIG. **2**, the cooling module **14** includes a first housing **16**. A second housing **17** is placed on the first housing **16**. A cover **18** is placed on the second housing **17**.

As shown in FIG. **3**, the first housing **16** includes a lower thermal conductive plate **21** defining a plane. A peripheral wall **22** is formed along the outer periphery of the lower thermal conductive plate **21**. The peripheral wall **22** stands from the upper surface of the lower thermal conductive plate **21**. The peripheral wall **22** endlessly extends without a gap. Tabs **23** are formed at the outer periphery of the lower thermal conductive plate **21**. The tabs **23** protrude from the outer periphery of the lower thermal conductive plate **21**. A through hole is defined in the individual tab **23** for receiving the insertion of the corresponding screw **15**.

A partition **24** is formed on the upper surface of the lower thermal conductive plate **21**. The partition **24** stands from the upper surface of the lower thermal conductive plate **21** inside the peripheral wall **22**. The partition **24** serves to divide a space surrounded by the peripheral wall **22** into two spaces. This division achieves the establishment of first and second divisional spaces **25**, **26** inside the peripheral wall **22**. A first connecting opening **27** is formed between one end of the partition **24** and the peripheral wall **22**. The first connecting opening **27** serves to connect the first and second divisional spaces **25**, **26** to each other. A second connecting opening **28** is likewise formed between the other end of the partition **24** and the peripheral wall **22**. The second connecting opening **28** serves to connect the first and second divisional spaces **25**, **26** to each other.

A circular opening **29** is formed in the lower thermal conductive plate **21** within the first divisional space **25**. An inner peripheral wall **31** is formed around the opening **29**. The inner peripheral wall **31** stands from the upper surface of the lower thermal conductive plate **21**. The inner peripheral wall **31** continuously surrounds the opening **29** without a gap.

First upright walls **32** are formed on the lower thermal conductive plate **21** within the first divisional space **25**. The first upright walls **32** stand from the upper surface of the lower thermal conductive plate **21**. The individual first upright walls **32** extend from positions near the first connecting opening **27** toward the inner peripheral wall **31**. A predetermined space is defined between the adjacent parallel first upright walls **32**. Flow passages are thus formed between the adjacent first upright walls **32**.

Second upright walls **33** are likewise formed on the lower thermal conductive plate **21** within the first divisional space **25**. The second upright walls **33** stand from the upper surface of the lower thermal conductive plate **21**. The individual second upright walls **33** extend from positions near the second connecting opening **28** toward the inner peripheral wall **31**. A predetermined space is defined between the adjacent parallel second upright walls **33**. Flow passages are thus formed between the adjacent second upright walls **33**.

An auxiliary partition **34** is formed on the lower thermal conductive plate **21** within the second divisional space **26**. The auxiliary partition **34** stands from the upper surface of the lower thermal conductive plate **21**. The auxiliary partition **34** serves to divide the second divisional space **26** into two spaces. In this case, the auxiliary partition **34** extends from the peripheral wall **22** toward the partition **24**. The second divisional space **26** is thus divided into a first small space **35** near the second connecting opening **28** and a second small space **36** near the first connecting opening **27**. The first and second small spaces **35**, **36** are connected to each other. A gap is defined between the end of the auxiliary partition **34** and the partition **24** so as to establish the connection between the first and second small spaces **35**, **36**.

Here, an upright wall **37** is formed on the lower thermal conductive plate **21** within the first small space **35**. The upright wall **37** stands from the upper surface of the lower thermal conductive plate **21**. The upright wall **37** serves to divide the first small space **35** into two spaces. The upright wall **37** extends in parallel with the auxiliary partition **34** from a position near the aforementioned other end of the partition **24** toward the peripheral wall **22** so as to realize the division of the first small space **35**. This division establishes a first smaller space near the second connecting opening **28** and a second smaller space near the auxiliary partition **34**. The first and second smaller spaces are connected to each other. A gap is defined between the end of the upright wall **37** and the peripheral wall **22** so as to establish the connection.

The second housing **17** includes a bottom plate or upper thermal conductive plate **41**. The upper thermal conductive plate **41** serves as an auxiliary member according to the present invention. The upper thermal conductive plate **41** covers over the first divisional space **25**. The upper thermal conductive plate **41** is thus opposed to the lower thermal conductive plate **21**. The upper thermal conductive plate **41** contacts the upper ends of the peripheral wall **22**, the inner peripheral wall **31** and the partition **24** along the first divisional space **25**. The upper thermal conductive plate **41** may be brazed to the peripheral wall **22**, the inner peripheral wall **31** and the partition **24**. The first divisional space **25** is in this manner closed between the lower and upper thermal conductive plates **21**, **41**. A closed flow passage is established between the first and second connecting openings **27**, **28**. Here, an endoergic chamber **42** is defined between the peripheral wall **22** and the partition **24**. The first upright walls **32** are contained within the endoergic chamber **42**. A radiative chamber **43** is likewise defined between the peripheral wall **22** and the partition **24**. The second upright walls **33** are contained within the radiative chamber **43**. A flow passage **44** serves to connect the endoergic and radiative chambers **42**, **43** to each other. The flow passage **44** extends around the inner peripheral wall **31**. The tip or upper ends of the first and second upright walls **32**, **33** may be brazed to the upper thermal conductive plate **41**. The first and second upright walls **32**, **33** serve to promote the transfer of thermal energy from the lower thermal conductive plate **21** to the upper thermal conductive plate **41**.

A circular opening **45** is defined in the upper thermal conductive plate **41** at a location corresponding to the opening **29** of the lower thermal conductive plate **21**. A support member **46** is disposed in the opening **45**. The support member **46** may be integral to the upper thermal conductive plate **41**. A ventilation fan **47** is attached to the support member **46**. The ventilation fan **47** includes a rotary member **48** rotating around a rotation axis standing in the vertical direction from the upper thermal conductive plate **41**. Blades **49** are fixed to the rotary member **48**. The blades **49** are designed to extend in planes parallel to the rotation axis. When the rotary member **48** rotates, airflow is generated in the centrifugal direction of the rotation axis. The ventilation fan **47** serves to suck air from the openings **29**, **45** during the rotation of the rotary member **48**. Wires, not shown, are employed to supply electric power to the ventilation fan **47**. The wires may extend outward from the second housing **17**.

A first outer wall **51** is formed on the upper thermal conductive plate **41**. The first outer wall **51** stands from the upper surface of the upper thermal conductive plate **41** at a location corresponding to the partition **24** of the lower thermal conductive plate **21**. The first outer wall **51** extends along the contour of the second divisional space **26**. A second outer wall **52** is likewise formed on the upper thermal conductive plate **41** along the contour of the first divisional space **25**. The second outer wall **52** stands from the upper surface of the upper thermal conductive plate **41** at a location corresponding to the peripheral wall **22** of the lower thermal conductive plate **41**. The second outer wall **52** extends in parallel with the first outer wall **51**. The ventilation fan **47** is placed within a space between the first and second outer walls **51**, **52**.

A first radiation fin set **53** is mounted on the upper surface of the upper thermal conductive plate **41** along the endoergic chamber **42**. The first radiation fin set **53** includes radiation fins **53***a* each extending in parallel with the first and second outer walls **51**, **52**. A predetermined space is set between the adjacent radiation fins **53***a* in the first radiation fin set **53**. Airflow passages are in this manner formed between the adjacent radiation fins **53***a* in the first radiation fin set **53**. A second radiation fin set **54** is likewise mounted on the upper surface of the upper thermal conductive plate **41** along the radiative chamber **43**. The second radiation fin set **54** includes radiation fins **54***a* each extending in parallel with the first and second outer walls **51**, **52**. A predetermined space is set between the adjacent radiation fins **54***a* in the second radiation fin set **54**. Airflow passages are in this manner formed between the adjacent radiation fins **54***a* in the second radiation fin set **54**. When the ventilation fan **47** rotates, airflow is generated along the airflow passages in the first and second radiation fin set **53**, **54**.

A surrounding wall **55** is formed integral to the first outer wall **51**. The surrounding wall **55** extends along the contour of the second divisional space **26**. The surrounding wall **55** and the first outer wall **51** cooperate to surround a small space without a gap. The surrounding wall **55** stands from the peripheral wall **22** at a portion that extends along the second divisional space **26**. The surrounding wall **55** may be brazed at the tip or upper end of the peripheral wall **22**.

An auxiliary partition **56** is formed integral to the surrounding wall **55**. The auxiliary partition **56** extends on the auxiliary partition **34**. Specifically, the auxiliary partition **56** stands from the top or upper end of the auxiliary partition **34**. The auxiliary partition **56** may be brazed to the auxiliary partition **34**. An upright wall **57** is likewise formed integral to the first outer wall **51**. The upright wall **57** extends on the upright wall **37**. Specifically, the uptight wall **57** stands from the top or upper end of the upright wall **37**. The upright wall **57** may be brazed to the upright wall **37**.

A support member **58** is placed between the auxiliary partition **56** and the first outer wall **51**. The support member **58** may be integral to the first outer wall **51** and the auxiliary partition **56**. A liquid circulation pump **59** is attached to the support member **58**. When the liquid circulation pump **59** rotates around the rotation axis in a liquid, flow of the liquid is induced based on the rotation. Wires, not shown, may be employed to supply the liquid circulation pump **59**. The wires may extend outward from the second housing **17**.

The cover **18** covers over the second housing **17**. Since the contour of the cover **18** corresponds to that of the second housing **17**, the cover **18** contacts the upper ends of the first and second outer walls **51**, **52**, the surrounding wall **55**, the auxiliary partition **45** and the upright wall **57**. The cover **18** may be brazed to the first and second outer walls **51**, **52**, the surrounding wall **55**, the auxiliary partition **45** and the upright wall **57**. An airflow passage is thus established between the cover **18** and the upper thermal conductive plate **41** within a space between the first and second outer walls **51**, **52**. The airflow passage contains the aforementioned first and second radiation fin sets **53**, **54**. A circular opening **61** is formed in the cover **18** at a location corresponding to the openings **29**, **45**. The ventilation fan **47** serves to suck air from the opening **61** during the rotation.

A reservoir **62** and a circulation pump chamber **63** are defined between the cover **18** and the lower thermal conductive plate **21**. The reservoir **62** and the circulation pump chamber **63** are surrounded by the partition **24**, the first outer wall **51**, the peripheral wall **22** and the surrounding wall **55**. The auxiliary partitions **34**, **56** serve to isolate the reservoir **62** from the circulation pump chamber **63**. The reservoir **62** includes the aforementioned first small space **35**. The circulation pump chamber **62** includes the aforementioned second small space **36**. The reservoir **62** is connected to the radiative chamber **43** through the aforementioned second connecting opening **28**. The circulation pump chamber **63** is connected to the endoergic chamber **42** through the aforementioned first connecting opening **27**. The aforementioned liquid circulation pump **59** is placed within the circulation chamber **63**.

As shown in FIG. **4**, a circulation channel is established along the lower thermal conductive plate **21** for a coolant or refrigerant in the cooling module **14**. The circulation channel is closed between the lower and upper thermal conductive plates **21**, **41** as well as between the lower thermal conductive plate **21** and the cover **18**. When the liquid circulation pump **59** operates, the coolant such as water is forced to circulate in the circulation channel. The liquid circulation pump **59** serves to generate flow of the coolant from the reservoir **62** to the circulation pump chamber **63**. The coolant discharged from the circulation pump chamber **63** is directed to the endoergic chamber **42** through the first connecting opening **27**. The CPU **13** contacts the lower thermal conductive plate **21** outside the endoergic chamber **42**. The thermal energy of the CPU **13** is thus transferred to the coolant within the endoergic chamber **42** through the lower thermal conductive plate **21**. The coolant gets heated. In this case, the first upright walls **32** receive the thermal energy from the lower thermal conductive plate **21**. The coolant is allowed to efficiently receive the thermal energy over a broader area in this manner. The transfer of the thermal energy is thus promoted. At the same time, the upper thermal conductive plate **41** receives the thermal energy from the first upright walls **32**. The thermal energy is radiated from the upper thermal conductive plate **41** into the air.

The coolant flows into the flow passage **44** from the endoergic chamber **42**. The thermal energy of the coolant is transferred to the lower and upper thermal conductive plates **21**, **41** within the flow passage **44**. The lower and upper thermal conductive plates **21**, **41** serve to absorb the thermal energy of the coolant. The coolant then enters the radiative chamber **43**. The thermal energy is efficiently taken away from the coolant through the second upright walls **33** over a broader area within the radiative chamber **43**. The thermal energy is rapidly lost in this manner. The lower and upper thermal conductive plates **21**, **41** serve to radiate the thermal energy into the air. The coolant is thus cooled. The cooled coolant is allowed to flow into the reservoir **62** through the second connecting opening **28**.

The cooling module **14** enables arrangement of the endoergic chamber **42**, the radiative chamber **43**, the reservoir **62** and the circulation pump chamber **63** along the plane defined by the lower thermal conductive plate **21**. The height of the cooling module **14** can be minimized. The cooling module **14** requires only a smaller space on the CPU **13**. The cooling module **14** also enables the production of the first and second housings **16**, **17** and the cover **18** based on metal plates, for example. In this case, pressing may be employed to form the first and second housings **16**, **17** and the cover **18**, respectively. It is thus possible to avoid complication of the production process. An increase in the production cost cannot be accompanied. The first and second upright walls **32**, **33** and the first and second radiation fin sets **53**, **54** may be brazed on the first and second housings **16**, **17**.

Moreover, the partition **24** and the auxiliary partitions **34**, **56** serve to isolate the endoergic chamber **42**, the radiative chamber **43**, the reservoir **62** and the circulation pump chamber **63** from one another. On the other hand, the breaks of the partition **24** and the auxiliary partitions **34**, **56** is utilized to connect the endoergic chamber **42**, the radiative chamber **43**, the reservoir **62** and the circulation pump chamber **63** to each other. Leakage of the coolant is reliably prevented in the cooling module **14** as compared with the case where piping is employed to connect the endoergic chamber, the radiative chamber, the reservoir and the circulation pump chamber to each other. The cooling module **14** is allowed to have an improved endurance and reliability.

Furthermore, the cooling module **14** enables establishment of the airflow passage along the upper thermal conductive plate **41**, as shown in FIG. **5**, for example. The ventilation fan **47** induces the airflow in a first direction that reaches the first radiation fin set **53**. The ventilation fan **47** also induces the airflow in a second direction different from the first direction so as to bring the airflow into the second radiation fin set **54**. The single ventilation fan **47** allows the airflow to flow along the different directions. The airflow from the ventilation fan **47** is efficiently utilized in this manner. The airflow efficiently absorbs the thermal energy from the first and second radiation fin sets **53**, **54**. The thermal energy of the coolant is efficiently radiated into the air through the first and second radiation fin sets **53**, **54** after it is transmitted to the first and second radiation fin sets **53**, **54** from the upper thermal conductive plate **41**. The cooling of the coolant is thus promoted.

It should be noted that the cooling module **14** may employ a compressor in place of the aforementioned liquid circulation pump **59**. It depends upon the kind of the coolant or refrigerant.

What is claimed is:

1. A cooling module comprising:

a thermal conductive member at least partly having a thermal conductivity;

an endoergic chamber defined along a plane of the thermal conductive member, said endoergic chamber designed to transfer thermal energy to a coolant;

a radiative chamber defined along the plane of the thermal conductive member off the endoergic chamber, said radiative chamber designed to absorb thermal energy from the coolant;

a circulation pump chamber defined along the plane of the thermal conductive member off the endoergic chamber; and

a circulation pump placed within the circulation pump chamber, said circulation pump designed to circulate the coolant through the endoergic and radiative chambers.

2. The cooling module according to claim **1**, further comprising an auxiliary member opposed to the thermal conductive member between the endoergic and radiative chambers so as to define a flow passage for bringing the coolant to the radiative chamber from the endoergic chamber.

3. The cooling module according to claim **1**, further comprising: a first fin standing from an outer wall surface of the endoergic chamber; a second fin standing from an outer wall surface of the radiative chamber; and a ventilation fan placed within a space adjacent the first and second fins.

4. The cooling module according to claim **1**, wherein the endoergic chamber, the radiative chamber and the circulation pump chamber are defined directly on the plane of the thermal conductive member.

5. A cooling module comprising:

a thermal conductive member at least partly having a thermal conductivity;

an endoergic chamber defined along the thermal conductive member, said endoergic chamber designed to transfer thermal energy to a coolant;

a radiative chamber defined along the thermal conductive member off the endoergic chamber, said radiative chamber designed to absorb thermal energy from the coolant;

a circulation pump chamber defined along the thermal conductive member off the endoergic chamber;

a circulation pump placed within the circulation pump chamber, said circulation pump designed to circulate the coolant through the endoergic and radiative chambers; and

a reservoir defined along the thermal conductive member off the radiative chamber, said reservoir designed to reserve the coolant discharged from the radiative chamber.

6. The cooling module according to claim **5**, further comprising a partition placed between the radiative chamber and the reservoir so as to isolate the radiative chamber from the reservoir.

7. The cooling module according to claim **5**, further comprising a partition placed between the reservoir and the circulation pump chamber so as to isolate the reservoir from the circulation pump chamber.

8. A cooling module comprising:

a plate-shaped upper thermal conductive member;

a plate-shaped lower thermal conductive member opposed to the upper thermal conductive member;

an endoergic chamber defined directly on a plane of the lower thermal conductive member, said endoergic chamber designed to transfer thermal energy to a coolant; and

a radiative chamber defined directly on the plane of the lower thermal conductive member at a location off the endoergic chamber, said radiative chamber designed to absorb thermal energy from the coolant.

9. The cooling module according to claim **8**, wherein said upper and lower thermal conductive members cooperate to define between the radiative and endoergic chambers a flow passage for bringing the coolant to the radiative chamber from the endoergic chamber.

10. A cooling module comprising:

a plate-shaped upper thermal conductive member;

a plate-shaped lower thermal conductive member opposed to the upper thermal conductive member;

an endoergic chamber defined directly on the lower thermal conductive member, said endoergic chamber designed to transfer thermal energy to a coolant;

a radiative chamber defined directly on the lower thermal conductive member at a location off the endoergic chamber, said radiative chamber designed to absorb thermal energy from the coolant;

a plate-shaped auxiliary member opposed to an upper surface of the upper thermal conductive member so as to define an airflow passage outside the endoergic and radiative chambers;

a first fin standing from the upper surface of the upper thermal conductive member outside the endoergic chamber; and

a second fin standing from the upper surface of the upper thermal conductive member outside the radiative chamber.

11. The cooling module according to claim **10**, wherein a ventilation fan is placed in the airflow passage.

12. A cooling module comprising:

a plate-shaped upper thermal conductive member;

a plate-shaped lower thermal conductive member opposed to the upper thermal conductive member;

an endoergic chamber defined between the upper and lower thermal conductive members, said endoergic chamber designed to transfer thermal energy to a coolant;

a radiative chamber defined between the upper and lower thermal conductive members at a location off the endoergic chamber, said radiative chamber designed to absorb thermal energy from the coolant;

a plate-shaped auxiliary member opposed to an upper surface of the upper thermal conductive member so as to define an airflow passage outside the endoergic and radiative chambers;

a first fin standing from the upper surface of the upper thermal conductive member outside the endoergic chamber; and

a second fin standing from the upper surface of the upper thermal conductive member outside the radiative chamber, wherein

said auxiliary member and lower thermal conductive member cooperate to define a reservoir designed to reserve the coolant discharged from the radiative chamber.

13. The cooling module according to claim **12**, wherein said auxiliary member and lower thermal conductive member cooperate to define a circulation pump chamber designed to receive the coolant discharged from the reservoir, said circulation pump chamber containing a circulation pump designed to discharge the coolant to the endoergic chamber.

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vertant /ˈvəːt(ə)nt/ *adjective*. Long *rare*. L17.
[French, from Latin *vertent-* pres. ppl stem of *vertere* turn.]
HERALDRY. Bending, curving.

vertebr- *combining form* see VERTEBRO-.

vertebra /ˈvəːtɪbrə/ *noun*. Pl. **-brae** /-briː, -breɪ/. E17.
[Latin, from *vertere* turn.]
1 ANATOMY & ZOOLOGY. Any of the bony joints or segments composing the spinal column in man and other vertebrates. E17.
2 In *pl.* The spinal column. E17.
3 ZOOLOGY & PALAEONTOLOGY. Any of the segments or ossicles of the arms of brittle-stars and other ophiuroid echinoderms. E18.
1 *caudal vertebra*, *cervical vertebra*, *lumbar vertebra*, *sacral vertebra*, *thoracic vertebra*, etc.

vertebral /ˈvəːtɪbr(ə)l/ *adjective & noun*. L17.
[mod. Latin *vertebralis*, from prec.: see -AL¹.]
▶ **A** *adjective*. **1** Of or pertaining to the vertebrae; situated in, on, or near the vertebrae. L17.
2 Composed of vertebrae. E19.
3 ZOOLOGY. = VERTEBRATE *adjective* 1. Now *rare*. E19.
4 ZOOLOGY. Designating the ossicles which form the vertebrae of ophiuroid echinoderms. L19.
2 **vertebral column** = *spinal column* s.v. SPINAL *adjective*.
▶ **B** *noun*. **1** A vertebral artery or vein. E18.
2 ZOOLOGY. Any of the row of dorsal scutes in the midline of the carapace of a tortoise or turtle. L19.

Vertebrata /vəːtɪˈbrɑːtə/ *noun pl.* Also **v-**. E19.
[mod. Latin from Latin, neut. pl. of *vertebratus*: see next.]
ZOOLOGY. (Members of) a subphylum of the phylum Chordata including all vertebrate animals.

vertebrate /ˈvəːtɪbrət/ *adjective & noun*. E19.
[Latin *vertebratus* jointed, articulated, formed as VERTEBRA: see -ATE¹, -ATE².]
▶ **A** *adjective*. **1** ZOOLOGY. Of or belonging to the subphylum Vertebrata, which comprises chordate animals with a bony or cartilaginous skeleton, skull, and spinal column, and includes fishes, amphibians, reptiles, birds, and mammals. E19.
2 Of, pertaining to, characteristic of, or found in a backboned animal or animals. M19.
3 *fig.* Of a literary text etc.: characterized by strength or coherence. L19.
▶ **B** *noun*. An animal of the subphylum Vertebrata; a vertebrate animal. E19.
■ **vertebrated** *adjective* (now *rare* or *obsolete*) (*a*) = VERTEBRATE *adjective* 1; (*b*) consisting of or provided with vertebrae: E19.

vertebrate /ˈvəːtɪbreɪt/ *verb trans*. Now *rare*. L19.
[from prec.: see -ATE³.]
Connect or join in a similar way to vertebrae. Usu. in *pass.*

vertebration /vəːtɪˈbreɪʃ(ə)n/ *noun*. L19.
[from VERTEBRA + -ATION.]
1 Vertebral formation; division into segments like those of the spinal column. L19.
2 *fig.* Strength, backbone. *rare*. L19.

†vertebre *noun*. M16.
[French *vertèbre* from Latin VERTEBRA.]
1 The rounded top of the thigh bone. Only in M16.
2 = VERTEBRA 1. L16–M19.

vertebro- /ˈvəːtɪbrəʊ/ *combining form* of VERTEBRA: see -O-. Before a vowel also **vertebr-**. Forming terms in ANATOMY.
■ **vertebrarˈterial** *adjective* of or pertaining to the vertebral artery L19. **vertebroˈbasilar** *adjective* of, pertaining to, or involving the vertebral and basilar arteries M20.

vertex /ˈvəːtɛks/ *noun*. Pl. **vertices** /ˈvəːtɪsiːz/, **vertexes**. LME.
[Latin = whirl, vortex, crown of the head, highest point, from *vertere* turn.]
1 **a** ANATOMY & ZOOLOGY. The crown or top of the head or skull; *spec.* in humans, the part lying between the occiput and the sinciput. LME. ▶**b** ENTOMOLOGY. The top of the head of an insect, between the eyes and the occipital suture. E19.
2 **a** GEOMETRY. The point opposite to the base of a (plane or solid) figure; the point in a curve or surface at which the axis meets it; an angular point of a triangle, polygon, etc. L16. ▶**b** OPTICS. The point where the optic axis intersects the surface of a lens. E18. ▶**c** ASTRONOMY. The point on the limb of a celestial object where it is intersected by a circle passing through the zenith and the centre of the object. Now also, the point to which a group of stars appears to converge, or from which a shower of meteors appears to radiate. L19. ▶**d** MATH. A junction of two or more lines in a network or graph; a node. M20.
3 The point in the sky vertically overhead, or directly above a given place; the zenith. M17.
4 The top or highest point of a thing; *spec.* (*a*) the summit of a hill; (*b*) the crown of an arch. M17.
Comb.: **vertex presentation** MEDICINE a presentation in which the vertex of the foetus lies nearest to the cervix as labour begins.

vertical /ˈvəːtɪk(ə)l/ *adjective & noun*. M16.
[French, or late Latin *verticalis*, from Latin *vertex*: see VERTEX, -AL¹.]
▶ **A** *adjective*. **1** Of, pertaining to, situated at, or passing through the vertex or zenith; occupying a position in the sky directly overhead or above a given place or point. M16.
2 Placed, extending, moving, or operating at right angles to a horizontal plane; perpendicular; upright. E18.
3 BOTANY & ZOOLOGY. Having a position at right angles to the plane of the axis, body, or supporting surface; pointing directly upwards or downwards. L18.
4 ZOOLOGY & ANATOMY. Of, pertaining to, situated on, or affecting the vertex of the head. E19.
5 MUSIC. Pertaining to or involving the relationship between notes sounded simultaneously (rather than successively); harmonic or chordal as opp. to melodic. L19.
6 Pertaining to or involving the different levels of a hierarchy or progression; *spec.* (*a*) involving successive stages in the production of a particular class of goods; (*b*) involving upward or downward social or economic mobility. E20.
7 Pertaining to or designating an aerial photograph taken looking vertically downwards. E20.
2 C. DARWIN We give a vertical nod of approval ... S. HEYWOOD The adaptation of the Virginian Creeper to climbing up vertical walls. N. SHERRY A storm burst and there was a vertical wall of water all day.
Special collocations: **vertical angle** MATH. (*a*) the angle opposite the base of a triangle or polygon; (*b*) (*pl.*) each of the pairs of opposite angles made by two intersecting straight lines. **vertical circle** an azimuth circle. **vertical fin** ZOOLOGY = *median fin* s.v. MEDIAN *adjective*² 1. **vertical integration** integration of firms engaged in successive stages in the production of goods. **vertical keel** NAUTICAL formed from plating resting vertically on the inner side of a plate keel, and supporting the keelson. **vertical market**: comprising all the potential purchasers in a particular occupation or industry. **vertical plane** a plane at right angles to the horizontal. **†vertical point** (*a*) = VERTEX 3; (*b*) *fig.* the culminating point, the peak of perfection. **vertical proliferation** the increase in the number, kinds, or power of the nuclear weapons of a State which already possesses such weapons. **vertical take-off** the take-off of an aircraft directly upwards. **vertical tasting** a tasting in order of year of several different vintages of a particular wine. **vertical thinking** deductive reasoning (opp. *lateral thinking*).
▶ **B** *noun*. **†1** *fig.* A high point; a zenith. E–M17.
2 A vertical circle, line, or plane. M17.
3 A vertical aerial photograph. E20.
Phrases: **out of the vertical** not vertical, deviating from the perpendicular. *prime vertical*: see PRIME *adjective*.
¶ In many senses opp. *horizontal*.
■ **vertic** *adjective* (*poet.*, now *rare* or *obsolete*) (esp. of the sun) overhead, vertical E17. **verticalism** *noun* (*rare*, ARCHITECTURE) the condition or quality of being vertical, vertical position M19. **vertiˈcality** *noun* (*a*) the fact of the sun or other celestial object being at the vertex or zenith; (*b*) the condition or quality of being vertical or perpendicular; vertical position: L16. **verticaliˈzation** *noun* the action or result of making something vertical M20. **verticalize** *verb trans.* make vertical M20. **vertically** *adverb* M17.

vertices *noun pl.* see VERTEX.

verticil /ˈvəːtɪsɪl/ *noun*. Also (earlier) **-cel** /-s(ə)l/. E18.
[Latin VERTICILLUS.]
†1 A kind of glass bead used as a bobbin. *rare*. Only in E18.
2 BOTANY & ZOOLOGY. A set of three or more similar organs arising at the same point on an axis; a whorl. L18.

verticillaster /ˌvəːtɪsɪˈlastə/ *noun*. M19.
[mod. Latin, from Latin VERTICILLUS + -ASTER.]
BOTANY. A kind of false whorl characteristic of inflorescences of the labiate family, formed by the confluence of several almost sessile opposite cymes.

verticillate /vəːˈtɪsɪlət, vəːtɪˈsɪlət/ *adjective*. M17.
[from VERTICILLUS + -ATE².]
BOTANY & ZOOLOGY. **1** Having leaves, flowers, setae, etc., arranged in whorls. M17.
2 Of leaves, flowers, setae, etc.: arranged in whorls. L18.
3 Characterized by verticillation. M19.
■ **verˈticillated** *adjective* (now *rare*) = VERTICILLATE L17. **verticilˈlation** *noun* the formation of verticils; a verticillate form or structure, a verticil: M19.

verticilli *noun* pl. of VERTICILLUS.

verticillium /vəːtɪˈsɪlɪəm/ *noun*. E20.
[mod. Latin (see below), from Latin VERTICILLUS + -IUM.]
Any of various hyphomycetous fungi constituting the genus *Verticillium*, some of which, esp. *V. albo-atrum* and *V. dahliae*, cause wilt in garden plants.

verticillus /vəːtɪˈsɪləs/ *noun*. Pl. **-cilli** /-ˈsɪlaɪ/. M18.
[Latin = whorl of a spindle, dim. of *vertex*.]
BOTANY. = VERTICIL 2.

verticity /vəːˈtɪsɪti/ *noun*. Now *rare* or *obsolete*. E17.
[mod. Latin *verticitas*, from Latin *vertic-* stem of *vertex*: see VERTEX, -ITY.]
1 The faculty (of a magnetic needle etc.) of turning towards a vertex or pole; magnetization; an instance of this. E17.
2 The power of turning or revolving; rotation, revolution. M17.

vertiginous /vəːˈtɪdʒɪnəs/ *adjective*. E17.
[Latin *vertiginosus*, formed as next: see -OUS.]
1 Of a person, the head, etc.: affected by or suffering from vertigo or giddiness; dizzy. E17. ▶**b** Of the nature of, pertaining to, or characterized by vertigo. E17.
2 *fig.* Unstable or unsettled in opinions etc.; inconstant, changeable; characterized by rapid change. E17.
3 Liable to cause vertigo or dizziness; inducing giddiness. M17.
4 Of motion: rotatory. M17.
2 C. LAMBERT This ... speeding up in technical experiment gives a ... vertiginous quality to the Impressionist period. 3 *Time* Trees are ... thick on the vertiginous mountain slopes. J. BUCHAN Going up into the vertiginous mountains. 4 S. JOHNSON That vertiginous motion, with which we are carried round by the diurnal revolution of the earth.
■ **†vertiginate** *verb intrans.* turn round, spin, or rush dizzily M18–M19. **vertiginously** *adverb* M18. **vertiginousness** *noun* L16.

vertigo /ˈvəːtɪɡəʊ/ *noun*. Pl. **-os**. LME.
[Latin *vertigo*, *-gin-* whirling about, giddiness, from *vertere* turn.]
1 MEDICINE. A sensation of whirling motion, tending to result in a loss of balance and sometimes of consciousness; giddiness, dizziness. LME.
2 *fig.* A disordered state of mind or things. M17.
2 W. S. JEVONS That ... intellectual vertigo which often attacks writers on the currency. M. SINCLAIR She realised, with a sudden sense of vertigo, that she had never deceived her family before.

Vertisol /ˈvəːtɪsɒl/ *noun*. M20.
[from VERTICAL + -SOL.]
SOIL SCIENCE. A clayey soil with little organic matter found in regions having distinct wet and dry seasons, characterized by deep wide cracks when dry and an uneven surface.

vertu *noun* var. of VIRTU.

verumontanum /ˌvɛrʊmɒnˈteɪnəm/ *noun*. Now *rare*. E18.
[Latin, from *veru* spit + *montanum* neut. of *montanus* hilly.]
ANATOMY. A rounded prominence in the wall of the male urethra, where the ejaculatory ducts enter it.

vervain /ˈvəːveɪn/ *noun*. LME.
[Old & mod. French *verveine* from Latin VERBENA.]
BOTANY. **1** A European and British plant of roadsides etc., *Verbena officinalis* (family Verbenaceae), with wiry stems and spikes of small lilac flowers. Also (now *rare*), with specifying word, any of various other plants of the genus *Verbena*. LME.
2 = VERBENA 2. M16.
Comb.: **vervain hummingbird** a minute green and white hummingbird, *Mellisuga minima*, which is found in Jamaica and Hispaniola.

verve /vəːv/ *noun*. L17.
[Old & mod. French = vigour (formerly also = form of expression, empty chatter, whim), from Latin *verba* pl. of *verbum* word.]
1 Special bent or talent in writing. Now *rare* or *obsolete*. L17.
2 Enthusiasm, vigour, or spirit, esp. in artistic or literary work or in sport; style, energy. E19.
2 V. BROME An intellectual dynamism which injected tremendous verve into their talk. *Guardian* Organizing ... wonderful events with the chutzpah and verve of a showman. *Times Educ. Suppl.* The story ... was told with considerable power and verve.

vervet /ˈvəːvɪt/ *noun*. L19.
[French, of unkn. origin.]
The common African savannah monkey, *Cercopithecus aethiops*; *spec.* one of a variable black-faced race found in southern and eastern Africa. Cf. *green monkey* s.v. GREEN *adjective*, GRIVET.

†vervil *noun* see VARVEL.

very /ˈvɛri/ *adjective*¹ & *adverb*. ME.
[Old French *ver(r)ai* (mod. *vrai*) from Proto-Gallo-Romance, ult. from Latin *verus* true: ending assim. to -Y¹.]
▶ **A** *adjective*. **1** Properly so called, truly entitled to the name or designation; real, genuine. *arch.* ME.
2 **†a** Truthful; sure, reliable. ME–E16. ▶**b** Of truth: exact, simple, actual. *arch.* LME.
†3 Exact or precise as opp. to approximate. ME–M17.
4 So called in the fullest sense, possessing all the essential qualities of that specified; complete, absolute. Freq. in *superl.* *arch.* LME.
†5 Of a friend etc.: faithful, sincere, staunch. LME–E17.
†6 Esp. of a person: rightful, lawful, legitimate. LME–E17.

PATENT
Customer No. 22,852
Attorney Docket No. 10494.8000-00000

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Inter Partes* Reexamination of:	)	
André Sloth ERIKSEN	)	Group Art Unit: 3993
U.S. Patent No.: 8,245,764 B2 Filed: October 7, 2011 Issued: August 21, 2012	)	Examiner: Joseph A. KAUFMAN
For: COOLING SYSTEM FOR A COMPUTER SYSTEM	)	Confirmation No.: 7254
Reexamination Proceeding Control No. 95/002,386 Filed: September 15, 2012	)	

Mail Stop *Inter Partes* Reexam
Attention: Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

RESPONSE UNDER 37 C.F.R. § 1.111

In response to the Office Action mailed on October 26, 2012, Patent Owner respectfully requests reconsideration in light of the Remarks that follow.

Claim Amendments begin on page 2 of this paper.

The **Status of Claims** is listed on page 10 of this paper.

Remarks/Arguments begin on page 11 of this paper.

Attachments: (1) Exhibit A - American Heritage® College Dictionary, Third Edition, 2000, pp. 232, 234. (4 pages); (2) Exhibit B - Office Action in U.S. Application No. 13/269,234 dated 12/20/2011 (9 pages).

CLAIM AMENDMENTS:

As permitted by 35 U.S.C. § 314(a) prior to recent amendments[1], Patent Owner proposes to add new claims 19-30 as provided below. Changes to the claims relative to the patent being reexamined are shown by markings as specified by 37 C.F.R. § 1.530(f). Since the newly added claims are dependent from, and further limit, an originally issued claim, these claims do not enlarge the scope of the issued claims. The originally issued claims remain pending without any amendments. These original claims are included in the listing below for the sake of completeness[2]. Patent Owner recognizes that 37 C.F.R. § 1.530(d)(2) does not require the use of parentheticals with newly added claims. However, following the advice of the Patent Office in other reexamination proceedings[3], these newly added claims are identified with the parenthetical "(New)."

1. (Original) A cooling system for a heat-generating component, comprising::

a double-sided chassis adapted to mount a pump configured to circulate a cooling liquid, the pump comprising a stator and an impeller, the impeller being positioned on the underside of the chassis and the stator being positioned on the upper side of the chassis and isolated from the cooling liquid;

a reservoir adapted to pass the cooling liquid therethrough, the reservoir including

[1] With regard to *inter partes* reexamination requests filed between September 16, 2011 and September 16, 2012, "the 'reasonable likelihood' standard will apply throughout the reexamination proceeding …[and] 35 U.S.C. chapter 31, as amended by section 6(c)(3) of the Leahy-Smith America Invents Act, §§ 1.902-1.997 and 41.60-41.81 of title 37 CFR, effective on September 16, 2011, will apply throughout the reexamination, even after September 16, 2012. Federal Register Volume 76, Number 185, September 23, 2011.

[2] Although 37 C.F.R. § 1.530(d)(2) does not require unamended claims to be included in the claim listing, it also does not require that such unamended claims be left out of the listing.

[3] See, e.g., *inter partes* reexamination 95/000031 (2007-09-18 Notice, p. 3); *inter partes* reexamination 95/000084 (2007-09-26 Notice, p. 2).

a pump chamber including the impeller and formed below the chassis, the pump chamber being defined by at least an impeller cover having one or more passages for the cooling liquid to pass through

a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber, the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages; and

a heat-exchanging interface, the heat-exchanging interface forming a boundary wall of the thermal exchange chamber, and configured to be placed in thermal contact with a surface of the heat-generating component; and

a heat radiator fluidly coupled to the reservoir and configured to dissipate heat from the cooling liquid.

2 (Original) The cooling system of claim 1, wherein the chassis shields the stator from the cooling liquid in the reservoir.

3 (Original) The cooling system of claim 1, wherein the heat-exchanging interface includes a first side and a second side opposite the first side, and wherein the heat-exchanging interface contacts the cooling liquid in the thermal exchange chamber on the first side and the heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component on the second side.

4 (Original) The cooling system of claim 3, wherein the first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber.

5 (Original) The cooling system of claim 4, wherein the features include at least one of pins or fins.

6 (Original) The cooling system of claim 1, wherein a passage of the one or more passages that fluidly couple the pump chamber and the thermal exchange chamber is offset from a center of the impeller.

7 (Original) The cooling system of claim 1, wherein the impeller includes a plurality of curved blades.

8. (Original) The cooling system of claim 1, wherein the heat-exchanging interface includes one of copper and aluminum.

9 (Original) The cooling system of claim 1, wherein the heat radiator is fluidly coupled to the reservoir using flexible conduits, and the heat radiator is configured to be positioned remote from the reservoir.

10 (Original) A cooling system for a computer system, comprising:

a centrifugal pump adapted to circulate a cooling liquid, the pump including:

an impeller exposed to the cooling liquid; and

a stator isolated from the cooling liquid;

a reservoir configured to be thermally coupled to a heat-generating component of the computer system, the reservoir including:

a thermal exchange chamber adapted to be positioned in thermal contact with the heat-generating component;

a separate pump chamber vertically spaced part from the thermal exchange chamber and coupled with the thermal exchange chamber through one or more passages configured for fluid communication between the pump chamber and the thermal exchange chamber, and wherein at least one of the one or more passages is offset from a center of the impeller.

11. (Original) The cooling system of claim 10, wherein a top wall of the reservoir physically separates the impeller from the stator.

12. (Original) The cooling system of claim 10, wherein the thermal exchange chamber includes a heat-exchange interface configured to be placed in thermal contact with the heat-generating component.

13. (Original) The cooling system of claim 10, further including a heat radiator fluidly coupled to the reservoir using flexible conduits, wherein the heat radiator is configured to be positioned remote from the reservoir.

14. (Original) The cooling system of claim 10, wherein the fluid passage that is offset from the center of the impeller is positioned tangentially to the circumference of the impeller.

15. (Original) A cooling system for a heat-generating component, comprising:

a pump adapted to circulate a cooling liquid, the pump including:

an impeller exposed to the cooling liquid; and

a stator isolated from the cooling liquid;

a reservoir including an impeller cover, an intermediate member and a heat exchange interface, wherein a top wall of the reservoir and the impeller cover define a pump chamber for housing the impeller, and the intermediate member and the heat exchange interface define a thermal exchange chamber, the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together; and

wherein a first side of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and a second side of the heat-exchanging interface opposite the first side is configured to be placed in thermal contact with a surface of the heat-generating component; and

a liquid-to-air heat exchanger fluidly coupled to the reservoir using flexible conduits, the heat exchanger being configured to be positioned remote from the reservoir.

16. (Original) The cooling system of claim 15, wherein the impeller cover includes a first opening radially offset from a center of the impeller and the intermediate member includes a second passage that is aligned with the first opening, the first and the second opening being

configured to direct the cooling liquid from the pump chamber into the thermal exchange chamber.

17. (Original) The cooling system of claim 15, wherein the first side of the heat-exchanging interface includes at least one of pins or fins.

18. (Original) The cooling system of claim 15, wherein the top wall of the reservoir extends between the stator and the impeller and shields the stator from the cooling liquid in the reservoir.

19. (New) The cooling system of claim 1, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.

20. (New) The cooling system of claim 1, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber.

21. (New) The cooling system of claim 1, wherein an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms the boundary wall of the thermal exchange chamber.

22. (New) The cooling system of claim 1, wherein the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.

23. (New) The cooling system of claim 10, wherein the one or more passages include a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.

24. (New) The cooling system of claim 10, wherein the one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber.

25. (New) The cooling system of claim 12, wherein an entire surface of the heat-exchange interface in contact with the cooling liquid in the reservoir forms a boundary wall of the thermal exchange chamber.

26. (New) The cooling system of claim 10, wherein the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.

27. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, the one or more

passages including a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber.

28. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by a plurality of passages positioned within the reservoir that open into the thermal exchange chamber.

29. (New) The cooling system of claim 15, wherein an entire surface of the heat-exchanging interface in contact with the cooling liquid in the reservoir forms a boundary wall of the thermal exchange chamber.

30. (New) The cooling system of claim 15, wherein the pump chamber and the thermal exchange chamber are fluidly coupled together by one or more passages, and the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir.

STATUS OF CLAIMS:

In accordance with 37 C.F.R. § 1.530(e), Patent Owner provides the status of the pending claims. Claims 1-18 are original patented claims. Of these claims, claims 1-18 are subject to reexamination. *See,* Office Action at page 1. The original patented claims have not been amended by this response. Claims 19-30 are proposed to be added by this response. Accordingly, claims 1-30 are pending.

REMARKS

I. Introduction

This Response is filed in reply to the Office Action mailed on October 26, 2012 (the Office Action). The deadline for filing a response to the Office Action is December 26, 2012. *See,* 37 C.F.R. § 1.945. Thus, this Response is timely filed.

A. Compliance with 37 C.F.R. § 1.943

The number of pages in this response is less than fifty pages. Therefore, this response is in compliance with 37 C.F.R. § 1.943.

B. Notice of Concurrent Litigation

Patent Owner notes that the present patent is involved in the following litigation: Civil Action No. 3:12-CV-04498-EMC, now pending in the U.S. District Court for the Northern District of California San Francisco Division, Asetek Holdings, Inc., v. CoolIT Systems, Inc., filed August 27, 2012.

A copy of this Response is being served on the third-party Requester, pursuant to 37 C.F.R. §§ 1.248 and 1.550(f).

C. Related Applications

U.S. Application No. 13/269,234 which issued on August 21, 2012 as U.S. Patent No. 8,245,764 B2 ("the '764 patent") is a continuation of currently-pending U.S. Application No. 11/919,974. The '764 patent further claims priority to International Application No. PCT/DK2005/000310 filed May 6, 2005 (the "International Application").

D. Related Reexamination Proceedings

On September 15, 2012, Requester, CoolIT Systems, Inc. also requested reexamination of U.S. Application No. 12/826,768 which issued as U.S. Patent No. 8,240,362 B2. In an Order dated 12/3/2012, the Patent Office denied this reexamination request. See, *inter partes* reexamination control no. 95/002,385.

E. Disclaimer Regarding Claim Construction

In accordance with 37 C.F.R. § 1.555(b) and M.P.E.P. § 2111, Patent Owner agrees that, for the purposes of proceedings before the U.S. Patent & Trademark Office, each term of the claims is to be given its broadest reasonable construction consistent with the specification.

Patent Owner, however, submits that the claim constructions discussed in the Request, the Office Action, and this Response do not necessarily comport with the construction of claims under the legal standards that are mandated to be used by the courts in litigation. *See* M.P.E.P. § 2686.04(IV). Thus, Patent Owner expressly reserves the right to present its own interpretations and construction of the claims of this patent at a later time, where such interpretation and/or construction may be the same, or may differ in whole or in part, from the interpretation and/or construction presented herein.

II. Support for Amendments

By this Proposed Amendment, new claims 19-30 are proposed to be added. These newly added claims find support throughout the specification and drawings of the '764 patent, and its earliest-filed parent application, the International Application. In accordance with 37 C.F.R. § 1.530(e), Patent Owner provides in the table below, specific examples of support in the originally filed specification of the '764 patent and the International Application. Patent Owner notes that the totality of support for each added claim is not necessarily limited to the specific examples provided herein.

New claim	*Support in U.S. Application No. 13/269,234*	*Support in International Application No. WO 2006/119761*
19, 23, 27	FIG. 17, "34", "48"; Col. 22: 26-43.	FIG. 17, "34", "48"; p. 26: 17-28
20, 24, 28	FIG. 17, "34", "48"; Col. 22: 26-43.	FIG. 17, "34", "48", p. 26: 17-28
21, 25, 29	FIG. 17, "34", "48"; Col. 22: 26-43.	FIG. 17, "34", "48"; p. 26: 17-28
22, 26, 30	FIG. 4, "15", "16"; Col. 11: 64 - col. 12: 4.	FIG. 4, "15", "16"; p. 15: 28-31; p. 28: 30-35.

III. Summary of the Office Action

The above-identified *inter partes* reexamination of the '764 patent was ordered, and an Office Action was issued on October 26, 2012 ("the Office Action"), in response to the Request for *Inter Partes* Reexamination filed on September 15, 2012 ("Request").

A. Rejection

The '764 patent has eighteen (18) claims. In the Request, the Requester proposed twelve (12) separate grounds of rejection for each of these claims based on combinations of one or more of the references listed on page 11 of the Request. *See,* Request, pp. 9-10. In the Office Action, the Examiner declined to adopt eleven (11) of the twelve (12) proposed grounds of rejection stating that none of the references upon which these rejections are based teach a pump chamber vertically spaced apart from a thermal exchange chamber, as required by all of claims 1-18. *See*, Order Granting/Denying Request for Inter Partes Reexamination, pp. 4-8.

However, the Examiner adopted the proposed rejection of claims 1-18 as being anticipated by U.S. Patent No. 7,544,049 B2 to Koga et al. ("*Koga*"). To describe the application of *Koga* to the elements of claims 1-18, the Examiner relied on claim chart K on pages 149-164 of the Request. Office Action, p. 3.

While disagreeing that claims 1-18 are anticipated by *Koga*, Patent Owner gratefully acknowledges the Examiner's confirmation that claims 1-18 are patentable over the other cited references in the Request. Since the Office Action relies on discussion in the Request for the application of *Koga* to the claims, the discussions below will also make reference to the Request.

B. Priority claim

In the Office Action, the Examiner notes that the Requester alleges that claims 1-18 are not eligible to the filing date of the International Application, since FIG. 20 and some text were added to the specification later. Therefore, the Examiner asserts, "the Examiner will use the effective filing date of 14 July 2011." Patent Owner disagrees that claims 1-18 are not eligible to the filing date of the International Application. As explained fully below, each of claims 1-18 is fully supported by the International Application (the earliest-filed parent application of the '764 patent), and is therefore entitled to its filing date.

IV. Discussion of Rejection

In the Office Action, the Examiner rejected claims 1-18 under 35 U.S.C § 102(b) as allegedly being anticipated by *Koga*. Office Action, p. 3. The Patent Owner respectfully traverses this rejection. Among claims 1-18, claims 1, 10, and 15 are independent.

A. **Independent claims 1, 10, and 15 are not anticipated by Koga**

Although different in scope, independent claims 1, 10, and 15 recite some common features of a reservoir of a cooling system. For instance, independent claim 1[4] recites a cooling system for a heat-generating component having a reservoir including "a pump chamber including the impeller and … a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber, the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages."

Independent claim 10 recites a cooling system for a computer system, comprising, a reservoir configured to be thermally coupled to a heat-generating component of the computer system, the reservoir including "a thermal exchange chamber adapted to be positioned in thermal contact with the heat-generating component; [and] a separate pump chamber vertically spaced part from the thermal exchange chamber and coupled with the thermal exchange chamber through one or more passages configured for fluid communication between the pump chamber and the thermal exchange chamber, and wherein at least one of the one or more passages is offset from a center of the impeller."

Independent claims 15 recites a cooling system for a heat-generating component, comprising, a reservoir including "a pump chamber for housing the impeller, and … a thermal exchange chamber, the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together."

[4] Independent claim 1 also recites a double-sided chassis with an "impeller being positioned on the underside of the chassis" and "a pump chamber including the impeller and formed below the chassis." Claim chart K of the Request incorrectly recites these limitations of claim 1 as "the impeller being positioned ***in a recess*** on the underside of the chassis," and "a pump chamber ***formed by the recess and*** including the impeller and formed below the chassis." (emphasis added). See, Request, p. 150. However, claim 1 does not include the limitations "in a recess," and "formed by the recess."

The Request alleges that *Koga* "exactly discloses [these] limitations." See, Request, pp. 150-154. For the reasons described in more detail below, Patent Owner disagrees.

1. *Koga* does not disclose a reservoir with "a thermal exchange chamber" vertically spaced apart from a "pump chamber" as required by independent claims 1, 10, and 15.

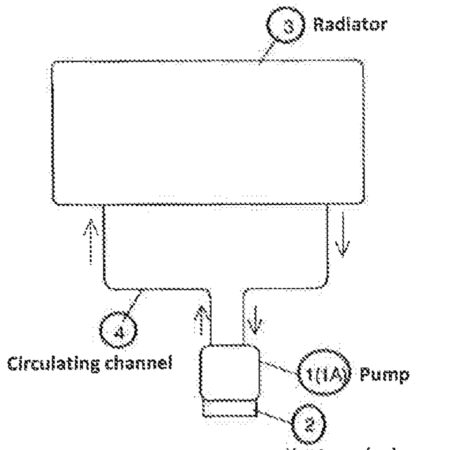


FIG.1

With reference to FIG. 1 of *Koga* reproduced above, *Koga* discloses a cooling device for a heat producing electronic component 2. Abstract. The cooling device of *Koga* includes a pump 1A, circulating a liquid coolant, and positioned atop a heat-producing component 2 to absorb heat. Col. 4, ll. 3-15. A circulating channel 4 directs the heated liquid coolant from the pump 1A to a radiator 3 to cool the coolant and direct the cooled coolant back to pump 1A. Col. 4, ll. 18-26.

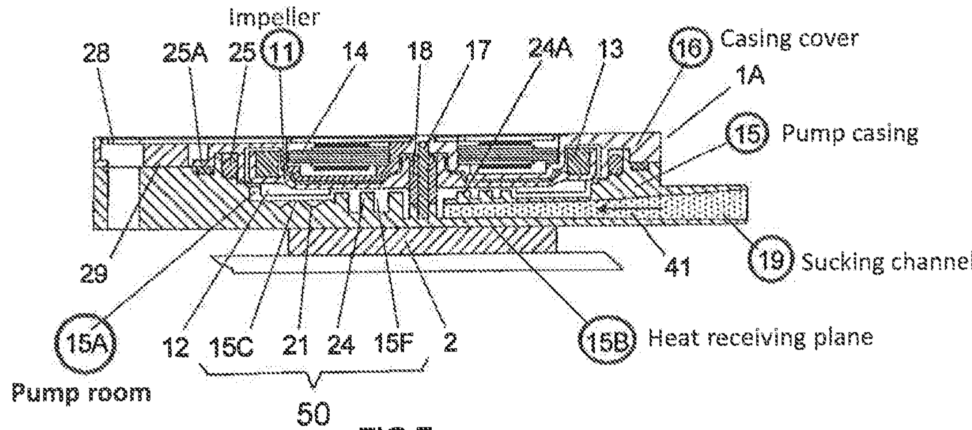


FIG.7

With reference to FIG. 7 of *Koga* annotated and reproduced above, pump 1A includes a pump casing 15 and a casing cover 16 that encloses a pump room 15A containing the coolant 41. Col. 4:51-53. An impeller 11 is positioned in the pump room 15A. Col. 4:30-32. The impeller 11 has blades 12 on a bottom surface. Col. 4:27-29. And, a ring magnet 13 and a stator 14 is inserted through an open top surface of the impeller 11. *Id.* In *Koga*, a bottom face of the casing 15 forms a heat-receiving plane 15B that is placed in contact with a surface of the heat producing component 2. Col. 4:38-41. A sucking channel 19 directs coolant into the pump room 15A, and a discharging channel 20 discharges the coolant 41 out of the pump room 15A. Col. 4:57-60; col. 5:50-57.

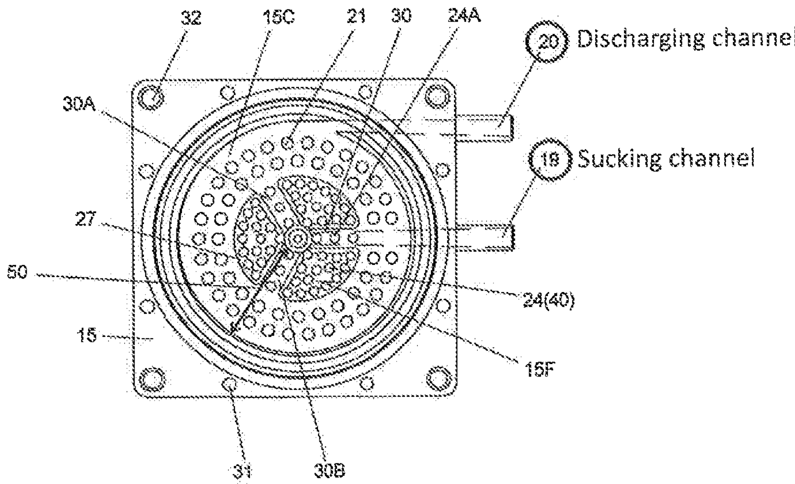


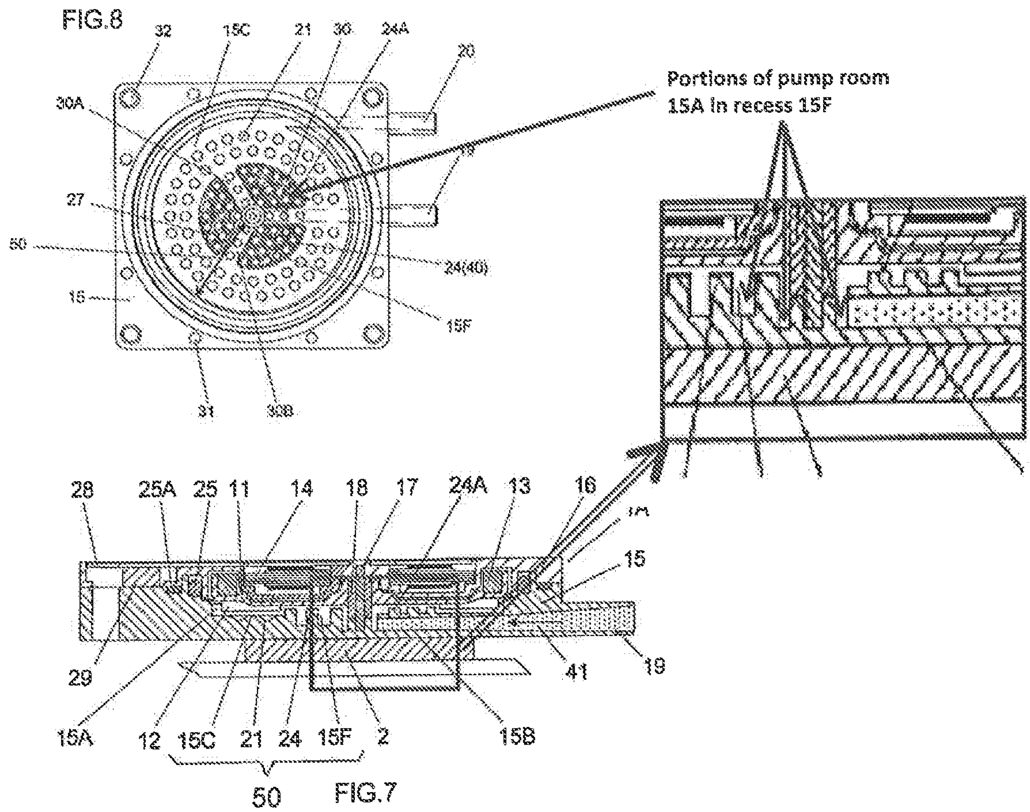
FIG.8

In the Office Action, pump room 15A of *Koga* is interpreted as the recited "pump chamber" of independent claims 1, 10, and 15. Request, pp. 151, 157, 160. And, sucking channel 19, that supplies coolant 41 to the pump room 15A (the alleged "pump chamber"), is interpreted as the recited vertically spaced apart "thermal exchange chamber" of independent claims 1, 10, and 15. See, Request, pp. 152, 157, 161. However, sucking channel 19 is not a "chamber" of *Koga*'s pump room 15A. As can be seen in FIG. 8 reproduced above, it is only a conduit that supplies coolant to the pump room 15A. As the Examiner correctly pointed out "[t]he definition of a chamber according to *Webster's New World Dictionary, Third Edition*, is 'any enclosed space; compartment…'." Order Granting/Denyinig Request for *Inter Partes* Reexamination, pp. 4, 7[5]. Sucking channel 19 is neither an "enclosed space" nor a "compartment" of pump room 15A. It is merely a tube that supplies coolant to the pump room 15A. Col. 8:65-67; *See* FIG. 8.

[5] Consistently, The American Heritage® College Dictionary also defines a chamber as an "enclosed space or compartment American Heritage® College Dictionary, Third Edition, 2000, p. 232 (attached as Exhibit A). In contrast, a channel is defined as a "tubular passage for liquids: a conduit." See, Exhibit A, p. 234.

"During reexamination, claims are given the broadest reasonable interpretation consistent with the specification." M.P.E.P. § 2258.I.G (citing *In re Yamamoto*, 740 F.2d 1569 (Fed. Cir. 1984)). The broadest reasonable construction requires "the words of the claim [to] be given their plain meaning unless the plain meaning is inconsistent with the specification." M.P.E.P. § 2111.01.I (citing *In re Zletz*, 893 F.2d 319, 321 (Fed. Cir. 1989)). "Ordinary, simple English words whose meaning is clear and unquestionable, absent any indication that their use in a particular context changes their meaning, are construed to mean exactly what they say." M.P.E.P 2111.01 I (internal citations deleted). The M.P.E.P. further explains that "plain meaning" refers to the ordinary and customary meaning given to the term by those of ordinary skill in the art at the time of the invention. M.P.E.P. 2111.01 III.

In the Request, the Requester's interpretation of a conduit that supplies coolant to pump room 15A as a separate "chamber" of the pump room 15A is erroneous in light of the plain meaning of term "chamber," and in light of the specification of this application. In the context of a reservoir, consistent with the Examiner's interpretation (Order Granting/Denying Request for *Inter Partes* Reexamination, pp. 4, 7), a person of ordinary skill in the art would have interpreted, a "chamber" to be an enclosed space or a compartment within the reservoir. The specification also consistently describes the pump chamber and the thermal exchange chambers to be vertically spaced apart enclosed spaces within the reservoir. *See*, '764 patent, FIG. 17, col. 22:26-43; see also, WO 2006/119761 A1, FIG. 17, p. 26:17-28. Therefore, contrary to the interpretation advanced by the Requester, a person of ordinary skill in the art would not have interpreted a conduit or a pipe (sucking channel 19) that supplies coolant to pump room 15A of <u>Koga</u> to be a chamber. Accordingly, <u>Koga</u> does not disclose a reservoir with "a thermal exchange chamber" in addition to a "pump chamber" as required by independent claims 1, 10, and 15.



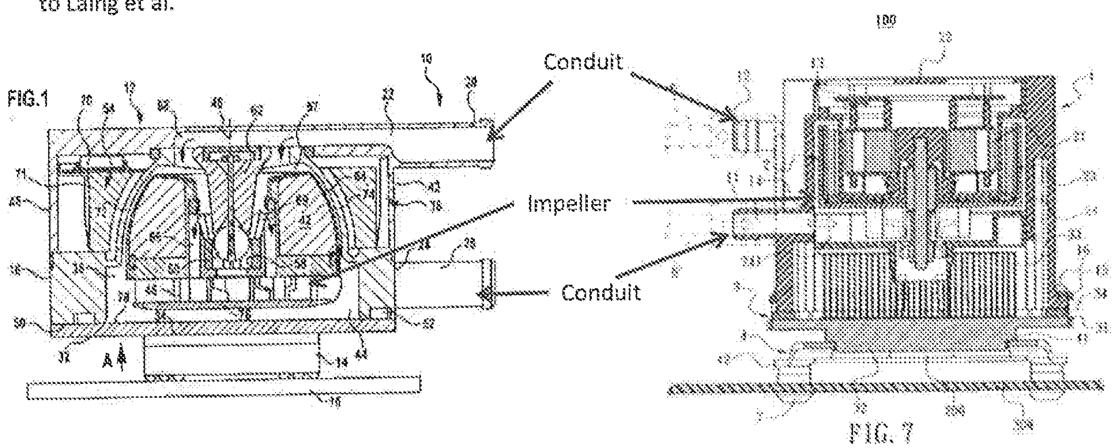
Furthermore, the alleged "thermal exchange chamber" of Koga is not "vertically spaced apart" from the "pump chamber" as required by claims 1, 10, and 15. Although, sucking channel 19 extends through the lower portion of the pump room 15A, sucking channel 19 is at the same level as the lower portion of the pump room 15A. Specifically, as illustrated in the FIGS 7 and 8 annotated and reproduced above, the portion of the pump room 15A in recess 15F is at the same level as the sucking channel 19. See, col. 10: 3-21. Therefore, the alleged thermal exchange chamber of _Koga_ is not vertically spaced apart from the pump room 15A.

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." M.P.E.P. 2131 quoting *Verdegaal Bros. v. Union Oil Co. of California*, 814 F. 2d 628, 631, 2 USPQ 2d 1051, 1053 (Fed. Cir. 1987). Furthermore, "[t]he identical invention must be shown in as complete detail as is contained in the … claim." M.P.E.P. § 2131, quoting *Richardson v. Suzuki Motor Co.*, 868 F. 2d 1126, 1236, 9 U.S.P.Q. 2d 1913, 1920 (Fed. Cir. 1989). *Koga* does not expressly or inherently disclose the above-recited aspects of independent claims 1, 10, and 15. Accordingly, amended independent claim 27 is not anticipated by *Koga*.

In fact, several of the references relied by the Requester in the eleven proposed grounds of rejection denied by the Examiner also have similar conduits that supply a coolant to a reservoir. For example, as shown in figures reproduced below, U.S. Patent Publication No. 2004/0052663 to Laing et al. ("*Liang*") and U.S. Patent No. 7,325,591 to Duan et al. ("*Duan*") also have conduits that supply coolant to, and discharge coolant from, a reservoir.

U.S. Patent Publication No. 2004/0052663
to Laing et al.

U.S. Patent No. 7,325,591
to Duan et al.



However, neither the Requester nor the Examiner interpreted these conduits of *Liang* and *Duan* as separate chambers of the reservoir. With respect to these references, the Examiner correctly stated that their reservoirs do "not show a separate pump chamber and thermal exchange chamber." Order Granting/Denying Request for *Inter Partes* Reexamination, p. 4; see also, p. 6. As the Examiner implicitly recognized with respect to these references, conduits or tubes that supply, and discharge coolant from, a reservoir are not separate "chambers" of the reservoir. Consistent with the Examiner's interpretation with respect to the reservoirs of *Laing* and *Duan*, Patent Owner respectfully requests the Examiner to reconsider the interpretation of sucking channel 19 of *Koga* as a "chamber."

2. Claims 2-9, 11-14, and 16-18 are allowable over *Koga* at least due to their dependency from their respective independent claims.

Claims 2-9 depend from independent claim 1, claims 11-14 depend from independent claim 10, and claims 16-18 depend from independent claim 15. These dependent claims include all the limitations of their respective independent claims. Therefore, these dependent claims are allowable over *Koga* at least for the same reason independent claims 1, 10, and 15 are allowable over *Koga*. Additionally, these dependent claims are not anticipated by *Koga* due to their added limitations and combinations.

For instance, claim 4 recites that "the first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber." In the Request, as discussed previously, sucking channel 19 of *Koga* was interpreted as the recited "thermal exchange chamber" and protrusions 24 and 24A of the heat-receiving plane 15B were interpreted as the recited "features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid **in the thermal exchange chamber**." (emphasis added). *See*, Request, p. 154.

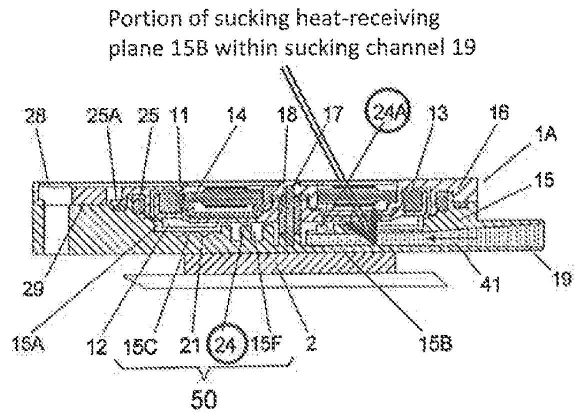


FIG.7

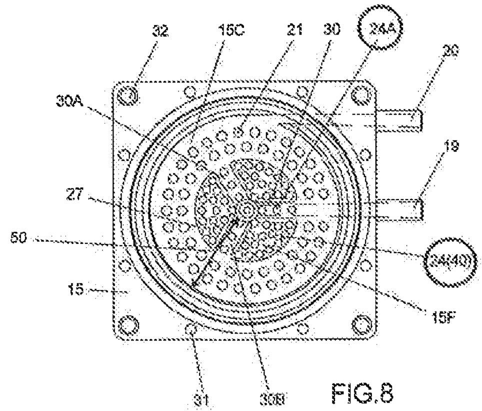


FIG.8

However, as evident from FIGS. 7 and 8 of Koga annotated and reproduced above, projections 24 and 24A are not located in the sucking channel 19 (the alleged "thermal exchanger chamber"). These projections are positioned in a region of the heat-receiving plane 15B located outside the sucking channel 19. Therefore, projections 24 and 24A are not features that are adapted to increase heat transfer from the heat-exchanging interface "to the cooling liquid in the thermal exchange chamber" as required by claim 4. Rather, these projections 24 and 24A increase heat transfer from the heat-receiving plane 15B to the coolant 41 in the pump room 15A (the alleged "pump chamber"). See, col. 8:9-22. Therefore, claims 4 and 5 (claim 5 depends from claim 4) are not anticipated by *Koga* for this additional reason.

3. New claims 19-30 are allowable over *Koga*.

New claims 19-30 are proposed to be added by this response. Each of these new claims are of a more narrow scope than at least one of the issued claims of the '764 patent. Support for these new claims in the disclosure of the original patent has been indicated above. Among these claims, claims 19-22 depend from independent claim 1, claims 23-26 depend from independent claim 10, and claims 27-30 depend from independent claim 15. These claims are allowable over

Koga at least for the same reason independent claims 1, 10, and 15 are allowable over *Koga*. As explained below, these claims are also allowable over *Koga* for additional reasons.

Claims 19, 23, and 27 recite that the "one or more passages includ[e] a passage configured to direct cooling liquid from the pump chamber directly into the thermal exchange chamber." In the Request, sucking channel 19 and discharge channel 20 are interpreted as the recited "one or more passages." *See*, Request, pp. 152, 158, 161. Sucking channel 19 supplies coolant 41 to the pump room 15A, and discharge channel 20 discharges the coolant 41 from pump room 15A to the circulating channel 4 outside the reservoir. Koga, FIG. 1; col. 4: 65-67; col. 5: 54-57. Therefore, neither sucking channel 19 nor discharge channel 20 "direct cooling liquid from the pump chamber directly into the thermal exchange chamber," as required by claims 19, 23, and 27.

Claims 20 and 24 recite that the "one or more passages include a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber." Similarly, claim 28 recites that the pump chamber and the thermal exchange chamber are fluidly coupled together by "a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber." As discussed above, the Request interprets sucking channel 19 and discharge channel 20 as the recited one or more passages. *See*, Request, pp. 152, 158, 161. However, as evident from FIG. 7 of *Koga*, sucking channel 19 and discharge channel 20 do not comprise "a plurality of passages positioned within the reservoir that opens into the thermal exchange chamber," as required by claims 20, 24, and 28.

Claims 21, 25, and 29 recite that "an entire surface of the heat-exchang[e] interface in contact with the cooling liquid in the reservoir forms [a] boundary wall of the thermal exchange chamber." In the Request, sucking channel 19 is interpreted as the recited thermal exchange chamber, and the lower portion of casing 15 is interpreted as the recited heat-exchange interface. *See*, Request, pp. 152-153 157-159, 161. Sucking channel 19 of *Koga* is a tubular conduit that extends to the center of the impeller 11. *Koga*, FIGS. 5, 8; col. 4: 61-67; col. 8: 5-9. As evident from FIGS. 7 and 8 of Koga reproduced above, the entire surface of the lower portion of casing 15 in contact with the cooling liquid in pump room 15A does not form a boundary wall of the sucking channel 19. Therefore, Koga does not disclose that "an entire surface of the heat-exchang[e] interface in contact with the cooling liquid in the reservoir forms [a] boundary wall of the thermal exchange chamber," as required by claims 21, 25, and 29.

Claims 22, 26, and 30 recite that "the reservoir further includes an inlet configured to direct the cooling liquid into the reservoir and an outlet configured to discharge the cooling liquid from the reservoir." In *Koga*, sucking channel 19 supplies coolant 41 to pump room 15A, and discharge channel 20 discharges the coolant 41 from the pump room 15A. *Koga*, FIG. 1; col. 4: 65-67; col. 5: 54-57. However, in the Request, the sucking and discharge channels are interpreted as the one or more passages that fluidly couple the pump chamber and thermal exchange chamber. Therefore, *Koga* does not disclose the recited "inlet" and "outlet" in addition to the one or more passages that fluidly couple the pump and thermal exchange chambers.

IV. **Discussion of Priority**

U.S. Application No. 13/269,234 (the '234 application) which issued as the '764 patent is a continuation of U.S. Patent Application No. 11/919,974 (the '974 application). The '974 application is a national stage entry of International Application No. PCT/DK2005/000310 (the International Application) filed on May 6, 2005.

The Requester alleges that since FIG. 20 and its description were added to the specification of the '974 application after the filing of the International Application, and this added subject matter "was relied on to confer patentability to each and every claim of the '764 Patent … no claim in the '764 Patent is entitled to priority from the [ ] filing date" of the International Application. *Request*, p. 18. Referring to these allegations, the Office Action states that "the Examiner will use the effective filing date of 14 July 2011." Office Action, p. 3.

The Patent Owner disagrees that the International Application does not provide support for the issued claims of the '764 patent. As clearly explained in the Supplemental Preliminary Amendment filed on January 9, 2009 during prosecution of the '974 application, FIG. 20 was only added to "help clearly identify ***previously presented*** subject matter." (emphasis added) Supplemental Preliminary Amendment in U.S. Patent Application No. 11/919,974 filed on January 9, 2009, p. 12. FIG. 20 did not add any new subject matter to the application. To the contrary, as will be explained below, the earliest parent of the '764 patent, the International Application, provides support for each and every claim of the '764 patent.

1. The priority date of the '764 patent is not relevant to this reexamination.

As a preliminary matter however, Asetek notes that the priority date of the '764 claims is not an issue relevant to this reexamination proceeding. Although Requester challenges the claimed priority date, all the prior art references relied upon in the Request predate the filing date of the International Application. That is, none of the prior art relied upon in the Request is an intervening reference. Patent Owner recognizes that the MPEP permits a third party requester to point out that the claims of a patent are not entitled to its claimed priority, and propose rejections using an intervening reference. M.P.E.P. § 2617. In such cases, the Patent Office addresses the priority issue to determine if the intervening reference qualifies as prior art for the reexamination. In this case, however, the availability of the references relied upon in the proposed rejections is not dependent on the priority date of the '764 patent. Therefore, the priority date of the '764 patent is not relevant to this reexamination proceeding.

The rules governing *inter partes* reexamination state that an issue not relevant to the reexamination, will not be resolved in the reexamination proceedings, and "[i]f such issues are raised … during a reexamination proceeding, the existence of such issues will be noted by the examiner in the next Office action." 37 C.F.R. § 1.906(c). Patent Owner believes that the remarks in the Office Action relating to the priority date are merely statements pointing out the existence of such issues, rather than an expression of the Examiner's opinion. However, since this statement may be misconstrued (and since a statement unconnected to an applied rejection cannot be corrected by appeal), Patent Owner respectfully requests the Examiner to retract this statement or further clarify this issue in the next Office Action.

2. The International Application provides § 112 support for claims 1-18 of the '764 patent.

During prosecution of the '234 application (that issued as the '764 patent), the Examiner considered whether the International Application provides support for the pending claims, and decided that it does. In fact, during this prosecution, all the pending claims were rejected as being anticipated by the International Application. Office Action dated 12/20/2011 (attached as Exhibit B). In this Office Action, the Examiner clearly identified portions of the International Application that he believed to disclose each and every aspect of the pending claims. *See*, Exhibit B, pp. 2-7. The '764 patent issued with claims similar to those that were rejected as being anticipated by the International Application. *See*, Reply to Office Action filed on April 6, 2012, pp. 2-7. That is, during prosecution of the '764 patent, the Examiner reviewed the International Application and decided that it provides adequate § 112 support for the '764 claims. Nevertheless, in the table below, Patent Owner identifies specific examples of support in the International Application for each issued claim of the '764 patent. Patent Owner notes that the totality of support for each issued claim is not necessarily limited to the specific examples provided below. In the table below, numbers in parenthesis refer to reference numbers in FIG. 17 of the International Application annotated and reproduced below.

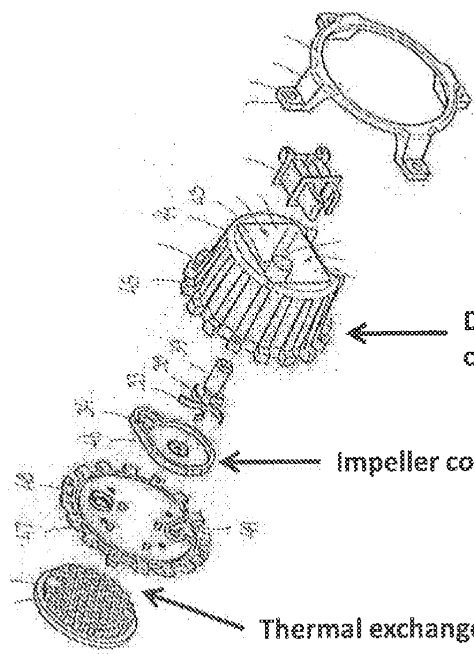


FIG. 17

Claim number	*Text of the claim showing exemplary support in International Application.*
1	A cooling system for a heat-generating component (p. 1: 5-7), comprising: a double-sided chassis (annotated in FIG. 17 reproduced above) adapted to mount a pump configured to circulate a cooling liquid, the pump comprising a stator (37) and an impeller (33), the impeller being positioned on the underside of the chassis and the stator being positioned on the upper side of the chassis and isolated from the cooling liquid (FIG. 17; p. 28: 6-20; p. 29: 17-28); a reservoir (14) adapted to pass the cooling liquid therethrough (FIG. 17; p. 28: 6-20; p. 29: 17-28), the reservoir including a pump chamber (46) including the impeller and formed below the chassis,

	the pump chamber being defined by at least an impeller cover (annotated in FIG. 17 reproduced above) having one or more passages for the cooling liquid to pass through a thermal exchange chamber (p. 29: 24-28, annotated in FIG. 17 reproduced above) formed below the pump chamber and vertically spaced apart from the pump chamber, the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages (34, 48, 49); and a heat-exchanging interface (4), the heat-exchanging interface forming a boundary wall of the thermal exchange chamber, and configured to be placed in thermal contact with a surface of the heat-generating component (p. 29: 35-38); and a heat radiator (11, FIG. 3) fluidly coupled to the reservoir and configured to dissipate heat from the cooling liquid (p. 28: 30-35).
2	The cooling system of claim 1, wherein the chassis shields the stator from the cooling liquid in the reservoir. P. 28: 14-19.
3	The cooling system of claim 1, wherein the heat-exchanging interface includes a first side and a second side opposite the first side, and wherein the heat-exchanging interface contacts the cooling liquid in the thermal exchange chamber on the first side and the heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component on the second side. P. 29:35 - p. 30: 6.
4	The cooling system of claim 3, wherein the first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber. FIG. 17, 4A; p. 29: 38 - p. 30: 6.
5	The cooling system of claim 4, wherein the features include at least one of pins or fins. FIG. 17, "4A"; p. 29: 38 - p. 30: 6.
6	The cooling system of claim 1, wherein a passage of the one or more passages that fluidly couple the pump chamber and the thermal exchange chamber is offset from a center of the impeller. FIG. 17, "34"; p. 29: 17-19.
7	The cooling system of claim 1, wherein the impeller includes a plurality of curved blades. *See*, FIG. 17, "33"; p. 31: 28-31.
8	The cooling system of claim 1, wherein the heat-exchanging interface includes one of copper and aluminum. P. 29: 35.
9	The cooling system of claim 1, wherein the heat radiator is fluidly coupled to the reservoir using flexible conduits, and the heat radiator is configured to be positioned remote from the reservoir. FIG. 4; p. 28: 37-39.
10	A cooling system for a computer system (p. 1: 5-7), comprising: a centrifugal pump adapted to circulate a cooling liquid (p. 1: 21-24; p. 29: 19), the pump including: an impeller (33) exposed to the cooling liquid (p. 28: 14-15; p. 29: 17-18);

	and a stator (37) isolated from the cooling liquid (p. 28: 14-21); a reservoir configured to be thermally coupled to a heat-generating component of the computer system (p. 28: 23-28), the reservoir including: a thermal exchange chamber (p. 29: 24-28; annotated in FIG. 17 reproduced above) adapted to be positioned in thermal contact with the heat-generating component (p. 29: 35-38); a separate pump chamber (46) vertically spaced part from the thermal exchange chamber and coupled with the thermal exchange chamber through one or more passages (34, 48, 49) configured for fluid communication between the pump chamber and the thermal exchange chamber, and wherein at least one (34) of the one or more passages is offset from a center of the impeller (p. 29: 17-18).
11	The cooling system of claim 10, wherein a top wall of the reservoir physically separates the impeller from the stator (p. 28: 6-21).
12	The cooling system of claim 10, wherein the thermal exchange chamber includes a heat-exchange interface configured to be placed in thermal contact with the heat-generating component (p. 29: 35 - p. 30: 2).
13	The cooling system of claim 10, further including a heat radiator fluidly coupled to the reservoir using flexible conduits, wherein the heat radiator is configured to be positioned remote from the reservoir (p. 28: 30-38).
14	The cooling system of claim 10, wherein the fluid passage (34) that is offset from the center of the impeller is positioned tangentially to the circumference of the impeller. (p. 29: 17-18).
15	A cooling system for a heat-generating component (p. 1: 5-7), comprising: a pump adapted to circulate a cooling liquid (p. 28: 6-35), the pump including: an impeller (33) exposed to the cooling liquid (p. 14-15); and a stator (37) isolated from the cooling liquid (p. 28: 14-20); a reservoir including an impeller cover (annotated in FIG. 17 reproduced above), an intermediate member (47) and a heat exchange interface (4), wherein a top wall of the reservoir and the impeller cover define a pump chamber (46) for housing the impeller, and the intermediate member and the heat exchange interface define a thermal exchange chamber (p. 29: 24-28; annotated in FIG. 17 reproduced above), the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together (p. 29: 17-38); and wherein a first side of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and a second side of the heat-exchanging interface opposite the first side is configured to be placed in thermal contact with a surface of the heat-generating component (p. 29: 35 - p. 30: 6); and

	a liquid-to-air heat exchanger fluidly coupled to the reservoir using flexible conduits (FIG. 8; p. 22: 18-21), the heat exchanger being configured to be positioned remote from the reservoir (p. 28: 37-38).
16	The cooling system of claim 15, wherein the impeller cover includes a first opening (34) radially offset from a center of the impeller (33) and the intermediate member (47) includes a second passage (48) that is aligned with the first opening, the first and the second opening being configured to direct the cooling liquid from the pump chamber into the thermal exchange chamber (p. 17-25).
17	The cooling system of claim 15, wherein the first side of the heat-exchanging interface includes at least one of pins or fins (p. 29: 38 - p. 30: 6).
18	The cooling system of claim 15, wherein the top wall of the reservoir extends between the stator and the impeller and shields the stator from the cooling liquid in the reservoir (p. 28: 14-20).

As evident from the table above, the specification of the International Application contains a written description of the claimed inventions, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to make and use the claimed inventions. Accordingly, contrary to the Requester's allegations, the effective filing date of claims 1-18 of the '764 patent is the filing date of the International Application.

VI. Conclusion

For at least the above reasons, it is respectfully submitted that reexamined claims 1-18, as well as new claims 19-30, patentably distinguish over the cited art. Thus, reconsideration and confirmation of the patentability of reexamined claims 1-18, as well as new claims 19-30, and an early Action Closing Prosecution (ACP), are solicited.

It is believed that all pending issues have been addressed. However, the absence of a reply to a specific rejection, issue, or comment does not signify agreement with or concession of that rejection, issue, or comment. In addition, because arguments made above may not be exhaustive, there may be other reasons for patentability of any or all pending claims and any other claims that have not been expressed. Finally, nothing in this Response should be construed as an intention to concede any issue with regard to any claim, except as stated in the Response.

The Office Action and Request contain characterizations of the claims and the related art with which Patent Owner does not necessarily agree. Unless expressly noted otherwise, Patent Owner declines to subscribe to any statement or characterization in the Office Action or Request.

In discussing the specification, claims, and/or drawings in this Response, it is to be understood that Patent Owner is in no way intending to limit the scope of the claims to an exemplary embodiment described in the specification or abstract and/or shown in the drawings. Rather, Patent Owner is entitled to have the claims interpreted broadly, to the maximum extent permitted by statute, regulation, and applicable case law.

Patent Owner has submitted herewith the fees for the newly added claims. It is believed that no other fees are required. However, if any additional fee or fees are necessary for consideration of this Response, please charge any such fee or fees and refund any excess payments to Deposit Account No. 06-0916.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

Dated: December 26, 2012

By: ______________________
Biju I. Chandran
Reg. No. 63,684
(202) 408-4000

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 1.248 and 1.903 and M.P.E.P. § 2666.06, the undersigned attorney for the Patent Owner certifies that a complete copy of this Response including the attachments, was served by Federal Express on December 26, 2012, on counsel for the third-party Requester at the following address:

Lloyd L. Pollard II
GANZ LAW, P.C.
P.O. Box 2200
Hillsboro, Oregon 97123

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

Dated: December 26, 2012

By: ____________________
Biju I. Chandran
Reg. No. 63,584

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/269,234	10/07/2011	André Sloth ERIKSEN	10494.0003-01000	1954

22852 7590 12/20/2011
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EXAMINER	
DUKE, EMMANUEL E	
ART UNIT	PAPER NUMBER
3784	
MAIL DATE	DELIVERY MODE
12/20/2011	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

EXHIBIT B (9 pages)

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No. 13/269,234	Applicant(s) ERIKSEN, ANDR LOTH FINNEGAN, HENDERSON,
	Examiner EMMANUEL DUKE	Art Unit 3784

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10/07/2011*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on ______; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *1-20* is/are pending in the application.

5a) Of the above claim(s) ______ is/are withdrawn from consideration.

6)☐ Claim(s) ______ is/are allowed.

7)☒ Claim(s) *1-20* is/are rejected.

8)☐ Claim(s) ______ is/are objected to.

9)☐ Claim(s) ______ are subject to restriction and/or election requirement.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *11/18/2011* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

12)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ______.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *10/07/2011, 12/01/2011*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. ______ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: ______.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

*Claims 1-20 are rejected under 35 U.S.C. 102(b) as being anticipated by Eriksen (**PCT Publication No.: DK2005-000310**), hereinafter referred to as Eriksen '310.*

Regarding claim 1, Eriksen '310 discloses a cooling system (Fig. 1-8: page 2, lines 5-6) for a heat-generating **1** (see Fig. 4, page 2, line 7) component, comprising: a double-sided chassis (Fig. 17, depicts a form of a double-sided chassis) adapted to mount a pump (as see page 29, line 19) configured to circulate a cooling liquid (see page 1, lines 21-24), the pump comprising a stator **37** (see page 28, lines 6-21) and an impeller **33** (see page 29, lines 17-28), the impeller being positioned in a recess (see Fig. 17: page 29, line 17, wherein a pump chamber **46** constitutes a recess) on the underside of the chassis and the stator being positioned on the upper side of the chassis and isolated from the cooling liquid (as shown in Fig. 17); a reservoir **14** (page 29, lines 6-25) adapted to pass the cooling liquid therethrough, the reservoir including: a pump chamber formed by the recess (see Fig. 17: page 29, line 17, wherein a pump chamber **46** constitutes the recess) and at least an impeller cover (see annotated Fig. 17: wherein **46A** constitutes an impeller cover) having one or more passages **34** for the cooling liquid to pass through; a thermal exchange chamber (see annotated Fig. 17: page 29, lines 24-28, wherein interior chamber **47A** between an intermediate member **47** and the heat exchange surface **4** constitutes a thermal exchange chamber), the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages **48, 49**; and a heat-exchanging interface **4** (see Fig. 15 and 17: page 29, lines 30-33), the heat-exchanging interface forming a boundary wall **4A** (see Fig. 15: page 24, lines 15-20) of the thermal exchange chamber, and configured to be placed in thermal contact with a surface (Fig. 10: page 23, lines 30-39: wherein a free surface constitutes a surface) of the heat-generating component; and a heat radiator (see page 28, lines 30-40) fluidly coupled to the reservoir and configured to dissipate heat from the cooling liquid.

Regarding claim 2, Eriksen '310 discloses the cooling system of claim 1, wherein the chassis shields the stator (see page 28, lines 6-12, wherein the stator is being shielded within recess 40) from the cooling liquid in the reservoir.

Regarding claim 3, Eriksen '310 discloses the cooling system of claim 1, wherein the heat-exchanging interface includes a first side **4A** (see Fig. 15: page 24, lines 15-20) and a second side **4B** opposite the first side, and wherein the heat- exchanging interface contacts the cooling liquid in the thermal exchange chamber on the first side and the heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component on the second side,

Regarding claim 4, Eriksen '310 discloses the cooling system of claim 3, wherein the first side of the heat- exchanging interface includes features **29** (see Fig. 15: page 24, lines 15-20) that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber.

Regarding claim 5, Eriksen '310 discloses the cooling system of claim 4, wherein the features include at least one of pins or fins (see Fig. 11-13: page 24, lines 15-20).

Regarding claim 6, Eriksen '310 discloses the cooling system of claim 1, wherein the impeller is positioned in the pump chamber (see Fig. 17: page 29, line 17).

Regarding claim 7, Eriksen '310 discloses the cooling system of claim 1, wherein a passage **34** of the one or more passages that fluidly couple the pump chamber and the thermal exchange chamber is offset from a center of the impeller (see Fig. 17: page 29, lines 17-19).

Regarding claim 8, Eriksen '310 discloses the cooling system of claim 1, wherein the impeller includes a plurality of curved blades (as shown in Fig 17).

Regarding claim 9, Eriksen '310 discloses the cooling system of claim 1, wherein the pump chamber and the thermal exchange chamber are spaced apart in a vertical direction (as shown in annotated FIG. 17).

Regarding claim 10, Eriksen '310 discloses the cooling system of claim 1, wherein the heat-exchanging interface includes one of copper and aluminum (see page 29, lines 6-11).

Regarding claim 11, Eriksen '310 discloses the cooling system of claim 1, wherein the heat radiator **11** (see Fig. 8: pages 33-39) is fluidly coupled to the reservoir **14** using flexible conduits **24 and 25**, and the heat radiator is configured to be positioned remote from the reservoir (as shown in Fig. 8).

Regarding claim 12, Eriksen '310 discloses a cooling system for a computer system (Fig. 1-8: page 2, lines 5-6), comprising: a centrifugal pump (as see page 29, line 19) adapted to circulate a cooling liquid (see page 1, lines 21-24), the pump including: an impeller **33** (see page 29, lines 17-28) exposed to the cooling liquid; and a stator **37** (see page 28, lines 6-21) isolated from the cooling liquid; a reservoir **14** (page 29, lines 6-25) configured to be thermally coupled to a heat-generating component **1** (see Fig. 4, page 2, line 7) of the computer system, the reservoir including: a thermal exchange chamber (see annotated Fig. 17: page 29, lines 24-28, wherein an interior chamber **47A** between an intermediate member **47** and the heat exchange surface **4** constitutes a thermal exchange chamber) adapted to be positioned in thermal contact with the heat-generating component; a separate pump chamber **46** vertically spaced part (as shown in annotated FIG. 17) from the thermal exchange chamber **47A** and coupled with the thermal exchange chamber through one or more passages **48 and 49** configured for fluid communication between the pump chamber and the thermal exchange chamber, and wherein at least one of the one **34** or more passages is offset from a center of the impeller (see Fig. 17: page 29, lines 17-19).

Regarding claim 13, Eriksen '310 discloses the cooling system of claim 12, wherein a top wall **44** (see page 28, lines 14-21) of the reservoir physically separates the impeller from the stator.

Regarding claim 14, Eriksen '310 discloses the cooling system of claim 12, wherein the thermal exchange chamber includes a heat-exchange interface **4** (see Fig. 15 and 17: page 29, lines 30-33) configured to be placed in thermal contact with the heat-generating component.

Regarding claim 15, Eriksen '310 discloses the cooling system of claim 12, further including a heat radiator **11** (see Fig. 8: pages 33-39) fluidly coupled to the reservoir **14** using flexible conduits **24 and 25**, wherein the heat radiator is configured to be positioned remote from the reservoir (as shown in Fig. 8).

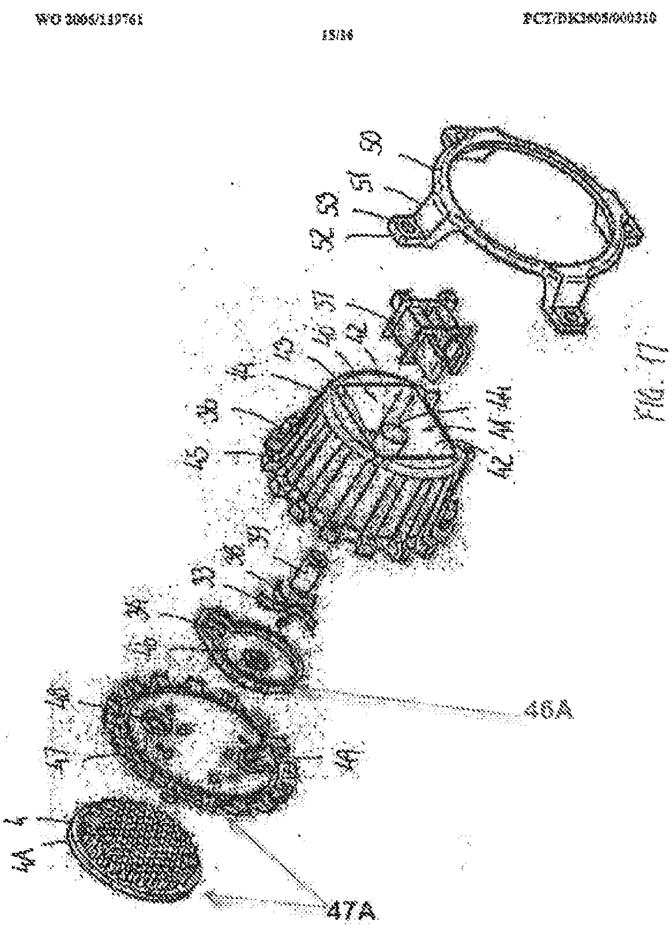
Regarding claim 16, Eriksen '310 discloses the cooling system of claim 12, wherein the fluid passage that is offset from the center of the impeller is positioned tangentially to the circumference of the impeller (see Fig. 17: page 29, lines 17-19).

Regarding claim 17, Eriksen '310 discloses a cooling system (Fig. 1-8: page 2, lines 5-6) for a heat-generating **1** (see Fig. 4, page 2, line 7) component, comprising: a pump (as see page 29, line 19) adapted to circulate a cooling liquid (see page 1, lines 21-24), the pump including: an impeller **33** (see page 29, lines 17-28) exposed to the cooling liquid; and a stator **37** (see page 28, lines 6-21) isolated from the cooling liquid; a reservoir including an impeller cover (see annotated Fig. 17: wherein **46A** constitutes an impeller cover), an intermediate member **47** (see page 29, lines 17-28) and a heat exchange interface **4**, wherein a top wall **44** (see page 28, lines 14-21) of the reservoir and the impeller cover define a pump chamber **46** for housing the impeller, and the intermediate member and the heat exchange interface define a thermal exchange chamber (see annotated Fig. 17: page 29, lines 24-28, wherein an interior chamber **47A** between an intermediate member **47** and the heat exchange surface **4** constitutes a thermal exchange chamber), the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together (as shown in annotated FIG. 17); and wherein a first side **4A** (see Fig. 15: page 24, lines 15-20) of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and a second side **4B** of the heat- exchanging interface opposite the first side is configured to be placed in thermal contact with a surface (Fig. 10: page 23, lines 30-39: wherein a free surface constitutes a surface) of the heat-generating component; and a liquid-to-air heat exchanger **11** (see Fig. 8: pages 33-39) fluidly coupled to the reservoir using flexible conduits **24 and 25**, the heat exchanger being configured to be positioned remote from the reservoir (as shown in Fig. 8).

Regarding claim 18, Eriksen '310 discloses the cooling system of claim 17, wherein the impeller cover includes a first opening **34** radially offset from a center of the impeller (see Fig. 17: page 29, lines 17-19) and the intermediate member includes a second passage **48** that is aligned with the first opening, the first and the second opening **49** being configured to direct the cooling liquid from the pump chamber into the thermal exchange chamber (as shown in Fig. 17).

Regarding claim 19, Eriksen '310 discloses the cooling system of claim 17, wherein the first side of the heat- exchanging interface includes at feast one of pins or fins **29** (see Fig. 11-13: page 24, lines 15-20).

Regarding claim 20, Eriksen '310 discloses the cooling system of claim 17, wherein the top wall of the reservoir extends between the stator and the impeller and shields the stator from the cooling liquid in the reservoir (as shown in Fig. 17: page 28, lines 14-21).



Annotated Fig. 17

Conclusion

2. Any inquiry concerning this communication or earlier communications from the examiner should be directed to EMMANUEL DUKE whose telephone number is (571)270-5290. The examiner can normally be reached on Monday - Friday; 8:00am - 5:00pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Cheryl Tyler or Frantz Jules can be reached on 571-272-4834 or 571-272-6681. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Frantz F. Jules/
Supervisory Patent Examiner, Art Unit 3784

/EMMANUEL DUKE/
Examiner, Art Unit 3784
12/13/2011

Electronic Patent Application Fee Transmittal

Application Number:	95002386
Filing Date:	15-Sep-2012
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Filer:	Biju I. Chandran/Faith Wills
Attorney Docket Number:	COOL-1.012

Filed as Large Entity

inter partes reexam Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Request for inter reexamination	1813	1	0	0
Pages:				
Claims:				
Reexamination claims in excess of 20	1822	10	62	620
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**620**

Electronic Acknowledgement Receipt

EFS ID:	14557153
Application Number:	95002386
International Application Number:	
Confirmation Number:	7254
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	8245764
Customer Number:	22852
Filer:	Biju I. Chandran
Filer Authorized By:	
Attorney Docket Number:	COOL-1.012
Receipt Date:	26-DEC-2012
Filing Date:	15-SEP-2012
Time Stamp:	13:31:56
Application Type:	inter partes reexam

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$620
RAM confirmation Number	12820
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1		Response.pdf	2696826 6fb2fde9f485ddcc558ce4e9a171bdcc07209627	yes	46

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Reexam Response to Final Rejection	1	32
	Reexam Certificate of Service	33	33
	Non Patent Literature	34	37
	Other Reference-Patent or Application Document	38	46

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	32023 31e0ae553bd2fd9e2b97e6a48b29ca9e080cc065	no	2

Warnings:

Information:

Total Files Size (in bytes): 2728849

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
95/002,386	09/15/2012	8245764	COOL-1.012	7254

22852 7590 10/26/2012
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

EXAMINER	
KAUFMAN, JOSEPH A	

ART UNIT	PAPER NUMBER
3993	

MAIL DATE	DELIVERY MODE
10/26/2012	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Transmittal of Communication to Third Party Requester *Inter Partes* Reexamination	Control No. 95/002,386	Patent Under Reexamination 8245764	
	Examiner JOSEPH KAUFMAN	Art Unit 3993	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

(THIRD PARTY REQUESTER'S CORRESPONDENCE ADDRESS)

GANZ LAW, P.C.
P.O. BOX 2200
HILLSBORO, OR 97123

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above-identified reexamination prceeding. 37 CFR 1.903.

Prior to the filing of a Notice of Appeal, each time the patent owner responds to this communication, the third party requester of the *inter partes* reexamination may once file written comments within a period of 30 days from the date of service of the patent owner's response. This 30-day time period is statutory (35 U.S.C. 314(b)(2)), and, as such, it cannot be extended. See also 37 CFR 1.947.

If an *ex parte* reexamination has been merged with the *inter partes* reexamination, no responsive submission by any *ex parte* third party requester is permitted.

All correspondence relating to this inter partes reexamination proceeding should be directed to the **Central Reexamination Unit** at the mail, FAX, or hand-carry addresses given at the end of the communication enclosed with this transmittal.

U.S. Patent and Trademark Office
PTOL-2070 (Rev. 07-04)

Paper No. 20121017A

OFFICE ACTION IN* INTER PARTES *REEXAMINATION	**Control No.** 95/002,386	**Patent Under Reexamination** 8245764
	Examiner JOSEPH KAUFMAN	**Art Unit** 3993

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

Responsive to the communication(s) filed by:
Patent Owner on _____
Third Party(ies) on 15 September, 2012

RESPONSE TIMES ARE SET TO EXPIRE AS FOLLOWS:

For Patent Owner's Response:
2 MONTH(S) from the mailing date of this action. 37 CFR 1.945. EXTENSIONS OF TIME ARE GOVERNED BY 37 CFR 1.956.
For Third Party Requester's Comments on the Patent Owner Response:
30 DAYS from the date of service of any patent owner's response. 37 CFR 1.947. NO EXTENSIONS OF TIME ARE PERMITTED. 35 U.S.C. 314(b)(2).

All correspondence relating to this inter partes reexamination proceeding should be directed to the **Central Reexamination Unit** at the mail, FAX, or hand-carry addresses given at the end of this Office action.

This action is not an Action Closing Prosecution under 37 CFR 1.949, nor is it a Right of Appeal Notice under 37 CFR 1.953.

PART I. THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:

1.☐ Notice of References Cited by Examiner, PTO-892
2.☐ Information Disclosure Citation, PTO/SB/08
3.☐ _____

PART II. SUMMARY OF ACTION:

1a. ☒ Claims 1-18 are subject to reexamination.
1b. ☐ Claims _____ are not subject to reexamination.
2. ☐ Claims _____ have been canceled.
3. ☐ Claims _____ are confirmed. [Unamended patent claims]
4. ☐ Claims _____ are patentable. [Amended or new claims]
5. ☒ Claims 1-18 are rejected.
6. ☐ Claims _____ are objected to.
7. ☐ The drawings filed on _____ ☐ are acceptable ☐ are not acceptable.
8. ☐ The drawing correction request filed on _____ is: ☐ approved. ☐ disapproved.
9. ☐ Acknowledgment is made of the claim for priority under 35 U.S.C. 119 (a)-(d). The certified copy has: ☐ been received. ☐ not been received. ☐ been filed in Application/Control No 95002386.
10. ☐ Other _____

Extensions of Time

Extensions of time under 37 CFR 1.136(a) will **not** be permitted in these proceedings because the provisions of 37 CFR 1.136 apply only to "an applicant" and not to parties in a reexamination proceeding. Additionally, 35 U.S.C. 314(c) requires that *inter partes* reexamination proceedings "will be conducted with special dispatch" (37 CFR 1.937). Patent owner extensions of time in *inter partes* reexamination proceedings are provided for in 37 CFR 1.956. Extensions of time are not available for third party requester comments, because a comment period of 30 days from service of patent owner's response is set by statute. 35 USC 314(b)(3).

Notification of Concurrent Proceedings

The patent owner is reminded of the continuing responsibility under 37 CFR 1.985 to apprise the Office of any litigation activity, or other prior or concurrent proceeding, involving the Eriksen patent throughout the course of this reexamination proceeding. The third party requester is also reminded of the ability to similarly apprise the Office of any such activity or proceeding throughout the course of this reexamination proceeding. See MPEP § 2686 and 2686.04.

Service of Papers

Any paper filed by either the patent owner or the third party requester ***must be served*** on the other party in the reexamination proceeding in the manner provided by 37 CFR 1.248. See 37 CFR 1.903 and MPEP 2666.06.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-18 are rejected under 35 U.S.C. 102(b) as being anticipated by Koga et al.

Requester has stated that Patent Owner is only eligible for the effective filing date of 7 October 2011 as the original application did not have Figure 20 or the passages in the specification to support the claimed subject matter. This material was added on 9 January 2009 and 14 July 2011. Therefore, the Examiner will use the effective filing date of 14 July 2011.

The Examiner incorporates by reference the claim charts on pages 149-164 of the Request.

Conclusion

All correspondence relating to this *inter partes* reexamination proceeding should be directed:

By EFS: Registered users may submit via the electronic filing system EFS-Web, at https://efs.uspto.gov/efile/myportal/efs-registered
.

By Mail to: Mail Stop *Inter Partes* Reexam

Attn: Central Reexamination Unit
Commissioner for Patents
United States Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

By Fax to: (571) 273-9900
Central Reexamination Unit

By hand: Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

For EFS-Web transmissions, 37 CFR 1.8(a)(1)(i)(C) and (ii) states that correspondence (except for a request for reexamination and a corrected or replacement request for reexamination) will be considered timely if (a) it is transmitted via the Office's electronic filing system in accordance with 37 CFR 1.6(a)(4), and (b) includes a certificate of transmission for each piece of correspondence stating the date of transmission, which is prior to the expiration of the set period of time in the Office action.

Any inquiry concerning this communication or earlier communications from the examiner, or as to the status of this proceeding, should be directed to the Central Reexamination Unit at telephone number (571) 272-7705.

Signed:

/Joseph A. Kaufman/
Joseph A. Kaufman
Primary Examiner
Art Unit 3993

Conferees:

/RMF/

/EDL/

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
95/002,386	09/15/2012	8245764	COOL-1.012	7254

22852 7590 10/26/2012
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

EXAMINER	
KAUFMAN, JOSEPH A	

ART UNIT	PAPER NUMBER
3993	

MAIL DATE	DELIVERY MODE
10/26/2012	PAPER

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PTOL-90A (Rev. 04/07)

Transmittal of Communication to Third Party Requester *Inter Partes* Reexamination	Control No. 95/002,386	Patent Under Reexamination 8245764	
	Examiner JOSEPH KAUFMAN	Art Unit 3993	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

(THIRD PARTY REQUESTER'S CORRESPONDENCE ADDRESS)

GANZ LAW, P.C.
P.O. BOX 2200
HILLSBORO, OR 97123

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above-identified reexamination prceeding. 37 CFR 1.903.

Prior to the filing of a Notice of Appeal, each time the patent owner responds to this communication, the third party requester of the *inter partes* reexamination may once file written comments within a period of 30 days from the date of service of the patent owner's response. This 30-day time period is statutory (35 U.S.C. 314(b)(2)), and, as such, it cannot be extended. See also 37 CFR 1.947.

If an *ex parte* reexamination has been merged with the *inter partes* reexamination, no responsive submission by any *ex parte* third party requester is permitted.

All correspondence relating to this inter partes reexamination proceeding should be directed to the **Central Reexamination Unit** at the mail, FAX, or hand-carry addresses given at the end of the communication enclosed with this transmittal.

ORDER GRANTING/DENYING REQUEST FOR **INTER PARTES** ***REEXAMINATION***	**Control No.** 95/002,386	**Patent Under Reexamination** 8245764
	Examiner JOSEPH KAUFMAN	**Art Unit** 3993

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

The request for *inter partes* reexamination has been considered. Identification of the claims, the references relied on, and the rationale supporting the determination are attached.

Attachment(s): ☐ PTO-892 ☒ PTO/SB/08 ☐Other: _____

1. ☒ The request for *inter partes* reexamination is GRANTED.

☒ An Office action is attached with this order.

☐ An Office action will follow in due course.

2. ☐ The request for *inter partes* reexamination is DENIED.

This decision is not appealable. 35 U.S.C. 312(c). Requester may seek review of a denial by petition to the Director of the USPTO within ONE MONTH from the mailing date hereof. 37 CFR 1.927. EXTENSIONS OF TIME ONLY UNDER 37 CFR 1.183. In due course, a refund under 37 CFR 1.26(c) will be made to requester.

All correspondence relating to this *inter partes* reexamination proceeding should be directed to the **Central Reexamination Unit** at the mail, FAX, or hand-carry addresses given at the end of this Order.

DECISION ON REQUEST FOR INTER PARTES REEXAMINATION

The information presented in the request for *inter partes* reexamination shows that there is a reasonable likelihood that the requester would prevail with respect to at least one claim challenged in the request for the reasons set forth below. Specifically, the request for *inter partes* reexamination, with a filing date of 15 September 2012, has made a reasonable likelihood of prevailing (RLP) showing that claims 1-18 of United States Patent Number 8,245,764 to Eriksen are unpatentable.

Extensions of Time

Extensions of time under 37 CFR 1.136(a) will **not** be permitted in these proceedings because the provisions of 37 CFR 1.136 apply only to "an applicant" and not to parties in a reexamination proceeding. Additionally, 35 U.S.C. 314(c) requires that *inter partes* reexamination proceedings "will be conducted with special dispatch" (37 CFR 1.937). Patent owner extensions of time in *inter partes* reexamination proceedings are provided for in 37 CFR 1.956. Extensions of time are not available for third party requester comments, because a comment period of 30 days from service of patent owner's response is set by statute. 35 USC 314(b)(3).

Notification of Concurrent Proceedings

The patent owner is reminded of the continuing responsibility under 37 CFR 1.985 to apprise the Office of any litigation activity, or other prior or concurrent proceeding, involving the Eriksen patent throughout the course of this reexamination proceeding. The third party requester is also reminded of the ability to similarly apprise the Office of any such activity or proceeding throughout the course of this reexamination proceeding. See MPEP § 2686 and 2686.04.

Service of Papers

Any paper filed by either the patent owner or the third party requester ***must be served*** on the other party in the reexamination proceeding in the manner provided by 37 CFR 1.248. See 37 CFR 1.903 and MPEP 2666.06.

A Reasonable Likelihood of Prevailing (RLP)

The Third Party Requester requested reexamination of claims 1-18 of the Eriksen patent based upon the following proposed rejections:

A. Claims 10-12 and 14 are Anticipated by Laing.

B. Claim 13 is Obvious from Laing.

C. Claim 13 is Obvious from Laing and Hamman.

D. Claims 1-9 and 15-18 are Obvious from Laing and Cheon.

E. Claims 7, 9 and 15-18 are Obvious from Laing, Cheon and Hamman.

F. Claims 1-18 are Obvious from Hamman and Cheon.

G. Claims 1-7, 10-12 and 14 are Anticipated by Duan.

H. Claims 8, 9, 13 and 15-18 are Obvious from Duan.

I. Claims 1-18 are Obvious from Duan and Cheon.

J. Claims 8, 9, 13 and 15-18 are Obvious from Duan and Hamman.

K. Claims 1-18 are Anticipated by Koga.

L. Claims 1-18 are Obvious from the '761 Publication and Laing.

Analysis of the RLP Showing for Claims 1-18 Provided in the Request

Proposed Rejections A-E: Laing either alone or in view of the various modifying references.

It is **not** agreed that the request has made a RLP showing that claims 1-18 of the Eriksen patent are unpatentable based upon the teachings of Laing when Laing is employed as the base reference. All of the claims require that there be a pump chamber vertically spaced from a thermal exchange chamber. Laing does not show a separate pump chamber and thermal exchange chamber. As seen in Figure 1 of Laing, the pump and thermal exchange are located in the same chamber. Requester has taken an arbitrary structure to delineate chambers. The definition of a chamber, according to *Webster's New World Dictionary, Third Edition*, is "any enclosed space; compartment..." Therefore, one of ordinary skill in the art would not view the pump and thermal exchange to be in separate chambers.

As for the other references, Cheon does not show vertically spaced chambers. Requester has stated (for example on page 55 of the Request) that vertically is to mean, "…in a direction parallel to the rotational axis of the impeller". There is no basis to interpret vertically in such a manner. Patent Owner, under certain circumstances, may be his/her own lexicographer. There is no basis for Requester to do so, however.

Under any standard definition of vertical, Cheon does not show such a relationship between the pump and thermal exchange. Further, there is no indication that Cheon's device would be operable if turned on its side as inferred by Requester. Hamman does not cure the deficiencies of either Laing or Cheon. For these reasons, Laing, either alone or in combination, does not meet the RLP standard with regard to proposed rejections A-E.

Proposed Rejection F: Hamman in view of Cheon.

It is **not** agreed that the request has made a RLP showing that claims 1-18 of the Eriksen patent are unpatentable based upon the teachings of Hamman in view of Cheon. All of the claims require that there be a pump chamber vertically spaced from a thermal exchange chamber. Cheon does not show vertically spaced chambers. Requester has stated (for example on page 55 of the Request) that vertically is to mean, "…in a direction parallel to the rotational axis of the impeller". There is no basis to interpret vertically in such a manner. Patent Owner, under certain circumstances, may be his/her own lexicographer. There is no basis for Requester to do so, however. Under any standard definition of vertical, Cheon does not show such a relationship between the pump and thermal exchange. Further, there is no indication that Cheon's device would be operable if turned on its side as inferred by Requester. Hamman does not cure the deficiencies of Cheon. For these reasons, Hamman in view of Cheon does not meet the RLP standard with regard to proposed rejections F.

Proposed Rejections G-J: Duan either alone or in view of the various modifying references.

It is **not** agreed that the request has made a RLP showing that claims 1-18 of the Eriksen patent are unpatentable based upon the teachings of Duan when Duan is employed as the base reference. All of the claims require that there be a pump chamber vertically spaced from a thermal exchange chamber and that the stator is isolated from the cooling liquid. As seen in Figures 3 and 7 the thermal chamber surrounds the pump chamber and cannot therefore, be vertically spaced from it. Note specifically how the fluid exits the casing via ports 12. Further, as seen in Figure 7, there is an opening between the thermal chamber and the area where the stator is, providing fluid access to the stator.

As for the other references, Cheon does not show vertically spaced chambers. Requester has stated (for example on page 102 of the Request) that vertically is to mean, "…in a direction parallel to the rotational axis of the impeller". There is no basis to interpret vertically in such a manner. Patent Owner, under certain circumstances, may be his/her own lexicographer. There is no basis for Requester to do so, however. Under any standard definition of vertical, Cheon does not show such a relationship between the pump and thermal exchange. Further, there is no indication that Cheon's device would be operable if turned on its side as inferred by Requester. Hamman does not cure the deficiencies of either Duan or Cheon. For these reasons, Duan, either alone or in combination, does not meet the RLP standard with regard to proposed rejections G-J.

Proposed Rejections K: Claims 1-18 are anticipated over Koga et al.

It is agreed that the request has made a RLP showing that claims 1-18 of the Eriksen patent are unpatentable based upon the teachings of Koga et al. The examiner has reviewed the Koga et al. reference and the request for reexamination. The examiner deems that the request has made a RLP showing that Koga et al. teaches every limitation in claims 1-18. Specifically, see the analysis on pages 149-164 of the Request. For this reason, the Request has made a RLP showing that claims 1-18 of the Eriksen patent is unpatentable based upon the teachings of Koga et al.

Proposed Rejections L: Claims 1-18 are Obvious from the '761 Publication and Laing.

It is **not** agreed that the request has made a RLP showing that claims 1-18 of the Eriksen patent are unpatentable based upon the teachings of the ‘761 publication in view of Laing. All of the claims require that there be a pump chamber vertically spaced from a thermal exchange chamber. The '761 publication was not discussed as showing this feature. Further, Laing does not show a separate pump chamber and thermal exchange chamber. As seen in Figure 1 of Laing, the pump and thermal exchange are located in the same chamber. Requester has taken an arbitrary structure to delineate chambers. The definition of a chamber, according to *Webster’s New World Dictionary, Third Edition*, is "any enclosed space; compartment..." Therefore, one of ordinary skill in the art would not view the pump and thermal exchange to be in separate chambers.

For these reasons, the ‘761 publication in view of Laing, does not meet the RLP standard with regard to proposed rejection L.

Conclusion

For the reasons given above, the information presented in the request for *inter partes* reexamination shows that there is a reasonable likelihood that the requester would prevail with respect to the following proposed rejections:

K. Claims 1-18 are Anticipated by Koga.

Accordingly, claims 1-18 of the Eriksen patent will be reexamined.

All correspondence relating to this *inter partes* reexamination proceeding should be directed:

By EFS: Registered users may submit via the electronic filing system EFS-Web, at https://efs.uspto.gov/efile/myportal/efs-registered
.

By Mail to: Mail Stop *Inter Partes* Reexam
Attn: Central Reexamination Unit
Commissioner for Patents
United States Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

By Fax to: (571) 273-9900
Central Reexamination Unit

By hand: Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

For EFS-Web transmissions, 37 CFR 1.8(a)(1)(i)(C) and (ii) states that correspondence (except for a request for reexamination and a corrected or replacement request for reexamination) will be considered timely if (a) it is transmitted via the Office's electronic filing system in accordance with 37 CFR 1.6(a)(4), and (b) includes a certificate of transmission for each piece of correspondence stating the date of transmission, which is prior to the expiration of the set period of time in the Office action.

Any inquiry concerning this communication or earlier communications from the examiner, or as to the status of this proceeding, should be directed to the Central Reexamination Unit at telephone number (571) 272-7705.

Signed:

/Joseph A. Kaufman/
Joseph A. Kaufman
Primary Examiner
Art Unit 3993

Conferees

/RMF/

/EDL/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	Not yet assigned
	Filing Date	2012-09-15
	First Named Inventor	Eriksen
	Art Unit	Not yet assigned
	Examiner Name	Not yet assigned
	Attorney Docket Number	COOL-1.012

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code1	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
JAK	1	6529376	B2	2003-03-04	Hamman	
JAK	2	5731954		1998-03-24	Cheon	
JAK	3	7325591	B2	2008-02-05	Duan	
JAK	4	7544049	B2	2009-06-09	Koga	

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code1	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
JAK	1	20040052663	A1	2004-03-18	Laing	

If you wish to add additional U.S. Published Application citation information please click the Add button.

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number3	Country Code2 i	Kind Code4	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T5

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	Not yet assigned
	Filing Date	2012-09-15
	First Named Inventor	Eriksen
	Art Unit	Not yet assigned
	Examiner Name	Not yet assigned
	Attorney Docket Number	COOL-1.012

JAK	1	2006119761	WO	A1	2006-11-16	Asetek A/S		☐

If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T5
	1		☐

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature	/Joseph A. Kaufman/	Date Considered	17 October 2012

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

Reexamination	Application/Control No. 95/002,386	Applicant(s)/Patent Under Reexamination 8245764
	Certificate Date	**Certificate Number**

Requester Correspondence Address:	☐ **Patent Owner**	☒ **Third Party**
GANZ LAW, P.C. P.O. BOX 2200 HILLSBORO, OR 97123		

LITIGATION REVIEW ☒	**JAK** (examiner initials)	**10/17/2012** (date)
Case Name		Director Initials
Asetek Holdings, Inc. et al. v. Coolit Systems Inc.; 3:12cv4498, US Dist. Ct. California Northern; open.		/EDL/ FOR IY

COPENDING OFFICE PROCEEDINGS	
TYPE OF PROCEEDING	**NUMBER**
1. none	
2.	
3.	
4.	

Search Notes	**Application/Control No.** 95/002,386	**Applicant(s)/Patent under Reexamination** 8245764	
	Examiner JOSEPH KAUFMAN	**Art Unit** 3993	

SEARCHED

Class	Subclass	Date	Examiner
none			

INTERFERENCE SEARCHED

Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)

	DATE	EXMR
Reviewed patented file's prosecution history.	10/17/2012	JAK

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www.uspto.gov

REEXAM CONTROL NUMBER	FILING OR 371 (c) DATE	PATENT NUMBER
95/002,386	09/15/2012	8245764

CONFIRMATION NO. 7254
ASSIGNMENT NOTICE

22852
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

OC000000056928682

Date Mailed: 10/05/2012

NOTICE OF ASSIGNMENT OF *INTER PARTES* REEXAMINATION REQUEST

The above-identified request for *inter partes* reexamination has been assigned to Art Unit 3993. All future correspondence in this proceeding should be identified by the control number listed above and directed to: Mail Stop Inter Partes Reexam, Commissioner for Patents, P.O. Box 1450, Alexandria VA 22313-1450.

A copy of this Notice is being sent to the latest attorney or agent of record in the patent file or, if none is of record, to all owners of record. (See 37 CFR 1.33(c).) If the addressee is not, or does not represent, the current owner, he or she is required to forward all communications regarding this proceeding to the current owner(s)

(MPEP 2222). An attorney or agent receiving this communication who does not represent the current owner(s) may wish to seek to withdraw pursuant to 37 CFR 1.36 in order to avoid receiving future communications. If the address of the current owner(s) is unknown, this communication should be returned with the request to withdraw pursuant to Section 1.36.

cc: Third Party Requester
GANZ LAW, P.C.
P.O. BOX 2200
HILLSBORO, OR 97123

/dlboyd/

Legal Instruments Examiner
Central Reexamination Unit 571-272-7705; FAX No. 571-273-9900

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REEXAM CONTROL NUMBER	FILING OR 371 (c) DATE	PATENT NUMBER
95/002,386	09/15/2012	8245764

CONFIRMATION NO. 7254
REEXAM ASSIGNMENT NOTICE

GANZ LAW, P.C.
P.O. BOX 2200
HILLSBORO, OR 97123

OC000000056928681

Date Mailed: 10/05/2012

NOTICE OF *INTER PARTES* REEXAMINATION REQUEST FILING DATE

Requester is hereby notified that the filing date of the request for *inter partes* reexamination is 09/15/2012, the date that the filing requirements of 37 CFR § 1.915 were received.

A decision on the request for *inter partes* reexamination will be mailed within three months from the filing date of the request for *inter partes* reexamination. (See 37 CFR 1.923.)

A copy of this Notice is being sent to the person identified by the requestor as the patent owner. Further patent owner correspondence will be with the latest attorney or agent of record in the patent file. (See 37 CFR 1.33.) Any paper filed should include a reference to the present request for *inter partes* reexamination (by Reexamination Control Number) and should be addressed to: Mail Stop Inter Partes Reexam, Commissioner for Patents, P.O. Box 1450, Alexandria VA 22313-1450.

cc: Patent Owner
22852
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER
LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

/dlboyd/

Legal Instruments Examiner
Central Reexamination Unit 571-272-7705; FAX No. 571-273-9900

Patent Assignment Abstract of Title

Total Assignments: 1

Application #: 13269234 **Filing Dt:** 10/07/2011 **Patent #:** 8245764 **Issue Dt:** 08/21/2012

PCT #: NONE **Publication #:** US20120061058 **Pub Dt:** 03/15/2012

Inventor: André Sloth ERIKSEN

Title: COOLING SYSTEM FOR A COMPUTER SYSTEM

Assignment: 1

Reel/Frame: 028525 / 0059 **Received:** 07/10/2012 **Recorded:** 07/10/2012 **Mailed:** 07/12/2012 **Pages:** 4

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Assignor: ERIKSEN, ANDRE S. **Exec Dt:** 07/08/2012

Assignee: ASETEK A/S
SALTUMVEJ 27, DK-970
BRONDERSLEV, DENMARK

Correspondent: BIJU CHANDRAN
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001

Search Results as of: 10/04/2012 06:26 PM

Litigation Search Report CRU 3999

Reexam Control No. 95/002,386

TO: Examiner Location: CRU Art Unit: 3999 Date: 10/01/2012	From: Shanette Brown Location: CRU 3999 MDW 07C71 Phone: (571) 272-6632 Shanett.Brown@uspto.gov

Search Notes

RE: 95/002,386– Litigation was found for US Patent Number: 8,245,764

Patent	Class	Subclass	Description	Court	Docket Number	Filed	Date Retrieved
8,245,764	165	80.4	Asetek Holdings, Inc Et Al V. Coolit Systems Inc	US-DIS-CAND	3:12cv4498 OPEN	8/27/2012	8/28/2012

Sources:

1) I performed a KeyCite Search in Westlaw, which retrieves all history on the patent including any litigation.

2) I performed a search on the patent in Lexis CourtLink for any open dockets or closed cases.

3) I performed a search in Lexis in the Federal Courts and Administrative Materials databases for any cases found.

4) I performed a search in Lexis in the IP Journal and Periodicals database for any articles on the patent.

5) I performed a search in Lexis in the news databases for any articles about the patent or any articles about litigation on this patent.

Westlaw.

Date of Printing: Oct 02, 2012

KEYCITE

C US PAT 8245764 COOLING SYSTEM FOR A COMPUTER SYSTEM, Assignee: Asetek A/S (Aug 21, 2012)

History

Direct History

=> 1 **COOLING SYSTEM FOR A COMPUTER SYSTEM,** US PAT 8245764 (U.S. PTO Utility Aug 21, 2012)

Patent Family

2 CENTRAL PROCESSING UNIT COOLING SYSTEM FOR COMPUTER SYSTEM, HAS RESERVOIR WITH AMOUNT OF COOLING LIQUID, WHERE COOLING LIQUID IS INTENDED FOR ACCUMULATING AND TRANSFERRING OF THERMAL ENERGY DISSIPATED FROM PROCESSING UNIT, Derwent World Patents Legal 2007-131862

Assignments

3 Action: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS). Number of Pages: 004, (DATE RECORDED: Jul 10, 2012)

Docket Summaries

4 ASETEK HOLDINGS, INC ET AL v. COOLIT SYSTEMS INC, (N.D.CAL. Aug 27, 2012) (NO. 3:12CV04498), (28 USC 1331 FED. QUESTION)

Prior Art (Coverage Begins 1976)

C 5 AIR OR LIQUID COOLED COMPUTER MODULE COLD PLATE, US PAT 6305463Assignee: Silicon Graphics, Inc., (U.S. PTO Utility 2001)

C 6 BRUSHLESS COOLANT PUMP AND COOLING SYSTEM, US PAT 6447270Assignee: Walbro Corporation; Isothermal Systems Research, Inc., (U.S. PTO Utility 2002)

C 7 CLOSED LOOP LIQUID COOLING FOR SEMICONDUCTOR RF AMPLIFIER MODULES, US PAT 5901037Assignee: Northrop Grumman Corporation, (U.S. PTO Utility 1999)

C 8 COMPUTER COOLING APPARATUS, US PAT 6725682Assignee: Coolit Systems Inc., (U.S. PTO Utility 2004)

C 9 COMPUTER COOLING APPARATUS, US PAT APP 20030010050 (U.S. PTO Application 2003)

C 10 COOLING APPARATUS AND METHOD EMPLOYING DISCRETE COLD PLATES DISPOSED BETWEEN A MODULE ENCLOSURE AND ELECTRONICS COMPONENTS TO BE

COOLED, US PAT 7298617Assignee: International Business Machines, (U.S. PTO Utility 2007)

C 11 COOLING ASSEMBLY FOR ELECTRONICS DRAWER USING PASSIVE FLUID LOOP AND AIR-COOLED COVER, US PAT 6967841Assignee: International Business Machines, (U.S. PTO Utility 2005)

C 12 COOLING FLUID PUMP AND ELECTRIC APPARATUS, SUCH AS PERSONAL COMPUTER, PROVIDED WITH THE PUMP, US PAT APP 20040105232Assignee: KABUSHIKI KAISHA TOSHIBA, (U.S. PTO Application 2004)

C 13 COOLING SYSTEM FOR COMPUTER, US PAT 5731954 (U.S. PTO Utility 1998)

C 14 COOLING SYSTEM FOR A COMPUTER SYSTEM, US PAT APP 20090218072 (U.S. PTO Application 2009)

C 15 CPU COOLING SYSTEM, US PAT 6166907 (U.S. PTO Utility 2000)

C 16 CROSS FLOW HEAT EXCHANGER, US PAT 3810509Assignee: UNION CARBIDE CORPORATION, (U.S. PTO Utility 1974)

C 17 CROSSFLOW MICRO HEAT EXCHANGER, US PAT 6892802Assignee: Board of Supervisors of Louisiana State, (U.S. PTO Utility 2005)

C 18 CROSSFLOW MICRO HEAT EXCHANGER, US PAT 6415860Assignee: Board of Supervisors of Louisiana State, (U.S. PTO Utility 2002)

C 19 ELECTRONIC APPARATUS HAVING PUMP UNIT, US PAT APP 20050069432Assignee: Kabushiki Kaisha Toshiba, (U.S. PTO Application 2005)

C 20 HEAT EXCHANGE APPARATUS, US PAT 6019165 (U.S. PTO Utility 2000)

C 21 HEAT EXCHANGER CONFIGURATION FOR PUMPED LIQUID COOLING COMPUTER SYSTEMS, US PAT APP 20060113066Assignee: Intel Corporation, (U.S. PTO Application 2006)

C 22 HEAT SINK ASSEMBLY WITH ADJUSTABLE MOUNTING CLIP, US PAT 5825622Assignee: Chip Coolers, Inc., (U.S. PTO Utility 1998)

C 23 HEAT SINK MOUNTING STRUCTURE, US PAT 5708564 (U.S. PTO Utility 1998)

C 24 HEAT SPREADER WITH OSCILLATING FLOW, US PAT APP 20030151895 (U.S. PTO Application 2003)

C 25 HEATSINK ASSEMBLY WITH ADJUSTABLE RETAINING CLIP, US PAT 5784257Assignee: Chip Coolers, Inc., (U.S. PTO Utility 1998)

C 26 HIGH SERVICEABILITY LIQUID COOLING LOOP USING FLEXIBLE BELLOWS, US PAT 7325588Assignee: Hewlett-Packard Development Company, L.P., (U.S. PTO Utility 2008)

C 27 INFUSION PUMP, US PAT 4898579Assignee: Pump Controller Corporation, (U.S. PTO Utility 1990)

C 28 INTEGRATED ACTIVE COOLING DEVICE FOR BOARD MOUNTED ELECTRIC COMPONENTS, US PAT 6263957Assignee: Lucent Technologies Inc., (U.S. PTO Utility 2001)

C 29 INTEGRATED FLUID COOLING SYSTEM FOR ELECTRONIC COMPONENTS, US PAT APP 20040052048 (U.S. PTO Application 2004)

C 30 INTEGRATED FLUID COOLING SYSTEM FOR ELECTRONIC COMPONENTS, US PAT APP 20040052049 (U.S. PTO Application 2004)

C 31 INTEGRATED LIQUID COOLING SYSTEM FOR ELECTRICAL COMPONENTS, US PAT APP 20050061482 (U.S. PTO Application 2005)

C 32 LIQUID-COOLING HEAT DISSIPATION APPARATUS, US PAT 7325591Assignee: Cooler Master Co., Ltd., (U.S. PTO Utility 2008)

C 33 LIQUID COOLING SYSTEM, US PAT APP 20050083656 (U.S. PTO Application 2005)

C 34 LIQUID COOLING SYSTEM AND PERSONAL COMPUTER USING THE SAME, US PAT 6972954Assignee: Hitachi, Ltd., (U.S. PTO Utility 2005)

C 35 LIQUID COOLING SYSTEM FOR PROCESSORS, US PAT 6749012Assignee: Intel Corporation, (U.S. PTO Utility 2004)

C 36 PUMP, ELECTRONIC APPARATUS, AND COOLING SYSTEM, US PAT 7215546Assignee: Kabushiki Kaisha Toshiba, (U.S. PTO Utility 2007)

C 37 PUMP SYSTEM FOR USE IN A HEAT EXCHANGE APPLICATION, US PAT 6668911Assignee: ITT Manufacturing Enterprises, Inc., (U.S. PTO Utility 2003)

C 38 SEALED MOTOR DRIVEN CENTRIFUGAL FLUID PUMP, US PAT 5890880 (U.S. PTO Utility 1999)

C 39 SOLID OXIDE FUEL CELL HAVING A MONOLITHIC HEAT EXCHANGER AND METHOD FOR MANAGING THERMAL ENERGY FLOW OF THE FUEL CELL, US PAT 6551734Assignee: Delphi Technologies, Inc., (U.S. PTO Utility 2003)

C 40 START-UP METHOD FOR SYNCHRONOUS MOTORS, US PAT 4563620 (U.S. PTO Utility 1986)

C 41 SYSTEM FOR EFFICIENTLY COOLING A PROCESSOR, US PAT 7359197Assignee: NVIDIA Corporation, (U.S. PTO Utility 2008)

C 42 WATER/AIR DUAL COOLING ARRANGEMENT FOR A CPU, US PAT 6343478 (U.S. PTO Utility 2002)

US District Court Civil Docket

U.S. District - California Northern
(San Francisco)

3:12cv4498

Asetek Holdings, Inc et al v. Coolit Systems Inc

This case was retrieved from the court on Tuesday, October 02, 2012

Date Filed:	**08/27/2012**	**Class Code:**	**OPEN**
Assigned To:	**Honorable Edward M. Chen**	**Closed:**	**No**
Referred To:		**Statute:**	**28:1331**
Nature of suit:	**Patent (830)**	**Jury Demand:**	**Plaintiff**
Cause:	**Fed. Question**	**Demand Amount:**	**$0**
Lead Docket:	**None**	**NOS Description:**	**Patent**
Other Docket:	**None**		
Jurisdiction:	**Federal Question**		

Litigants	Attorneys
Asetek Holdings, Inc Plaintiff	Robert Francis McCauley LEAD ATTORNEY;ATTORNEY TO BE NOTICED Finnegan, Henderson, Farabow, Garrett & Dunner LLP 3300 Hillview Avenue Palo Alto , CA 94304-1203 USA 650-849-6600 Fax: 650-849-6666 Email:Robert.Mccauley@finnegan.Com
Asetek A/S Plaintiff	Robert Francis McCauley LEAD ATTORNEY;ATTORNEY TO BE NOTICED Finnegan, Henderson, Farabow, Garrett & Dunner LLP 3300 Hillview Avenue Palo Alto , CA 94304-1203 USA 650-849-6600 Fax: 650-849-6666 Email:Robert.Mccauley@finnegan.Com
Coolit Systems Inc Defendant	

Date	#	Proceeding Text	Source
08/27/2012	1	COMPLAINT FOR PATENT INFRINGEMENT: DEMAND FOR JURY TRIAL; against Coolit Systems Inc (Filing fee $ 350.00, receipt number 34611077936.). Filed byAsetek Holdings, Inc, Asetek A/S. (aaa, COURT STAFF) (Filed on 8/27/2012) (Additional attachment(s) added on 8/28/2012: # 1 Complaint Pt.02) (aaa, COURT STAFF). (Additional attachment(s) added on 8/28/2012: # 2 Complaint Pt.03) (aaa, COURT STAFF). (Additional attachment(s) added on 8/28/2012: # 3 Complaint Pt.04, # 4 Civil Cover Sheet) (aaa, COURT STAFF). (Entered: 08/28/2012)	

08/27/2012	2	ADR SCHEDULING ORDER: Case Management Statement due by 11/21/2012. Case Management Conference set for 11/28/2012 10:00 AM. Signed by Magistrate Judge Nathanael M. Cousins on 8/27/12. (Attachments: # 1 NC Standing Order, # 2 Standing Order)(aaa, COURT STAFF) (Filed on 8/27/2012) (Entered: 08/28/2012)
08/27/2012	3	Certificate of Interested Entities or Persons; by Asetek A/S, Asetek Holdings, Inc (aaa, COURT STAFF) (Filed on 8/27/2012) (Entered: 08/28/2012)
08/27/2012	4	Summons Issued as to Coolit Systems Inc. (aaa, COURT STAFF) (Filed on 8/27/2012) (Entered: 08/28/2012)
08/28/2012	5	REPORT on the filing or determination of an action regarding:PATENT INFRINGEMENT (cc: form mailed to register). (aaa, COURT STAFF) (Filed on 8/28/2012) (Entered: 08/28/2012)
09/21/2012	6	DECLINATION to Proceed Before a US Magistrate Judge by Asetek A/S, Asetek Holdings, Inc. (McCauley, Robert) (Filed on 9/21/2012) Modified on 9/24/2012 (mcl, COURT STAFF). (Entered: 09/21/2012)
09/21/2012	7	CLERK'S NOTICE of Impending Reassignment to U.S. District Judge. (lmh, COURT STAFF) (Filed on 9/21/2012) (Entered: 09/21/2012)
09/24/2012	8	ORDER, Case reassigned to Hon. Edward M. Chen. Magistrate Judge Nathanael M. Cousins no longer assigned to the case.. Signed by Executive Committee on 9/24/12. (ha, COURT STAFF) (Filed on 9/24/2012) (Entered: 09/24/2012)
09/27/2012	9	CERTIFICATE OF SERVICE by Asetek A/S, Asetek Holdings, Inc (McCauley, Robert) (Filed on 9/27/2012) (Entered: 09/27/2012)

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269234 (13) 8245764 August 21, 2012

UNITED STATES PATENT AND TRADEMARK OFFICE GRANTED PATENT

8245764

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August 21, 2012

Cooling system for a computer system

INVENTOR: Eriksen, André Sloth - Aalborg C, Kingdom of Denmark (DK), Kingdom of Denmark ()

APPL-NO: 269234 (13)

FILED-DATE: October 7, 2011

GRANTED-DATE: August 21, 2012

CORE TERMS: heat, reservoir, cooling, pump, processing, exchanging, electrical, computer system, cooling system, impeller, pumping, housing, interface, sink, thermal, voltage, rotor, channels, inlet, outlet, radiator, inside, fan, aperture, driving, segments, fastening, intermediate, generating, alternatively

ENGLISH-ABST:

The invention relates to a cooling system for a computer system, said computer system comprising at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit and comprising a reservoir having an amount of cooling liquid, said cooling liquid intended for accumulating and transferring of thermal energy dissipated from the processing unit to the cooling liquid. The cooling system has a heat exchanging interface for providing thermal contact between the processing unit and the cooling liquid for dissipating heat from the processing unit to the cooling liquid, Different embodiments of the heat exchanging system as well as means for establishing and controlling a flow of cooling liquid and a cooling strategy constitutes the invention of the cooling system.

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1. VR-Zone, August 29, 2012 Wednesday 4:25 PM EST, , 500 words, The Battle for Liquid Cooling: Asetek Sues CoolIT, is Corsair in Danger?

   CORE TERMS: Asetek, cooling, liquid, CoolIT, patent, heatsink, OEM, enthusiast-oriented, practically, competitor, granted, console, timing, cooled, pump'

   ... hearing, we took a detailed look at the patents in question (8,240,362, **8,245,764)**. Based on the engineering drawings, the initial design and size stem from an Intel ...

2. US Fed News, August 27, 2012 Monday 11:19 PM EST, , 263 words, US Patent Issued to Asetek on Aug. 21 for "Cooling System for a Computer System" (Danish Inventor), ALEXANDRIA, Va.

   CORE TERMS: cooling, liquid, cooling system, computer system, thermal, patent, heat, Denmark, comprising, exchanging, invention, intended, please

   ALEXANDRIA, Va., Aug. 27 -- United States Patent no. **8,245,764,** issued on Aug. 21, was assigned to Asetek A/S (Bronderslev, Denmark). " ...
   ... r=1&f=G&l=50&co1=AND&d=PTXT&s1=**8245764**&OS=**8245764**&RS=**8245764**
   For any query with respect to this article or any other content requirement, please ...

3. Plus Patent News, August 23, 2012 Thursday, 210 words, US Patent Issued to Asetek A/S on August 21 for "Cooling system for a computer system", ALEXANDRIA, Va

   CORE TERMS: cooling, liquid, cooling system, computer system, thermal, patent, heat, comprising, exchanging, invention, intended

   United States Patent no. **8,245,764** issued on August 21 was assigned Asetek A/S (Bronderslev, DK) :

4. GlobalAdSource (English), December 10, 2009 Thursday, 29 words, VACATION MORE OFTEN.

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PTO/SB/58 (02-12)
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(Also referred to as FORM PTO-1465)

REQUEST FOR *INTER PARTES* REEXAMINATION TRANSMITTAL FORM

Address to:
Mail Stop *Inter Partes* Reexam
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Attorney Docket No.: COOL-1.012

Date: September 15, 2012

1. ☑ This is a request for *inter partes* reexamination pursuant to 37 CFR 1.913 of patent number 8,245,764 issued August 21, 2012. The request is made by a third party requester, identified herein below.

2. ☑ a. The name and address of the person requesting reexamination is:
   Lloyd L. Pollard, II - Ganz Law, P.C.
   163 SE 2nd Avenue
   Hillsboro, Oregon 97213

   b. The real party in interest (37 CFR 1.915(b)(8)) is: COOLIT SYSTEMS, INC.

3. ☐ a. A check in the amount of $ ________ is enclosed to cover the reexamination fee, 37 CFR 1.20(c)(2);

   ☐ b. The Director is hereby authorized to charge the fee as set forth in 37 CFR 1.20(c)(2) to Deposit Account No. __________; **or**

   ☑ c. Payment by credit card. Form PTO-2038 is attached.

4. ☑ Any refund should be made by ☐ check or ☐ credit to Deposit Account No. __________. 37 CFR 1.26(c). If payment is made by credit card, refund must be made to credit card account.

5. ☑ A copy of the patent to be reexamined having a double column format on one side of a separate paper is enclosed. 37 CFR 1.915(b)(5)

6. ☐ CD-ROM or CD-R in duplicate, Computer Program (Appendix) or large table
   ☐ Landscape Table on CD

7. ☐ Nucleotide and/or Amino Acid Sequence Submission
   If applicable, items a. – c. are required.

   a. ☐ Computer Readable Form (CRF)
   b. Specification Sequence Listing on:
      i. ☐ CD-ROM (2 copies) or CD-R (2 copies); **or**
      ii. ☐ paper
   c. ☐ Statements verifying identity of above copies

8. ☑ A copy of any disclaimer, certificate of correction or reexamination certificate issued in the patent is included.

9. ☑ Reexamination of claim(s) 1 through 18 is requested.

10. ☑ A copy of every patent or printed publication relied upon is submitted herewith including a listing thereof on Form PTO/SB/08, PTO-1449, or an equivalent.

11. ☐ An English language translation of all necessary and pertinent non-English language patents and/or printed publications is included.

12. ☑ The attached detailed request includes at least the following items:

a. A listing of the grounds that the requester asserts to raise a showing of a reasonable likelihood that the requester will prevail with respect to at least one of the claims challenged in the request. 37 CFR 1.915(b)(3).

b. For each ground listed, an identification of every claim to which the showing applies, and a detailed explanation of the pertinency and manner of applying the patents and printed publications to every claim which is identified for that ground. 37 CFR 1.915(b)(3).

13. ☑ It is certified that the estoppel provisions of 37 CFR 1.907 do not prohibit this reexamination. 37 CFR 1.915(b)(7).

14. ☑ a. It is certified that a copy of this request has been served in its entirety on the patent owner as provided in 37 CFR 1.33(c).

The name and address of the party served and the date of service are:

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP

901 New York Avenue, NW

Washington, D.C. 20001-4413

Date of Service: September 15, 2012; **or**

☐ b. A duplicate copy is enclosed because service on patent owner was not possible. An explanation of the efforts made to serve patent owner **is attached**. See MPEP 2620.

15. Third Party Requester Correspondence Address: Direct all communications about the reexamination to:

☑ The address associated with Customer Number: 22874

OR

☐ Firm or Individual Name

Address		
City	State	Zip
Country		
Telephone	Email	

16. ☑ The patent is currently the subject of the following concurrent proceeding(s):

☐ a. Copending reissue Application No.

☐ b. Copending reexamination Control No.

☐ c. Copending Interference No.

d. Copending litigation styled:

Asetek Holdings, Inc. v. Coolit Systems Inc. Case No. 3:12-cv-04498-NC

in the United States District Court for the Northern District of California

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/LLOYD L. POLLARD II/	September 15, 2012
Authorized Signature	Date
Lloyd L. Pollard II	64793
Typed/Printed Name	Registration No., if applicable

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The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of	:	Andre Sloth Eriksen
U.S. Patent No.	:	8,245,764
Application No.	:	13/269,234
Issue Date	:	August 21, 2012
Filing Date	:	October 7, 2011
Title	:	COOLING SYSTEM FOR A COMPUTER SYSTEM

REQUEST FOR *INTER PARTES* REEXAMINATION

FILED VIA ELECTRONIC FILING SYSTEM ON SEPTEMBER 15, 2012
COMMISSIONER FOR PATENTS

Mail Stop *Inter Partes* Reexam
ATTN: Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Pursuant to 35 U.S.C. §§ 311 *et seq.*, as amended by the Leahy-Smith America Invents Act, reexamination of all claims (i.e., claims 1 through 18) of United States Patent No. 8,245,764 (hereinafter "the '764 Patent") is requested.[1] The '764 Patent issued on August 21, 2012, to Eriksen and purportedly was assigned to Asetek A/S (hereinafter "Asetek") (collectively hereinafter the "Applicants") from U.S. Patent Application No. 13/269,234 (hereinafter, the "Application") filed on October 7, 2011 (hereinafter the "Application Date").

The '764 Patent is currently the subject of litigation in the case styled Asetek Holdings, Inc v. CoolIT Systems, Inc., Case No. 3:12-cv-4498, now pending in the United States District Court for the Northern District of California (hereinafter "the Concurrent Litigation"). The Concurrent Litigation does not preclude the present Request for Reexamination.

Requester CoolIT Systems Inc. ("Requester") respectfully submits that it shows herein a reasonable likelihood that at least one, and indeed all, of claims 1 through 18 ("the challenged claims") of the '764 Patent should be and will be cancelled or at least narrowed in view of the prior art. This reasonable likelihood that Requester will prevail (hereinafter, "Reasonable Likelihood") is based in part on previously uncited prior art that renders the claims invalid.[2] Accordingly, Requester respectfully asks that this Request for *Inter Partes* Reexamination (hereinafter "Request") be granted and that the claims be cancelled.

Pursuant to 37 C.F.R. § 1.915(b)(8), Requester CoolIT Systems Inc. is the sole real-party-in-interest.

---

[1] A complete copy of the '764 Patent, including any certificates of correction, disclaimer or reexamination, is attached as Appendix A.

[2] All of the prior art cited herein against the challenged claims is listed in the Information Disclosure Statement attached as Appendix B.

TABLE OF CONTENTS

APPENDICES

APPENDIX A - Copy of U.S. Patent No. 8,245,764 to Eriksen

APPENDIX B - Information Disclosure Statement listing each prior art reference relied on in the Request

APPENDIX C - U.S. Publication No. 2004/0052663 of Laing

APPENDIX D - Relevant portions of the '764 Patent file history

- Applicant's request for Certificate of Correction dated August 23, 2012.
- Amendment dated April 6, 2012, p. 8-10.
- Notice of Allowance dated May 23, 2012, p. 2-3.
- Office Action dated December 20, 2011, p. 2.
- Information Disclosure Statement filed October 7, 2011 considered in Non-final OA dated December 20, 2011.
- Amendment dated January 30, 2012
- Office Action dated March 13, 2012, pp. 2-9.

APPENDIX E - Relevant portions of the prosecution history of the Parent Application

- Preliminary Amendment dated November 6, 2007, p. 3.
- Preliminary Amendment dated January 9, 2009, p. 4.
- Preliminary Amendment dated March 10, 2011, p. 7.
- Preliminary Amendment dated July 14, 2011, p. 8.

APPENDIX F - U.S. Patent No. 6,529,376 to Hamman

APPENDIX G - U.S. Patent No. 5,731,954 to Cheon

APPENDIX H - U.S. Patent No. 7,325,591 to Duan

APPENDIX I - U.S. Patent No. 7,544,049 to Koga.

APPENDIX J - Applicant's International Publication No. WO 2006/119761 (PCT/DK2005/000310).

APPENDIX K - Comparison of claim 15 in the '764 Patent to cancelled claim 113 from Parent Application

I. REQUESTER SATISFIES THE "REASONABLE LIKELIHOOD" OF PREVAILING REQUIREMENT FOR *INTER PARTES* REEXAMINATION UNDER CHAPTER 31, 35 U.S.C., AS AMENDED BY THE ACT

Requester satisfies each requirement for *Inter Partes* reexamination of the '764 Patent pursuant to Chapter 31 of Title 35, United States Code, as amended September 16, 2011, by the Leah-Smith America Invents Act ("the Act").

Section 312(a) of Chapter 31, as amended by Section 6(c)(3)(A)(i)(I) of the Act, provides (emphasis added):

> (a) REEXAMINATION. – Not later than 3 months after the filing of a request for inter partes reexamination under section 311, the Director shall determine whether **the information presented in the request shows that there is a reasonable likelihood that the requester would prevail with respect to at least 1 of the claims challenged in the request**, with or without consideration of other patents or printed publications. A showing there is a reasonable likelihood that the requester would prevail with respect to at least 1 of the claims challenged in the request is not precluded by the fact that a patent or printed publication was previously cited by or to the Office or considered by the Office.

Requester herein demonstrates such Reasonable Likelihood, and more, by demonstrating that each challenged patent claim is fully anticipated by or obvious from one or more prior art references (Section IX). Requester relies upon the entirety of this Request to satisfy the required "reasonable likelihood" showing, but immediately below, Requester highlights how one particular reference (Laing) fully disclosed the "claimed invention" of '764 Patent claim 10, thus demonstrating a "reasonable likelihood" that at least claim 10 will be cancelled on account of this Request.

A. OVERVIEW OF THE '764 PATENT

The '764 Patent matured from U.S. Patent Application No. 13/269,234, filed October 7, 2011, as a purported continuation of U.S. Patent Application No. 11/919, 974 (the "Parent Application"), a national stage filing of International Patent Application No. PCT/DK2005/000310, filed May 6, 2005 (the "International Application").[3] The '764 Patent is generally directed to a liquid cooling system for a computer system.

The '764 Patent remains within its period of enforceability for reexamination purposes, has not expired due to non-payment of maintenance fees, and has yet to be held invalid or unenforceable by any court. Requester is unaware of any disclaimer or reexamination certificates for the '764 Patent.

THE '764 PATENT CONCERNS A LIQUID COOLING SYSTEM HAVING "VERTICALLY" SPACED "THERMAL EXCHANGE" AND "PUMP" CHAMBERS

As with conventional liquid cooling systems, the liquid cooling system described in the '764 Patent includes a reservoir, a heat exchanging interface for transferring heat to a cooling liquid, a radiator for dissipating heat from the cooling liquid, and a pump for circulating the cooling liquid through the cooling system. Appendix A, '764 Patent, 1:65-2:12. The alleged invention in the '764 Patent concerns a pump chamber vertically spaced from a thermal exchange chamber. Id. (claims 1, 10 and 15); Appendix D, Amendment dated April 6, 2012, pp. 8-14 and Examiner's Reasons for Allowability, pp. 2-3.

For example, the reservoir claimed in each independent claim has a thermal exchange chamber and a pump chamber. Appendix A, '764 Patent, claims 1, 10 and 15. The thermal exchange chamber and the pump chamber are coupled to each other, through one or more passages configured for fluid communication. *See* Appendix A, '764 Patent, 22:26-23:8, claim 10.

Nonetheless, the claimed vertically spaced thermal exchange and pump chambers were inadequately described when the International Application (also referred to herein as the "'761 Publication") was filed. Indeed, the subject matter the Patent Owner believed to be patentable was only adequately described well after the Parent Application was filed as a national stage of the International Application (also referred to herein as the "'761 Publication").

---

[3] The Patent Owner's published International Application (WO 2006/119761) is prior art under 35 U.S.C. § 102(b) as to all claims, since subject matter purportedly conferring patentability to those claims was inadequately described in the International Application under § 112. NOTE: Requester raises § 112 issues in the Request solely for purposes of attempting to determine priority dates for claimed subject matter, and not as a basis for this Request, for that would be improper under the Act.

For example, FIG. 20 in the '764 Patent, reproduced below for convenience, first appears in the filed history of the Parent Application on January 9, 2009, almost four years after the International Application was filed and more than two years after it published. Appendix E, Preliminary Amendment dated January 9, 2009, p. 4. Yet FIG. 20 purports to illustrate a cross-sectional view of a reservoir housing having a reservoir with a pump chamber 46 vertically spaced from a thermal exchange chamber 47A, as claimed.

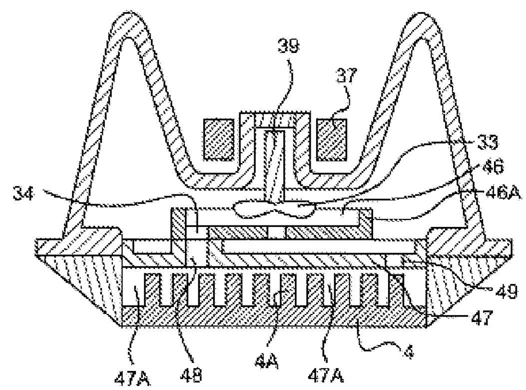

FIG. 20

FIGURE 1 - FIG. 20 IN '764 PATENT

For example, independent claim 10 of the '764 Patent purports to claim a cooling system of the type shown in FIG. 20. In particular, independent claim 10 recites (with annotations added to reflect features shown in new FIG. 20 as discussed in the '764 Patent's specification):

> A cooling system for a computer system, comprising:
> a centrifugal pump adapted to circulate a cooling liquid, the pump including:
> an impeller [33] exposed to the cooling liquid; and
> a stator [37] isolated from the cooling liquid;
> a reservoir configured to be thermally coupled to a heat-generating component of the computer system, the reservoir including:
> a thermal exchange chamber [47A] adapted to be positioned in thermal contact with the heat-generating component;
> a separate pump chamber [46] vertically spaced apart from the thermal exchange chamber and
> coupled with the thermal exchange chamber through one or more passages ["outlet 34," 48, 49]configured for fluid

> communication between the pump chamber [46] and the thermal exchange chamber [47A], and wherein at least one of the one or more passages is offset from a center of the impeller.

The corresponding Notice of Allowance was predicated on the claimed "pump chamber vertically spaced from the thermal exchange chamber." *See*, Appendix D, Notice of Allowance dated May 23, 2012, pp. 2-3.

B. Laing Discloses a Cooling System having Vertically Spaced Thermal Exchange and Pump Chambers and Anticipates Claim 10 of the '764 Patent

But, the '764 Patent's idea of a pump chamber vertically separated from a thermal exchange chamber to circulate a cooling liquid is an old one, described in multiple prior art references that were not disclosed to or considered by the Patent Office when it granted the '764 Patent. As a first example, a previously published patent application, Oliver Laing's U.S. Publication No. 2004/0052663, described the same concept a number of years earlier, using strikingly similar language as the '764 Patent.

Laing's patent application was filed on May 7, 2003, and published on March 18, 2004, and thus qualifies as prior art to the '764 Patent under Section 102(b) (even if any claim might somehow enjoy priority from the International Application). Laing's publication – not considered by the Patent Office – described a "device for the local cooling" of, for example, a microprocessor.

An example of Laing's device is shown immediately below (with annotations reflecting Laing's terminology for convenience):

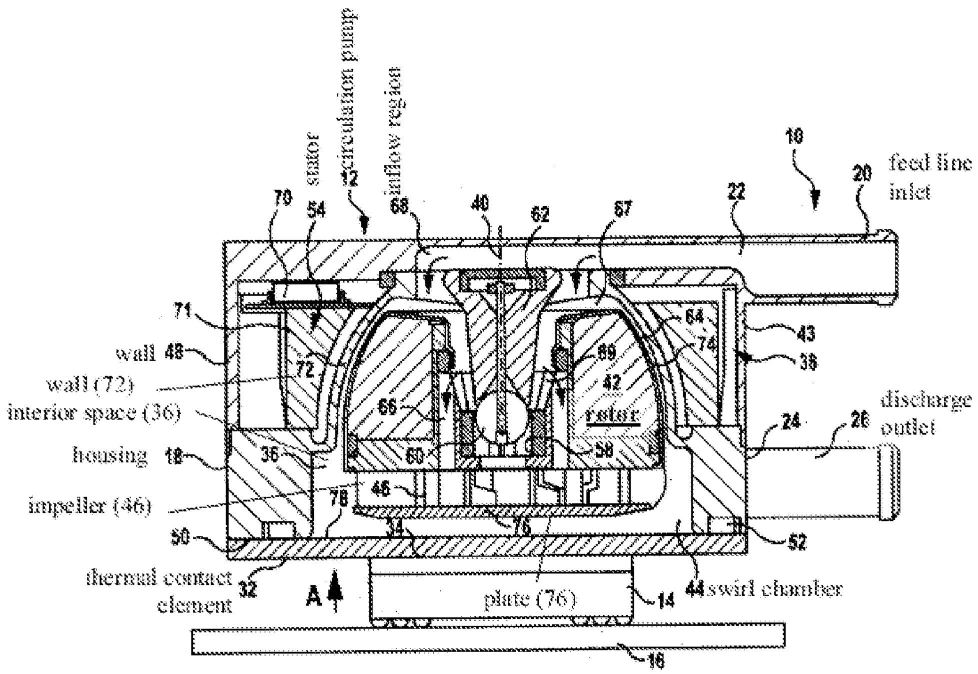

FIGURE 2 - LAING'S COOLING DEVICE SHOWN IN FIG. 1 OF LAING (WITH ANNOTATIONS ADDED FOR EASE OF REFERENCE)

Immediately following is a summary mapping of each limitation of claim 10 in the '764 Patent to Laing. (A more detailed mapping is set forth below.)

CLAIM 10: "A cooling system for a computer system, comprising:"

Laing discloses exactly the type of cooling system claimed in the '764 Patent. Laing's title states it clearly: "Device for the Local Cooling or Heating of an Object." Laing, Title. An example of an object cooled by Laing's device is a processor positioned on a circuit board 16. Appendix C, Laing, ¶ [0044].

CLAIM 10: "a centrifugal pump adapted to circulate a cooling liquid, the pump including:"

As Laing describes, "[i]n the exemplary embodiment shown in FIG. 1, the circulation pump 12 is formed as a centrifugal pump …." Appendix C, Laing, ¶ [0058].

CLAIM 10: "an impeller exposed to the cooling liquid; and"

Laing's publication states: "Then, liquid is guided through the circulation pump 12 via the through-flow space 66, and a swirl is imparted to the liquid which is conducted through by the paddle wheel 46; the pressure required to pump the liquid through the loop 28 is then produced." Appendix C, Laing, ¶ [0064]. Laing's "paddle wheel" is a form of impeller, as recited in claim 10.

CLAIM 10: "a stator isolated from the cooling liquid;"

Laing states: "Between the rotor 42 and the stator 54 there is a substantially spherical wall 72 …." Laing, ¶ [0068]. As shown above, the wall 72 isolates the stator 54 from the cooling liquid in the through-flow region 66. Appendix C, Laing, FIG. 1.

CLAIM 10: "a reservoir configured to be thermally coupled to a heat-generating component of the computer system, the reservoir including:"

As the '764 Patent explains: "The reservoir serves as a storage unit for excess liquid not capable of being contained in the remaining components. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." Appendix A, '764 Patent, 45-49.

Laing's housing 18 defines an interior space 36 constituting a chamber for holding excess liquid not capable of being contained in the remaining components. For example, Laing discloses a housing 18 configured to accommodate volume fluctuations of a coolant. "In particular, it is provided that the circulation pump has a housing part which is formed flexibly and/or is movable …. By way of example, the housing part may be a flexible plate, a flexible diaphragm or a bellows." Appendix C, Laing, ¶ [0029]; *see also*, Laing, ¶¶ [0082]-[0086] (describing a flexible thermal contact element 32 to accommodate fluctuations in volumes without requiring a separate expansion vessel).

Also, the interior space 36 is configured to be thermally coupled to an object 14, such as a processor mounted to a motherboard 16, as claimed. For example, Laing explains: "An interior space 36 … is formed in the housing 18 of the circulation pump 12. … A swirl chamber 44, in which a swirl is imparted to liquid which has been supplied via the feed line 20, using an impeller 46 (paddle wheel) which is connected in a rotationally fixed manner to the rotor 42, and in which swirling liquid flows, is formed in the interior space 36 of the housing 18. … The liquid is also guided past the thermal contact element 32 in order to transfer heat. … The swirl chamber 44 is formed in the interior space 36 between walls 48 ….” Appendix C, Laing, ¶¶ [0052]-[0056].

The thermal contact element 32 is configured to be thermally coupled to a processor mounted to a motherboard. “To form the thermal contact, the thermal contact element 32 touches the object 14 over the largest possible surface area.” Id. at ¶ [0051] and FIG. 1.

CLAIM 10: “a thermal exchange chamber adapted to be positioned in thermal contact with the heat-generating component;”

A portion of the interior space 36 shown between the thermal contact element 32 and the plate 76 defines a thermal exchanger chamber. Laing, ¶ [0055] (stating "[t]he liquid is also guided past the thermal contact element 32 in order to transfer heat”).

CLAIM 10: “a separate pump chamber vertically spaced part from the thermal exchange chamber and coupled with the thermal exchange chamber through one or more passages configured for fluid communication between the pump chamber and the thermal exchange chamber, and”

The region shown between thermal contact element 32 and plate 76 is separate from the volume occupied by the impeller 46 or the impeller 46 and rotor 42. The region and volume are fluidly coupled to each other by the "swirl chamber" 44. Laing, FIG. 1.

CLAIM 10: “wherein at least one of the one or more passages is offset from a center of the impeller.”

The swirl chamber 44 is offset from a center of the impeller 46. Laing, FIG. 1.

In sum, Laing is prior art to Claim 10 of the ‘764 Patent and fully discloses each and every feature arranged in the same manner as claimed in claim 10. Laing therefore anticipates claim 10, establishing a reasonable likelihood that Requester will prevail with respect to at least one challenged claim.

II. Requester Satisfies the Requirements for *Inter Partes* Reexamination under 37 C.F.R. § 1.915

Requester also satisfies each requirement for *Inter Partes* reexamination of the '764 Patent pursuant to 37 C.F.R. § 1.915.

A. 37 C.F.R. § 1.915(a): Fee for Reexamination

In accordance with 37 C.F.R. § 1.915(a), please charge the Fee for reexamination of $8,800 to the credit card account referenced and authorized via the EFS Web (Electronic Filing System) concurrently with the filing of this Request .

Moreover, the Commissioner is hereby authorized to charge any fees, including extension fees, or to charge any additional fees or underpayments, or to credit any overpayments, to the Credit Card account referenced and authorized via the EFS Web (Electronic Filing System). And if any extension of time is needed, this hereby constitutes a petition for any such extension.

B. 37 C.F.R. § 1.915(b)(1): Claims for Which Reexamination is Requested

Reexamination of all claims, i.e., claims 1-18, in the '764 Patent is requested.

C. 37 C.F.R. § 1.915(b)(2): Identification of Prior art

This Request is based on the prior art references listed in Section III, below.

D. 37 C.F.R. § 1.915(b)(3): Statement Pointing Out Each Showing of a Reasonable Likelihood Requester will Prevail

This Request is based on the cited prior art documents set forth herein and on the accompanying Information Disclosure Statement. All of the cited prior art patents and publications constitute effective prior art as to the challenged claims of the '764 Patent under 35 U.S.C. § 102 and/or 35 U.S.C. § 103.

Requester presents below "A statement pointing out, based on the cited patents and printed publications, each showing of a reasonable likelihood that the requester will prevail with respect to at least one of the claims challenged in the request," in accordance with 37 C.F.R. § 1.915(b)(3) (as amended, 76 Fed. Reg. 59055, September 23, 2011). In addition, Requester presents a detailed explanation of the pertinency and manner of applying the patents and printed publications to the challenged claims of the '764 Patent, below and in attached claim charts in accordance with 37 C.F.R. § 1.915(b)(3).

The references were either not cited or not fully considered during the original prosecution of the '764 Patent. Each reference, alone or in a specific combination with another reference set forth below, raises a Reasonable Likelihood for the challenged claims in the '764 Patent. A more detailed identification and explanation of each Reasonable Likelihood is provided in Section IX. To summarize, the Reasonable Likelihoods presented by this Request are listed below:

No.	Reasonable Likelihood Requester Will Prevail
1	Newly found Laing raises a Reasonable Likelihood under § 102 as to Claims 10-12 and 14.
2	Laing raises a Reasonable Likelihood under § 103 as to Claim 13.
3	Laing combined with newly found Hamman raises a Reasonable Likelihood under § 103 as to Claim 13.
4	Laing combined with Cheon raises a Reasonable Likelihood under § 103 as to Claims 1-9 and 15-18.
5	Laing combined with Hamman and Cheon raises a Reasonable Likelihood under § 103 as to Claims 7, 9 and 15-18.
6	Newly found Hamman combined with Cheon raises a Reasonable Likelihood under § 103 as to Claims 1-18.
7	Duan raises a Reasonable Likelihood under § 102 as to Claims 1-7, 10-12 and 14.
8	Duan raises a Reasonable Likelihood under § 103 as to claims 8, 9, 13 and 15-18
9	Duan combined with Cheon raises a Reasonable Likelihood under § 103 as to Claims 1-18.
10	Duan combined with Hamman raises a Reasonable Likelihood under § 103 as to Claims 8, 9, 13 and 15-18.

11	Koga raises a Reasonable Likelihood under § 102 as to Claims 1-18
12	Applicant's own International Publication No. WO 2006/119761 combined with Laing raises a Reasonable Likelihood under § 103 as to Claims 1-18.

E. 37 C.F.R. § 1.915(b)(4): COPY OF EVERY PATENT OR PRINTED PUBLICATION RELIED UPON TO PRESENT A REASONABLE LIKELIHOOD

Pursuant to 37 C.F.R. § 1.915(b)(4), a copy of every patent or printed publication relied upon to present a Reasonable Likelihood is submitted herein at Appendices C, F, G, H, I and J, citation of which may be found on the accompanying Information Disclosure Statement in accordance with 37 C.F.R. § 1.915(b)(2). Each of the cited prior art publications constitutes effective prior art as to the claims of the '764 Patent under 35 U.S.C. § 102 and/or 35 U.S.C. § 103. Furthermore, each piece of prior art submitted was not considered in a light set forth herein by the Office during prosecution of the '764 Patent.

F. 37 C.F.R. § 1.915(b)(5): COPY OF THE ENTIRE PATENT FOR WHICH REEXAMINATION IS REQUESTED

A full copy of the '764 Patent is submitted herein as Appendix A in accordance with 37 C.F.R. § 1.915(b)(5).

G. 37 C.F.R. § 1.915(b)(6): CERTIFICATION THAT A COPY OF THE REQUEST HAS BEEN SERVED IN ITS ENTIRETY ON THE PATENT OWNER

A copy of this request has been served in its entirety on the purported Patent Owner in accordance with 37 C.F.R. § 1.915(b)(6) at the address listed on the certificate of service following the last page of this Request.

H. 37 C.F.R. § 1.915(b)(7): CERTIFICATION THAT ESTOPPEL PROVISIONS DO NOT PROHIBIT *INTER PARTES* REEXAMINATION

Requester hereby certifies that is it not prohibited under the provisional of 35 U.S.C. § 317 or 37 C.F.R. § 1.907 from filing this Request for *inter partes* reexamination. Requester may request *inter partes* reexamination because neither it nor its privies has previously requested *inter partes* reexamination of the '764 Patent. 35 U.S.C. § 317(b); 37 C.F.R. § 1.907; M.P.E.P. § 2612.

I. 37 C.F.R. § 1.915(b)(8): IDENTIFICATION OF THE REAL PARTY IN INTEREST

Pursuant to 37 C.F.R. § 1.915(b)(8), Requester CoolIT Systems Inc. is the sole real-party-in-interest in this Request.

III. IDENTIFICATION OF THE PRIOR ART REFERENCES THAT PRESENT A REASONABLE LIKELIHOOD OF PREVAILING AS TO AT LEAST ONE CLAIM

The following references present a Reasonable Likelihood that Requester will prevail as to at least one claim. The references are listed on an Information Disclosure Statement accompanying this Request as Appendix B:

APPENDIX C - Oliver Laing, *et al.*, U.S. Publication No. 2004/0052663, published March 18, 2004, from an application filed on May 7, 2003 (hereinafter "**Laing**");

APPENDIX F - Brian A. Hamman, U.S. Patent No. 6,529,376, issued March 4, 2003, from an application filed August 3, 2001 (hereinafter "**Hamman**")

APPENDIX G - Kioan Cheon, U.S. Patent No. 5,731,954, issued on March 24, 1998, from an application filed August 22, 1996 (hereinafter "**Cheon**");

APPENDIX H - Qiang-Fei Duan, *et al.*, U.S. Patent No. 7,325,591, issued on February 5, 2008, from an application filed February 18, 2005 (hereinafter "**Duan**");

APPENDIX I - Shinya Koga, *et al.*, U.S. Patent No. 7,544,049, issued on June 9, 2009, from an application filed May 25, 2004 (hereinafter "**Koga**")

APPENDIX J - Applicant's International Publication No. WO 2006/119761 (hereinafter the "**International Application**" or the "**'761 Publication**")

IV. OVERVIEW OF THE TECHNOLOGICAL TEACHINGS APPLICANTS ARGUED WERE MISSING IN THE ART

U.S. Publication No. 2005/0069432 formed the basis for an anticipation rejection of independent claims 1 and 10 in the '764 Patent (corresponding to claims 1 and 12 in the application leading to the '764 Patent), and was the lead reference in an obviousness rejection of claim 15 in the '764 Patent (corresponding to claim 17 in the application). In the only substantive response to prior art rejections during prosecution of the '764 Patent, Applicants amended independent claim 1 and argued that the old and well-known vertically spaced thermal exchange and pump chambers recited in the claims are lacking from the lead reference, and that somehow such old features confer patentability to the claims. Appendix D, Amendment dated April 6, 2012, pp. 8-15. The Examiner did not object or respond that other references cited on the face of the '764 Patent disclose those allegedly missing features, as a different Examiner did in the Parent Application.

Despite claiming substantially overlapping subject matter, the Parent Application and the application leading to the '764 Patent were assigned to different examiners, with dramatically different outcomes for claims to such subject matter. Indeed, rejected and now cancelled, claim 113 from the Parent Application is identical to issued claim 15 in the '764 Patent, as Appendix K illustrates. In the Parent Application, the Examiner rejected claim 113 as being unpatentable over U.S. Patent No. 6,019,165 combined with U.S. Publication No. 2005/0083656.

Nonetheless, the Examiner in the '764 Patent proceeded to allow the claims, as amended, and conclusorily stated that the "thermal exchange chamber formed below the pump chamber and vertically space [*sic*: spaced] apart from the pump chamber" are lacking from the applied references. Appendix D, Notice of Allowability dated May 23, 2012, Reason for Allowance, pp. 2-3.

As explained below, Laing and other prior art references cited herein supply some or all of the very features Applicants alleged were lacking from the references applied during prosecution of the '764 Patent. Thus, these references would have been important to a reasonable Examiner in deciding patentability.

V. IDENTIFICATION AND STATUS OF CO-PENDING PROSECUTION AND LITIGATION INVOLVING THE '764 PATENT

As noted, the '764 Patent is currently asserted in the action captioned Asetek Holdings, Inc v. CoolIT Systems, Inc., Case No. 3:12-CV-4498, now pending in the United States District Court for the Northern District of California (the "Concurrent Litigation"). The Patent Owner initiated the action on August 27, 2012, against Requester CoolIT Systems, Inc. Given the recent initiation of the litigation, Requester has yet to answer, respond, or otherwise appear in the Concurrent Litigation. The District Court litigation does not preclude the present Request for Reexamination.

The '764 Patent issued from a purported continuation application claiming priority from U.S. Patent Application No. 11/919,974, filed January 6, 2009, which remains pending. Although not related under a claim of priority, the '764 Patent discloses and claims subject matter identically reproduced in U.S. Patent Application No. 12/826,768, which has matured into U.S. Patent No. 8,240,362. Pending U.S. Patent Application No. 13/547,240, filed on July 12, 2012, claims the benefit of U.S. Patent Application No. 12/826,768.

Requester is concurrently pursuing *inter partes* reexamination of Patent Owner's U.S. Patent No. 8,240,362.

Requester is aware of no other co-pending patent applications relating to the '764 Patent.

VI. REQUEST FOR PRIORITY HANDLING AND A SCHEDULING ORDER

Pursuant to 35 U.S.C. § 314, Requester respectfully urges that this Request be granted and reexamination be conducted not only with "special dispatch," but also with "priority over all other cases" in accordance with MPEP § 2661 due to the ongoing nature of the Concurrent Litigation. Further, pursuant to the policy of the Office concerning revised reexamination procedures to provide for a scheduling-type order of expected substantive action dates in Requests ordered after the Office's 2005 fiscal year, Requester respectfully seeks such a scheduling order upon the granting of this Request.

VII. LEGAL STANDARDS FOR REEXAMINATION – CLAIM CONSTRUCTION

During *inter partes* reexamination, claims are interpreted according to the "broadest reasonable interpretation" standard. *See* MPEP 2258(I)(G). The analysis in this Request is intended to comport with this standard.

According to the Patent Owner, Asetek A/S, an apparently wholly owned subsidiary of Asetek Holdings, Inc., one or more of the '764 Patent claims allegedly cover an independently developed, liquid-cooled heat sink. *See* Appendix I. Not only is the Patent Owner's asserted claim scope far beyond the contemplation of the '764 Patent's specification and original examination, but such assertions of an overly broad claim scope necessarily ensnares multiple anticipatory prior art references that were not considered during the original prosecution.

Whether the claims are interpreted in the overly broad manner proffered by Patent Owner, or under a narrower, more reasonable interpretation, the claims are unpatentable over the prior art described herein.

Because the standards of claim interpretation applied by the Federal Courts during patent litigation proceedings differ from the claim interpretation standard that must be used in the Patent Office during claim reexamination proceedings, any interpretations of terms in the claims discussed herein for the purpose of reexamination are not binding on Requester in any litigation related to the '764 Patent (or other patents) and do not necessarily correspond to the construction of claims under the legal standards that must be applied by the Federal Courts in litigation. *See In re Zletz*, 13 USPQ2d 1320, 1322 (Fed. Cir. 1989). In applying the particular prior art references identified herein, Requester neither admits nor acquiesces as to any interpretation of any claim of the '764 Patent asserted now or in the future in litigation before the Federal Courts, or in any other proceeding before any other tribunal. Requester reserves all rights to challenge in any proceeding, before any forum, any claim interpretations proferred by the Patent Owner in putting forth allegations of infringement against Requester.

VIII. PROSECUTION HISTORY OF THE '764 PATENT

The '764 Patent matured from U.S. Patent Application No. 13/269,234, filed October 7, 2011, as a purported continuation of U.S. Patent Application No. 11/919, 974 (the "Parent Application"), a national stage filing of International Patent Application No. PCT/DK2005/000310, filed May 6, 2005 (the "International Application"). As explained more fully below, the '764 Patent issued in error after an incomplete and faulty examination permitted a number of prior art references to escape proper consideration.

A. THE '764 PATENT CLAIMS ARE NOT ENTITLED TO AN EFFECTIVE FILING DATE EARLIER THAN THE ACTUAL FILING DATE (OCTOBER 7, 2011

On its face, the '764 Patent alleges priority to U.S. Patent Application No. 11/919,974 (hereinafter, the "Parent Application"), purportedly filed on November 6, 2007, claiming benefit of International Application No. PCT/DK2005/00310 (the "International Application"), filed on May 6, 2005, according to the face of the '764 Patent.

The Patent Owner amended the Parent Application no fewer than four times before filing the application leading to the '764 Patent. Notwithstanding substantially adding to the specification and drawings, and substantially revising the claims, compared to the original disclosure filed in the International Application, the application leading to the '764 Patent was filed as a purported "continuation" patent application rather than as a "continuation-in-part patent" application. Requester submits that neither the International Application nor the Parent Application, as filed, provided a written description or an enabling disclosure of the full scope of the purported "invention" recited in the challenged claims in the '764 Patent. As a consequent, the challenged claims are not entitled to the benefit of either of the earlier applications' filing dates.

The International Application included 36 claims and on filing the Parent Application on November 6, 2007, the Patent Owner substituted the original claims with claims 37-72. Appendix E, Preliminary Amendment dated November 6, 2007, p. 3.

On January 9, 2009, ***more than two years*** after the International Application published (i.e., November 16, 2006), claims 73-96 were substituted for claims 37-72, original FIG. 17 was amended ***<u>and</u>***

an entirely new drawing, FIG. 20, was added to the Parent Application. Appendix E, Preliminary Amendment dated January 9, 2009, p. 4. Patent Owner filed another Preliminary Amendment on March 10, 2011, cancelling claims 93-96 in connection with an ultimately denied Green Tech Petition. Appendix E, Preliminary Amendment dated March 10, 2011, p. 7.

Almost five years after the International Patent Application published, Applicant filed a Fourth Preliminary Amendment, ***substantially adding to the specification*** and substituting claims 97-116 for claims 73-92. Appendix E, Preliminary Amendment dated July 14, 2011, p. 8. ***In particular, the specification was amended to discuss features shown in new FIG. 20 (added more than two years after the International Application published)***. For example, paragraph [0166] was amended as follows (emphasis added to show new text):

> [0166]The reservoir housing 14 has a recess 40 in the centre on the upper side of the reservoir. The recess 37 is intended for accommodating a stator 37 of an electrical motor driving an impeller 33 of the pump, said impeller being attached to a shaft 38 of a rotor 39 of the electrical motor. The recess 40 has an orifice 41, four sidewalls 42, a bottom 43 and a circular jacket 44 extending from the bottom 43 of the recess 40 and outwards towards the orifice 41 of the recess 40. The interior (not shown) of the jacket 44 is intended for encompassing the rotor 39 of the pump. As shown in FIG. 20, the impeller 33 is housed in a recess on the underside of the reservoir housing 14, the recess being an extension of the interior of the jacket 44.

As well, Paragraph [0172] was amended as follows (emphasis added to show amendments):

> [0172]An impeller 33 of the pump of the cooling system is provided in direct communication with a pump chamber 46 having an outlet 34 provided tangentially to the circumference of the impeller 33. Thus, the pump functions as a centrifugal pump. The inlet if of the pump chamber 46 is the entire opening into the cavity that the pump chamber configures, said cavity being in direct communication with the interior of the reservoir housing 14 as such. An intermediate member 47 is provided between the pump chamber 46 together with the interior of the reservoir and a heat exchanging interface 4. The intermediate member 47 is provided with a first passage 48 for leading

> cooling liquid from the pump chamber 46 to a thermal exchange chamber 47A provided at the opposite of the intermediate member 47. The intermediate member 47 is provided also with a second passage 49 for leading cooling liquid from the thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47 to the interior of the reservoir housing 14. Thus, the area enclosed between the underside of the reservoir housing 14 and the heat exchange surface 4 constitutes an enclosed space for circulating the cooling liquid therethrough. The enclosed spaced is divided into two separate chambers by the impeller cover 46A and the intermediate member 47, as shown in FIG. 20. The impeller cover 46A interfaces with the recess on the underside of the reservoir 14 to define the pump chamber 46 which houses the impeller 33, while the intermediate member 47 and the heat exchange surface 4 together define the thermal exchange chamber 47A.

At least because FIG. 20 and the text emphasized above were added well after the Parent Application was filed as a U.S. national stage application, there is no evidence that the disclosure in the Parent application or the International Application ***at the time they were filed*** provided a written description of the purported invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to make and use the same.

Another line of amendments to the specification purportedly attempted to clarify that feature 14 shown in the drawings is a "reservoir housing" as opposed to a "reservoir." Apparently, Applicant recognized that the term "reservoir," as recited elsewhere in the specification and claims, refers to a "chamber" and that feature 14 is not a "chamber" but rather a "housing." *See, e.g.,* Appendix E, July 14, 2011, Preliminary Amendment, p. 8; "Marked-Up Copy of Substitute Specification," ¶¶ [0144], [0153], [0154], [0158]-[0160], [0164] (stating "The reservoir housing 14, as shown in FIGS. 17 and 20, is in the form of a double-sided chassis configured to mount an electrical motor. The reservoir housing 14 has basically the same features as the reservoir housing shown in FIG. 15-16." (emphasis added to show amendments)), [0166], [0168]-[0172], [0178], [0180]-[0182]. At the time of filing the International and Parent Applications, use of the term "reservoir" interchangeably to mean a "chamber" and a "housing" was confusing. Thus, Requester submits that the description of the purported "invention" was not set forth in sufficiently full, clear, concise and exact terms at the time either of the International Application or the Parent Application was filed. Moreover, such uncertain use of the term "reservoir" throughout the various claimings during prosecution of the International and the Parent Applications could not have pointed out and distinctly defined any subject matter sufficiently clearly as to put the public on notice as to the subject matter regarded by the Patent Owner regarded as his "invention."

As explained below, in Section VIII.B., Patent Owner and Examiner considered vertically separate thermal exchange and pump chambers somehow to confer patentability to claims 1-18 in the '764 Patent. *See* Appendix D, Amendment dated April 6, 2012, p. 8-10, and Notice of Allowability dated May 23, 2012, p. 2-3. Nonetheless, that is precisely the subject matter added to the Parent Application years after the U.S. national phase filing.

In the first Office Action, Examiner Duke rejected all claims as being anticipated by the WO 2006/119761, the publication of the International Application from which priority benefit in the '764 Patent is claimed. Appendix D, Office Action dated December 20, 2011, p. 2. In a Reply dated January 30, 2012, the Patent Owner alleged that the application leading to the '764 Patent is entitled to priority to the International Application, with no substantive analysis of whether claimed subject matter absent from the International Application might somehow be entitled to such priority.[4]

The subject matter added to the Parent Application after its actual filing date is not supported by the original filing, yet was relied on to confer patentability to each and every claim in the '764 Patent. As a consequence, no claim in the '764 Patent is entitled to priority from the Parent Application's filing date. Indeed, Requester submits that no claim is entitled to an effective filing date earlier than the actual date of filing the application leading to the '764 Patent.

For at least these reasons, none of the claims in the '764 Patent is entitled to priority from any earlier-filed applications. Accordingly, the Patent Office should declare for purposes of this

[4] As indicated in the Patent Owner's Reply and in the subsequent Office Action dated March 13, 2012, a conversation occurred between the Patent Owner's attorney and Examiner Duke, but whether the conversation dealt with substantive matters is unclear from the record. *See* Appendix D, Reply dated January 30, 2012, p. 2, and Office Action dated March 13, 2012, p. 2.

reexamination that the challenged patent claims' effective filing date is their actual filing date, i.e., October 7, 2011.[5]

B. SUMMARY OF PROSECUTION OF THE '764 PATENT

On filing the application leading to the '764 Patent, Applicant disclosed a number of prior art references before a first Office Action on the merits issued. Appendix D, Information Disclosure Statement filed October 7, 2011. The examiner appears on December 13, 2011, to have considered the Information Disclosure Statement listing U.S. Patent No. 5,731,954, filed August 22, 1996 (Cheon) and U.S. Patent No. 7,325,591, filed February 18, 2005 (Duan). Appendix D, Information Disclosure Statements.

In the first Office Action, Examiner Duke rejected all claims as being anticipated by the '761 Publication (i.e., the publication of the International Application from which priority benefit in the '764 Patent is alleged). Appendix D, Office Action dated December 20, 2011, p. 2. Given the anticipation position propounded by Examiner Duke, all prior art references then of record were presumably set aside in favor of the published International Application. Those references included U.S. Patent No. 7,325,591 (Duan) and U.S. Patent No. 5,731,954 (Cheon), collectively referred to below as the "Set-Aside References."

In responding to the anticipation rejection based on the '761 Publication, Patent Owner merely recited 35 U.S.C. § 120 followed by allegations of filing dates purportedly corresponding to the chain of applications listed in the '764 Patent, as well as a portion of a filing receipt reciting a claim of priority. Appendix D, Reply dated January 30, 2012. However, Patent Owner's reply omitted key information concerning the extent to which the specification, drawings and claims had been amended. Id.

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[5] Requester does not raise any Section 112 issues as a basis for instituting a reexamination pursuant to this Request, for that would be improper under the Act. Rather, Section 112 issues are raised insofar as needed to determine those references qualifying as prior art to the claims. That said, nothing herein is deemed to be an admission by Requester that any claims satisfy any aspect of Section 112.

According to standard Patent Office procedure, the merits of an applicant's claim of priority are not considered during the original prosecution unless the applicant claims priority to a foreign application, or there is an interference. (MPEP § 201.15). Thus, Examiner Duke would not have considered the merits of whether the '761 Publication indeed was prior art, particularly since he was not responsible for examining the earlier applications that had been amended and was presented with Applicant's assertions that the application leading to the '764 Patent somehow was entitled to priority from the '761 Publication.

On that basis, Examiner Duke simply withdrew the anticipation rejections based on the '761 Publication, leaving no evidence that the merits of Patent Owners allegations of priority under Sections 120, 371 were ever considered in view of the substantial post-filing amendments.

After withdrawing the rejections based on the published International Application, the Examiner rejected claims 1-4, 6-9 and 11-16 for anticipation by U.S. Publication No. 2005/0069432 (Tomioka); claim 5 was rejected as being obvious from the combination of Tomioka and U.S. Publication No. 2005/0061482 (erroneously identified in the Office Action as Publication No. "2005/0069432," and referred to in this Request as "Lee"); claims 10, 17, 18 and 20 were rejected as being obvious from Tomioka and U.S. Patent No. 6,019,165 (Batchelder); and claim 19 was rejected for being obvious from Tomioka, Batchelder and Lee. Appendix D, Office Action dated March 13, 2012, pp. 2-9.

After apparently sending Examiner Duke an e-mail (not entered in the record), Patent Owner's attorney telephonically interviewed Examiner Duke and SPE Jules. Appendix D, Amendment dated April 6, 2012, pp. 8-9.

In the April 6, 2012, Amendment, Patent Owner argued that none of the applied references provided "a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber," as recited in amended claim 1 (emphasis shows amendment). [6] In support of that position, Patent Owner alleged that, rather than being vertically spaced apart chambers, Tomioka's

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[6] Claim 10 (then pending claim 12) recited: "a separate pump chamber vertically spaced part [*sic*: apart] from the thermal exchange chamber …"; and claim 15 (then pending claim 17) recited: "the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction." *Id.* at pp. 9 and11.

thermal exchange chamber was "radially outwards of the pump chamber." *Id.* at pp. 9-10. Thus, whatever "vertically spaced apart" might mean, the Patent Owner took the position that it does not mean "radially outwards of the pump chamber."

Subsequently, the Examiner allowed all claims, emphasizing as a basis for allowability the claimed "thermal exchange chamber formed below the pump chamber and vertically space [*sic*: spaced] apart from the pump chamber."[7] Appendix D, Notice of Allowability dated May 23, 2012, Reason for Allowance, pp. 2-3.

As noted, the file history lacks any indication that the examiner considered the Set Aside References after withdrawing the rejections based on the International Application, even after new features were added to the claims. Indeed, neither the Patent Owner nor the Examiner subsequently mentioned any of the Set Aside References.

Thus, the newly discovered Laing and Hamman references have entirely escaped review. In addition, Duan and Cheon were not fully considered in view of the newly discovered references, or insofar as they appear to have been set aside. As well, whether the published International Application is prior art under 35 U.S.C. § 103(a) and (c) in view of the additions to the specification and drawings has entirely escaped review.

On that basis, the application matured into the '764 Patent.

IX. IDENTIFICATION OF THE REASONABLE LIKELIHOOD THAT REQUESTER WILL PREVAIL

The prior art references provided in this Request raise a Reasonable Likelihood as to claims 1 through 18 in the '764 Patent. This section summarizes the reasonable likelihood of prevailing raised by

[7] Despite claiming substantially overlapping subject matter, the Parent Application and the application leading to the '764 Patent were assigned to different examiners, with dramatically different outcomes for claims to that subject matter. Indeed, rejected and now cancelled, claim 113 from the Parent Application is identical to issued claim 15 in the '764 Patent, as Appendix K illustrates.

the references cited above and in Appendix B. The claim charts in Section X below show correspondence between the prior art references and the limitations in claims 1-18.

A. REASONABLE LIKELIHOOD #1: NEWLY FOUND LAING (§ 102)

The newly found Laing reference qualifies as prior art under 35 U.S.C. § 102(b), 103(a) and 103(c), having published on March 18, 2004, more than one year prior to the '764 Patent's earliest priority date of May 6, 2005. Laing was cited by neither the Examiner nor the Applicants, and thus was not applied during prosecution of the '764 Patent.

Laing discloses each of the above-identified features Applicants said were lacking from the references applied during prosecution of the '764 Patent, namely vertically separated pump and thermal exchange chambers. Indeed, Laing discloses each and every feature arranged in the manner recited in claims 10-12 and 14. Thus, Laing anticipates those claims.

For example, Laing discloses a device for cooling or heating of an object. *See* Laing, Title. As explained more fully below, Laing's device 10 includes vertically separate pump and thermal exchange chambers and overcomes the perceived deficiencies of the prior art identified by the Examiner in the Statement of Reasons for Allowance of the '764 Patent. *See* Appendix C, Laing, FIG. 1, reproduced below and annotated for convenience.

In particular, Laing's device 10 includes thermal contact element 32 for transferring heat from, for example, an electronic component, to a coolant. Appendix C, Laing, Abstract. The device 10 includes a housing enclosing a centrifugal pump for circulating the coolant through a closed loop fluid circuit including a radiator for dissipating heat absorbed by the coolant. Id. at FIG. 2; ¶¶ [0049], [0058]. The centrifugal pump is driven by an electric motor 38 having a stator 54 and a rotatably mounted rotor 42. Id. at ¶ [0058]. As shown below, a portion of the housing 18 extends between the stator 54 and the rotor 42 and impeller 46.

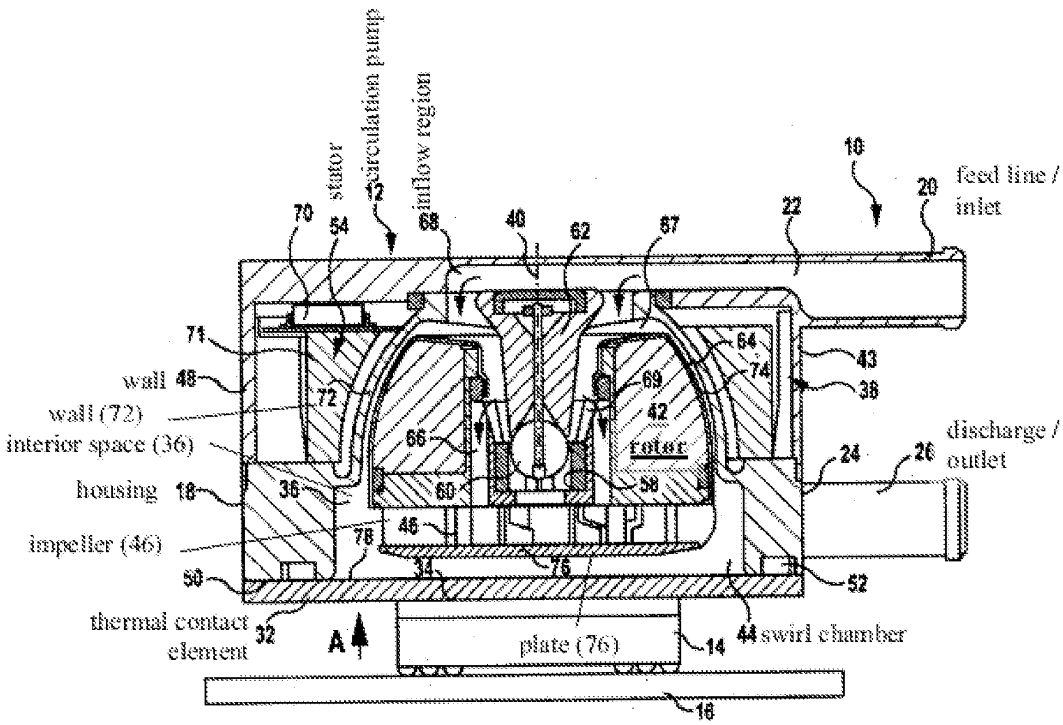

FIGURE 3 - LAING, FIG. 1 (ANNOTATED WITH TERMS USED IN LAING)

As shown in FIG. 1 of Laing (reproduced above), coolant enters Laing's device 10 through a feed line 20, through the inflow region 68 and through a plurality of through-flow passages 66. Id. at ¶ [0064]. Coolant also passes between the wall 72 and the rotor 42 through the gap 74. Id. at ¶ [0068]. The impeller imparts momentum to the coolant, and the coolant passes over the thermal contact element 32 below the plate 76, absorbing heat from the component 14. Id. at ¶ [0076]. Laing's device 10 is fluidly coupled to a radiator 30 to dissipate heat from the coolant that previously had been absorbed from the component 14. Id. at ¶ [0049]; FIG. 2. As well, Laing explains that a portion of the device can be flexible to accommodate expansion of the liquid without any load being imposed on the housing 18, allowing the device 10 to store excess liquid not capable of being contained in the remaining system components. Id. at ¶ [0083].

Specifically, Laing discloses a cooling system for a computer system. The cooling system has a centrifugal pump adapted to circulate a cooling liquid. The pump includes an impeller an impeller exposed to the cooling liquid and a stator isolated from the cooling liquid. The cooling system also includes a reservoir configured to be thermally coupled to a heat-generating component of the computer system. The reservoir includes a thermal exchange chamber adapted to be positioned in thermal contact with the heat-generating component and a separate pump chamber vertically spaced apart from the thermal exchange chamber. The thermal exchange chamber and the pump chamber are coupled with each other through one or more passages configured for fluid communication between the pump chamber and the thermal exchange chamber. At least one of the one or more passages is offset from a center of the impeller.

Thus, Laing's disclosure of a thermal exchange chamber vertically separated from a pump chamber provides for and overcomes the purported deficiencies Applicants argued, without objection by the Examiner, were found from the prior art applied during prosecution of the '764 Patent. Accordingly, none of claims 10-12 and 14 can be patentable over Laing. Thus, by virtue of disclosing all limitations set forth in claims 10-12 and 14, Laing raises a Reasonable Likelihood under 35 U.S.C. § 102 as to those claims.

B. Reasonable Likelihood #2: Newly Found Laing (§ 103)

As noted above, Laing discloses each and every limitation of claim 10. Laing also discloses virtually an identical structure to that described in claim 13.

For example, Laing's discharge line 26 "leads away from the housing 18 via an opening 24 from a pressure side (delivery side) of the circulation pump 12," and delivers coolant to the radiator 30. Appendix C, Laing, ¶¶ [0045], [0049] (explaining "This loop 28 has a cooling section or heating section 30 which is arranged outside the housing 18 …").

Specifically, Laing discloses that the heat radiator is fluidly coupled to the reservoir using conduits, and that the radiator is configured to be positioned remote from the reservoir, as claim 13 recites. Thus, the only potential trivial difference is whether Laing's disclosed conduits might be "flexible." Indeed, the Supreme Court has addressed such a "deficiency" in KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007), stating "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." One of ordinary skill in the art would have used flexible conduit to fluidly couple

Laing's radiator and reservoir as an obvious choice to permit a flexible placement of the radiator among different computer chassis designs well-known to ordinary artisans at the time of the purported invention.

Thus, claim 13 cannot be patentable over Laing. However, Laing entirely escaped review during examination of the '764 Patent.

Accordingly, Laing raises a Reasonable Likelihood under 35 U.S.C. § 103 as to claim 13.

C. REASONABLE LIKELIHOOD #3: LAING COMBINED WITH NEWLY FOUND HAMMAN

The newly found Hamman reference qualifies as prior art under 35 U.S.C. § 102(b) and § 103(a), having issued on March 4, 2003, more than two years prior to the '764 Patent's earliest priority date of May 6, 2005.

As noted above, Laing alone raises Reasonable Likelihood with regard to independent claim 13. That argument will not be repeated here, but is incorporated by reference.

To the extent one of ordinary skill in the art somehow might not have recognized the obviousness of using a "flexible" conduit after reviewing Laing alone, a review of newly discovered Hamman would have led the artisan to use a flexible conduit as claimed in claim 13. Hamman discloses a reservoir 711 in thermal contact with a heat generating component 707. Appendix F, Hamman, FIG. 7; 9:57-59. The reservoir 711 is fluidly coupled to a radiator 703. Id. Hamman discloses using flexible conduits to fluidly couple a heat radiator to a reservoir in thermal contact with a heat generating component. Id. at FIG. 7; 9:12-14 (stating "[c]onduits 701 and 702 may comprise a number of suitable rigid, semi-rigid, or flexible materials (e.g., copper tubing, metallic flex tubing, or plastic tubing) depending upon desired cost and performance characteristics.").

Because Laing and Hamman render claim 13 obvious and yet both escaped review during examination, Laing and Hamman raise a Reasonable Likelihood under Section 103 as to claim 13.

D. REASONABLE LIKELIHOOD #4: LAING COMBINED WITH CHEON

The Cheon reference qualifies as prior art under 35 U.S.C. § 102(b), 103(a) and 103(c), having issued on March 24, 1998, more than seven years prior to the '764 Patent's earliest priority date of May 6, 2005.

Laing has not been applied against any of claims 1-9 and 15-18. To the extent Cheon might have initially been considered, Cheon was not considered in the context of any differences between Laing and claims 1-9 and 15-18.

As noted above, Laing discloses a cooling system having a reservoir configured to cause a coolant to absorb heat from, for example, an electronic component, and a remotely positioned radiator configured to dissipate the absorbed heat. As well, Laing discloses a thermal exchange chamber vertically separated from a pump chamber, a limitation allegedly conferring patentability to all claims in the '764 Patent, including claims 1-9 and 15-18. On this basis alone, Laing raises a substantial new question as to the patentability of claims 1-9 and 15-18.

Like Laing, Cheon discloses a fluid circuit configured to cause a coolant to absorb heat from an electronic component and to dissipate the heat through a radiator. Trivially, Cheon's system places the reservoir adjacent the radiator rather than adjacent the electronic component like Laing. Except perhaps for such an inconsequential difference, Cheon's reservoir, pump and heat exchange configuration discloses each and every limitation recited in claims 1-9 and 15-18.

For example, with regard to Figure 3, below, Cheon's reservoir 48 has a casing 50. Appendix G, Cheon, FIG. 3. Cheon explains "[t]he interior space of the reservoir 48 is divided into an upstream portion 58 in communication with the inlet opening 54 and a downstream portion 60 in communication with the outlet opening 56. An internal divider wall 62 substantially separates the two interior portions 58, 60. " Id. at 4:67-5:4. Cheon explains further that "[a] pump is positioned in the casing of the reservoir adjacent to the outlet opening to pump liquid coolant from the reservoir ...." Id. at 1:55-58. "The divider wall 62 has a passage 66 extending therethrough and communicating the upstream portion 58 with the downstream portion 60. The passage 66 is positioned so that liquid coolant C entering the interior space of the reservoir through the inlet opening 54 passes through the upstream portion 58 by and through the heat-gathering fins 64 and then flows through the passage 66 into the downstream portion 60 and out the outlet opening 56." Id. at 5:13-20. Cheon's pump P has an impeller 82 (FIG. 5) or an impeller 100 (FIG.

7). Cheon's pump P has a stator 94 (FIG. 5) or a stator 108 (FIG. 7). Id. Cheon's impeller 82 (FIG. 5) is positioned in a recess formed by the fluid guide 90 (FIG. 5) on the underside of the casing 50. Id. The corresponding stator, or coil 94, is positioned on the upper side of the chassis 50 and is isolated from the cooling liquid (e.g., inside the casing 50). Id.

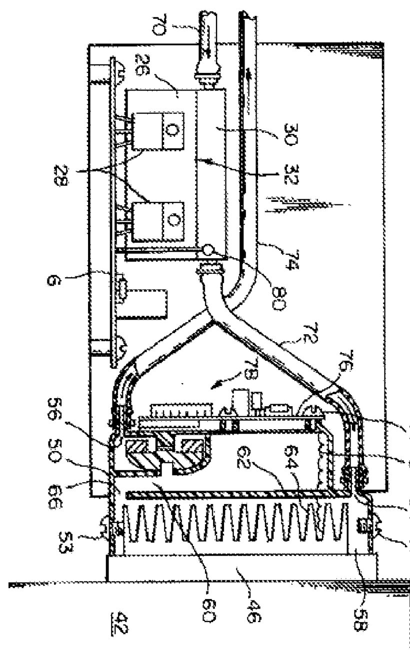

FIGURE 4 - CHEON, FIG. 4.

Specifically, Cheon discloses a cooling system for a heat-generating component. The cooling system includes a double-sided chassis adapted to mount a pump configured to circulate a cooling liquid. The pump has a stator and an impeller. The impeller is positioned in a recess on the underside of the chassis and the stator is positioned on the upper side of the chassis and isolated from the cooling liquid. The cooling system also includes a reservoir adapted to pass the cooling liquid therethrough. The reservoir includes a pump chamber formed by the recess and including the impeller and formed below the chassis. The pump chamber is defined by at least an impeller cover having one or more passages for the cooling liquid to pass through. A thermal exchange chamber is formed below the pump chamber and vertically spaced apart from the pump chamber. The pump chamber and the thermal exchange chamber are separate chambers that are fluidly coupled together by the one or more passages. Cheon’s reservoir also has a heat-exchanging interface. The heat-exchanging interface forms a boundary wall of the thermal exchange chamber, and is configured to be placed in thermal contact with a surface of another component. However, Cheon does not explicitly disclose that the metal outer reservoir wall is placed in thermal contact with a heat-generating component.

Nonetheless, this minor missing teaching in Cheon is clearly disclosed in Laing. Laing's thermal contact element 32 defines a boundary wall between a heated object 14 (e.g., a processor) and the interior space 36 of Laing's circulation pump. Appendix C, Laing, FIG. 1. Laing's thermal contact element 32 is configured to be placed in contact with a heated object 14 (e.g., a processor). Id. at ¶ [0050]; FIG. 2. Considering the common knowledge held by every person of ordinary skill in the computer cooling art that energy in the form of heat inherently flows from relatively warmer regions to relatively cooler regions absent the addition of work, simply substituting Laing's thermal contact element 32 for Cheon's metal outer reservoir wall to permit Cheon's reservoir and pump assembly to be placed in thermal contact with Laing's heated object 14 (e.g., a processor) would have taken no more than ordinary skill.

As already noted, Laing discloses a heat radiator fluidly coupled to the reservoir using conduits, and that the radiator is configured to be positioned remote from the reservoir. Appendix C, Laing, FIG. 2. Thus, the only trivial limitation potentially missing from Laing is whether the disclosed conduits might be "flexible." Indeed, the Supreme Court has addressed such a "deficiency" in KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007), stating "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." One of ordinary skill in the art would have used flexible conduit to fluidly couple Laing's radiator and reservoir as an obvious choice to permit a flexible placement of the radiator among different computer chassis designs well-known to ordinary artisans at the time of the purported invention.

Thus, Laing combined with Cheon raises a Reasonable Likelihood under 35 U.S.C. § 103(a) with regard to claims 1-9 and 15-18.

E. Reasonable Likelihood #5: Laing Combined with Hamman and Cheon

For reasons already stated, Laing and Cheon present a Reasonable Likelihood as to independent claim 1. For brevity, that argument is incorporated by reference and is not repeated here.

Laing combined with Hamman and Cheon raises a Reasonable Likelihood with regard to each of claims 7, 9 and 15-18, as described below.

CLAIM 7:

Dependent claim 7 adds to claim 1 the trivial limitation that the impeller includes a plurality of curved blades. To the extent that a person having ordinary skill in the computer cooling art somehow might not have considered using curved blades with the impellers of Laing and Cheon, Hamman cures such a deficiency. In particular, Hamman discloses an impeller having "co-radially curved blades 508" configured "to enhance fluidic movement induced by the [impeller] assembly 500." Hamman, 10:6-11; FIG. 5. As Hamman states and one of ordinary skill would have understood, such blades can enhance fluidic movement induced by the pump. Id.

Thus, claim 7 is obvious from Laing, Cheon and Hamman. By virtue of Laing and Hamman entirely escaping review, Cheon could not have been considered in view of any differences from Laing and Hamman.

In sum, the combination of Laing, Hamman and Cheon raises a Reasonable Likelihood under 35 U.S.C. § 103 as to claim 7.

CLAIM 9:

Dependent claim 9 adds to claim 1 the trivial limitation that flexible conduits are used to couple the reservoir to the heat radiator. Laing discloses that the heat radiator is fluidly coupled to the reservoir using conduits, and that the radiator is configured to be positioned remote from the reservoir, as claim 9 recites. Thus, the only potential trivial difference is whether Laing's disclosed conduits might be "flexible." Indeed, the Supreme Court has addressed such a "deficiency" in KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007), stating "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton."

Thus, claim 9 cannot be patentable over Laing and Cheon. However, Laing entirely escaped review during examination of the '764 Patent.

To the extent one of ordinary skill in the art might not have recognized the obviousness of using a "flexible" conduit after reviewing Laing alone, a review of newly discovered Hamman would have led the artisan to use a flexible conduit as claimed.

Hamman discloses a reservoir 711 in thermal contact with a heat generating component 707. Hamman, FIG. 7; 9:57-59. The reservoir 711 is fluidly coupled to a radiator 703. Id. Hamman discloses using flexible conduits to fluidly couple a heat radiator to a reservoir in thermal contact with a heat generating component. Id. at FIG. 7; 9:12-14 ("Conduits 701 and 702 may comprise a number of suitable rigid, semi-rigid, or flexible materials (e.g., copper tubing, metallic flex tubing, or plastic tubing) depending upon desired cost and performance characteristics.").

Because Laing combined with Cheon and Hamman renders claim 9 obvious and yet escaped review during examination, Laing, Cheon and Hamman raise a Reasonable Likelihood under 35 U.S.C. § 103 as to claim 9.

CLAIMS 15-18:

For reasons already stated, Laing and Cheon present a substantial new question as to claims 15-18. For brevity, that argument is incorporated by reference as if fully set forth here.

To the extent the "flexible" limitation in claim 15 could somehow not be considered obvious from a review of Laing and Cheon, the new Hamman reference would overcome such a deficiency for reasons already stated. Thus, the combination of Laing, Cheon and Hamman raise a Reasonable Likelihood under 35 U.S.C. § 103 as to claims 15-18.

F. REASONABLE LIKELIHOOD #6: NEWLY FOUND HAMMAN AND CHEON

Hamman has not been applied against any of claims 1-18. Hamman discloses that a combined reservoir, pump and heat exchanger can be configured to dissipate heat from a coolant in one instance or to absorb heat from, for example, an electronic component in another instance. Thus, Hamman's disclosure is non-cumulative of Tomioka, Lee and Batchelder with regard to this technical aspect.

To the extent Cheon might have been considered at all, Cheon was apparently not considered after being set aside at the outset of examination, let alone in view of any differences between Hamman and claims 1-18. Thus, Cheon entirely escaped review in the context of newly discovered Hamman's disclosure that a combined reservoir, pump and heat exchanger can be configured to dissipate heat from a coolant in one instance or to absorb heat from, for example, an electronic component in another instance.

Hamman discloses systems for dissipating heat from a processor. Appendix F, Hamman, Abstract. In one embodiment, Hamman discloses a liquid-cooled heat sink thermally coupled to a processor and a remotely positioned radiator configured to reject heat absorbed by coolant in the heat sink. Id. at 4:49-60; FIG. 1.

In another embodiment, Hamman discloses a reservoir 711 in thermal contact with a processor 707. Id. at FIG. 7. The reservoir 711 is in contact with the processor 707 and serves as a heat transfer unit. Id. at 9:57-59. Hamman's reservoir 711 is adapted to house a pump assembly 712. Id. at FIG. 7; 9:28-32 (stating "Assembly 712 may comprise a motor 710 disposed upon an upper surface of reservoir 711, and an impeller assembly720 which extends from the motor 710 to the bottom portion of the reservoir 711"). Hamman's radiator 703 is fluidly coupled to the reservoir 711 by conduits 701 and 702, and is configured to dissipate heat from the cooling liquid. Id. at 9:9-15; FIG. 7. The conduits can be flexible conduits. Id.

Although certain internal details of Hamman's reservoir are not described, like Hamman, Cheon discloses a fluid circuit configured to cause a coolant to absorb heat from an electronic component and to dissipate the heat through a radiator. Cheon's system places the reservoir adjacent the radiator rather than adjacent the electronic component. Except for such inconsequential differences, Cheon's reservoir, pump and heat exchange configuration discloses each and every limitation recited in claims 1-18.

Specifically, Cheon discloses a cooling system for a heat-generating component. The cooling system includes a double-sided chassis adapted to mount a pump configured to circulate a cooling liquid. The pump has a stator and an impeller. The impeller is positioned in a recess on the underside of the chassis and the stator is positioned on the upper side of the chassis and isolated from the cooling liquid. The cooling system also includes a reservoir adapted to pass the cooling liquid therethrough. The reservoir includes a pump chamber formed by the recess and including the impeller and formed below the chassis. The pump chamber is defined by at least an impeller cover having one or more passages for the cooling liquid to pass through. A thermal exchange chamber is formed below the pump chamber and vertically spaced apart from the pump chamber. The pump chamber and the thermal exchange chamber are separate chambers that are fluidly coupled together by the one or more passages. Cheon's reservoir also has a heat-exchanging interface. The heat-exchanging interface forms a boundary wall of the thermal exchange chamber, and is configured to be placed in thermal contact with a surface of another component.

However, Cheon does not explicitly disclose that the component can be a heat dissipating processor. Nonetheless, such a minor missing teaching in Cheon is clearly disclosed in Hamman, as noted above.

Cheon explains that the disclosed configuration of the reservoir, pump and heat exchanger fins provides a high level of efficiency in heat exchange and also helps maximize the compactness of the cooling system. Appendix G, Cheon, 1:65-67. Accordingly, one of ordinary skill in the art would have found it obvious to substitute Cheon's reservoir for Hamman's reservoir 711 to obtain a more compact computer systems, among a number of advantages.

For the foregoing reasons, newly found Hamman and Cheon raise a Reasonable Likelihood under 35 U.S.C. § 103 as to claims 1-18.

G. REASONABLE LIKELIHOOD #7: DUAN (§ 102)

The Duan reference was published on August 24, 2006, and therefore qualifies as prior art to the claims in the '764 Patent under 35 U.S.C. § 102(b). However, even if the Office somehow concludes that one or more claims in the '764 Patent could be entitled to priority from the International Application's filing date of May 6, 2005, the Duan reference, having been filed on February 18, 2005, presumptively qualifies as prior art under 35 U.S.C. § 102(a) and (e), as well as under 35 U.S.C. § 103.

To the extent Duan might have been considered at all, Duan apparently was not considered after being set aside in favor of the published International Application. As well, after Duan was set aside, claim 1 was amended. Thus, Duan entirely escaped review as to the amendments to claim 1.

In particular, claim 1 was amended to recite (with emphasis added to show added limitations):

> a pump chamber <u>including the impeller and formed below the chassis, the pump chamber being defined by</u> at least an impeller cover having one or more passages for the cooling liquid to pass through;
>
> a thermal exchange chamber <u>formed below the pump chamber and vertically spaced apart from the pump chamber</u> …
>
> [Appendix D, Amendment dated April 6, 2012, p. 2]

As noted, Patent Owner and Examiner considered vertically separate thermal exchange and pump chambers somehow to confer patentability to claims 1-18. *See* Appendix D, Amendment dated April 6, 2012, p. 8-10, and Notice of Allowability dated May 23, 2012, p. 2-3. However, Duan exactly discloses such a combination of features. Thus, Duan raises a Reasonable Likelihood as to the claims in the '764 Patent.

For example, as shown immediately below, Duan discloses a liquid-cooling heat dissipation apparatus 100 having a casing defining a first compartment for assembling a pump, a cooling plate configured to be placed in thermal contact with a process, the plate positioned on the bottom of the casing, a second compartment defined between the inner space of the casing and the cooling plate containing a cooling liquid. Appendix H, Duan, Abstract; FIGS. 2 and 7 (reproduced below for convenience).

Duan's pump has a stator (coil stage 21), an upper cover 22, an impeller stage 23 and a lower cover 24 in the first compartment 13. Id. at 62-64. A runner 241 (or "passage") is defined on the bottom face of the lower cover 24 and corresponds to the liquid inlet 11. Id. at 65-67; FIG. 7. The cooling plate 31 has a plurality of heat-dissipating fins 33 extending inwardly of the casing in the second compartment. Id. at 3:3; FIG. 7. A radiator 20 is remotely positioned from the heat dissipation apparatus 100. Id. at 3:18-29; FIG. 6.

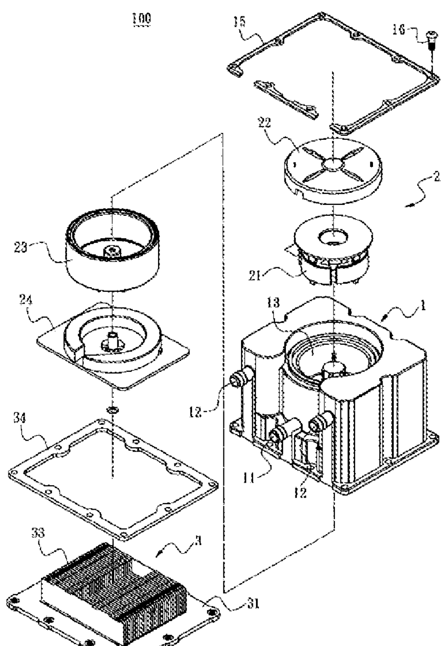

FIG. 2

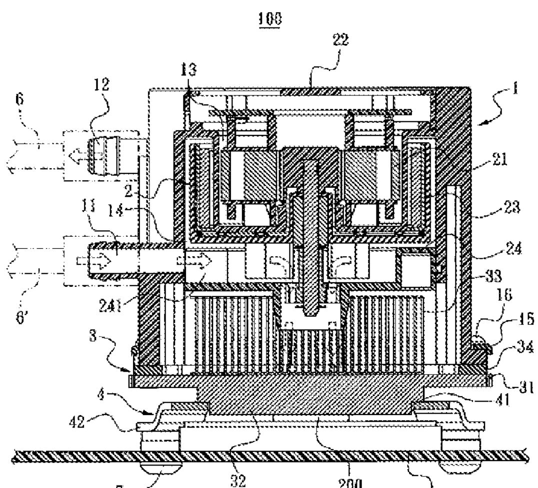

FIG. 7

Specifically, Duan discloses a cooling system for a heat-generating component. The cooling system includes a double-sided chassis adapted to mount a pump configured to circulate a cooling liquid. The pump includes a stator and an impeller having curved blades. The impeller is positioned on the underside of the chassis and the stator is positioned on the upper side of the chassis and isolated from the cooling liquid. The system also includes a reservoir adapted to pass the cooling liquid therethrough.

Duan's reservoir includes a pump chamber including the impeller and formed below the chassis. The pump chamber is defined by at least an impeller cover having one or more passages for the cooling liquid to pass through. A thermal exchange chamber is formed below the pump chamber and vertically spaced apart from the pump chamber. The pump chamber and the thermal exchange chamber are separate chambers that are fluidly coupled together by the one or more passages.

Duan's reservoir also includes heat-exchanging interface. The heat-exchanging interface forms a boundary wall of the thermal exchange chamber, and is configured to be placed in thermal contact with a surface of the heat-generating component. A heat radiator is fluidly coupled to the reservoir and configured to dissipate heat from the cooling liquid.

Thus, Duan's disclosure of a thermal exchange chamber vertically separated from a pump chamber, as well as every other feature arranged as claimed in claims 1-7, 10-12 and 14, provides for and overcomes the purported deficiencies Applicants argued, without objection by the Examiner, were found from the prior art applied during prosecution of the '764 Patent. Accordingly, none of claims 1-7, 10-12 and 14 can be patentable over Duan. Thus, by virtue of disclosing all limitations set forth in claims 1-7, 10-12 and 14, Laing raises a Reasonable Likelihood under 35 U.S.C. § 102 as to those claims.

H. REASONABLE LIKELIHOOD #8: DUAN (§ 103)

As noted above, Duan discloses each and every limitation of claim 1. Duan also discloses virtually an identical structure to that described in claims 8, 9, 13 and 15-18.

Duan discloses that the heat radiator is fluidly coupled to the reservoir using conduits, and that the radiator is configured to be positioned remote from the reservoir. Duan also emphasizes that the liquid-cooling heat dissipation apparatus 100 is used to dissipate heat from a heat emitting device 200.

The only potential trivial differences are whether Duan's disclosed conduits might be "flexible," and the exact material selected for Duan's bottom plate 31. Indeed, the Supreme Court has addressed such a "deficiency" in KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007), stating "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." One of ordinary skill in the art would have found using a flexible conduit obvious from a review of Duan to provide flexibility in positioning the remote radiator. Moreover, one of ordinary skill in the art would have known to use aluminum or copper for the bottom plate 31 given the well-known thermal conductance properties of aluminum and copper.

Thus, by virtue of rendering each of claims 8, 9, 13 and 15-18 obvious, Duan raises a Reasonable Likelihood as to those claims.

I. REASONABLE LIKELIHOOD #9: DUAN AND CHEON

As noted above, Duan alone raises a substantial new question of patentability with regard to claims 1-18. That argument will not be repeated here, but is incorporated by reference.

Like Duan, Cheon discloses a fluid circuit configured to cause a coolant to absorb heat from an electronic component and to dissipate the heat through a radiator. Trivially, Cheon's system places the reservoir adjacent the radiator rather than adjacent the electronic component like Duan. Accordingly, one of ordinary skill in the art would have found it obvious to apply Cheon's reservoir, pump and heat exchange interface to an electronic component in a manner similar to that disclosed in Duan. Except perhaps for inconsequential differences, Cheon's reservoir, pump and heat exchange configuration discloses each and every limitation recited in claims 1-18.

Moreover, even if Duan does not identically disclose each and every limitation recited in any of claims 1-18, a review of Duan would have led one of ordinary skill in the art to appreciate that Cheon's reservoir, pump and heat exchange interface assembly could be placed in thermal contact with an electronic component instead of a radiator. Moreover, Duan discloses that the heat radiator is fluidly coupled to the reservoir using conduits, and that the radiator is configured to be positioned remote from the reservoir.

Thus, the only trivial limitation potentially missing from Duan and Cheon is whether the disclosed conduits might be "flexible." For reasons already stated and incorporated by this reference, one of ordinary skill in the art would have found using a flexible conduit obvious from a review of Duan and Cheon to provide flexibility in positioning the remote radiator.

Thus, the combination of limitations recited in claims 1-18 would have been obvious from a review of Duan and Cheon when viewed in a light not previously considered. Accordingly, Duan and Cheon present a substantial new question as to each of claims 1-18.

J. Reasonable Likelihood #10: Duan and Hamman

As noted above, Duan raises a Reasonable Likelihood with regard to claims 1-18. That argument will not be repeated here, and is incorporated by reference.

Even if including the aluminum or copper with Duan's bottom plate 31, or coupling Duan's radiator and reservoir with flexible conduits, might somehow have not been obvious to one of ordinary skill in the art after reviewing Duan, the Hamman reference cures any such deficiency. Hamman explicitly discloses a copper heat exchanger and flexible conduits for fluidly coupling a reservoir and a radiator.

Thus, each of claims 8, 9, 13 and 15-18 would have been obvious to one of ordinary skill in the art following a review of Duan and Hamman. Accordingly, Duan combined with Hamman raises a Reasonable Likelihood under 35 U.S.C. § 103 as to claims 8, 9, 13 and 15-19.

K. Reasonable Likelihood #11: Koga

The newly found Koga reference qualifies as prior art under 35 U.S.C. § 102(b), having been published on March 18, 2004, more than one year before the actual filing date of the Parent Application and more than seven years earlier than the actual filing date of the '764 Patent. Even if the claims in the '764 Patent ultimately might be deemed to be entitled to priority from the International Application, the newly found Koga reference presumptively qualifies as prior art under 35 U.S.C. § 102(a) and (e). Koga was cited by neither the Examiner nor the Applicants, and thus was not considered during prosecution of the '764 Patent.

Koga discloses each of the above-identified features Applicants said were lacking from the references applied during prosecution of the '764 Patent, namely vertically separated pump and thermal exchange chambers. Indeed, Koga discloses each and every feature arranged in the manner recited in claims 1-18. Thus, Koga anticipates each and every claim in the '764 Patent.

In particular, Koga discloses a cooling device for having a closed circulating channel for circulating coolant. Appendix I, Koga, Abstract. In the channel, a radiator and a contact heat-exchanger type centrifugal pump are provided. Id. Heat is absorbed by the coolant passing through the chambers in the pump housing and is rejected from a remotely positioned radiator. *See*, Koga, Abstract, FIGS. 7 and 8.

As shown in Figure 3, below, Koga's device 1A includes vertically separate pump and thermal exchange chambers. Appendix I, Koga, Specification, 9:10-47; FIG. 7. For example, the "sucking channel" 19 extends radially inward toward the shaft 17. Id. At least a portion of the channel 19 defines a thermal exchange chamber (e.g., a portion "above" the lead line from reference numeral 15B in FIG. 7) adapted to be positioned in thermal contact with the heat-generating component 2, precisely as claimed in the '764 Patent. Id. A separate pump chamber (e.g., Koga's "pump room" 15A, occupied by Koga's impeller 12) is vertically spaced apart from the thermal exchange chamber, e.g., by the horizontal wall having "protrusions" 24A. Id. As shown in Figure 3, below, the channel 19 terminates below the pump chamber 15A and defines a gap through which coolant 41 can flow from the channel 19 into the pump chamber, coupling the thermal exchange chamber and the pump chamber with each other through one or more passages configured for fluid communication between the pump chamber as claimed. Id. The gap adjacent the terminal end of the channel 19 is offset from a center of the impeller 12, as claimed. Id. As shown in Koga's FIG. 1, the outlet conduit 4 fluidly couples the reservoir 1A with the radiator 3, and thus also must fluidly couple the thermal exchange chamber with the pump chamber (e.g., fluid discharged from the pump chamber flows through the conduit 4, through the radiator 3 and into the channel 19 shown in FIG. 7). Id. at FIGS. 1 and 7. As shown in FIG. 8, the discharge channel 20 is positioned tangentially relative to the pump chamber. Id. at FIG. 8. As well, the stator 14 is positioned above a portion of Koga's double-sided chassis 11, the impeller 12 is positioned below the portion of the double-sided chassis 11 in contact with the coolant. Id. The wall 11 isolates the stator 14 from the coolant. Id. Koga discloses that the casing 15 can be formed of a material having a high thermal conductivity, such as, for example, aluminum or copper. Id. at 5:14-18. The thermal exchange chamber includes a plurality of pins or fins. Id. at FIG. 8. Koga discloses that the fluid coupling between the reservoir and the radiator can be flexible. Id. at 1:67-2:1.

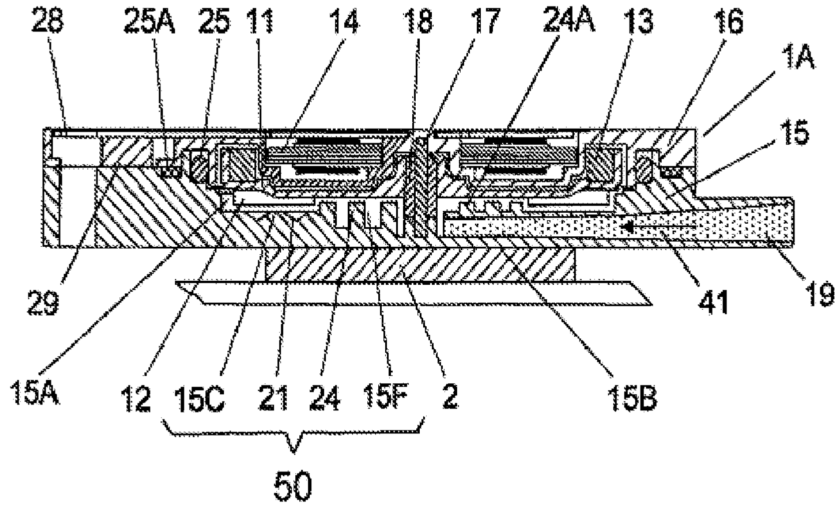

FIGURE 5 – KOGA'S FIG. 7

Specifically, Koga discloses a cooling system for a heat-generating component including a double-sided chassis adapted to mount a pump configured to circulate a cooling liquid. The pump includes a stator and an impeller, with the impeller being positioned on the underside of the chassis and the stator being positioned on the upper side of the chassis and isolated from the cooling liquid. The cooling system also includes a reservoir adapted to pass the cooling liquid therethrough. The reservoir includes a pump chamber including the impeller and formed below the chassis. The pump chamber is defined by at least an impeller cover having one or more passages for the cooling liquid to pass through. A thermal exchange chamber is formed below the pump chamber and vertically spaced apart from the pump chamber. The pump chamber and the thermal exchange chamber are separate chambers that are fluidly coupled together by the one or more passages. The cooling system also includes a heat-exchanging interface, the heat-exchanging interface forming a boundary wall of the thermal exchange chamber. The heat exchanging interface is configured to be placed in thermal contact with a surface of the heat-generating component. Koga's system also includes a heat radiator fluidly coupled to the reservoir and configured to dissipate heat from the cooling liquid.

Koga's chassis shields the stator from the cooling liquid in the reservoir. The heat-exchanging interface includes a first side and a second side opposite the first side, and wherein the heat-exchanging interface contacts the cooling liquid in the thermal exchange chamber on the first side and the heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component on the second side. The first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber. The features include at least one of pins or fins. A passage of the one or more passages that fluidly couple the pump chamber and the thermal exchange chamber is offset from a center of the impeller. The fluid passage that is offset from the center of the impeller is positioned tangentially to the circumference of the impeller. Koga's impeller includes a plurality of curved blades. Koga's heat-exchanging interface includes one of copper and aluminum. Koga discloses that the heat radiator is fluidly coupled to the reservoir using flexible conduits, and the heat radiator is configured to be positioned remote from the reservoir.

Thus, Koga's disclosure of a thermal exchange chamber vertically separated from a pump chamber provides for and overcomes the purported deficiencies of the prior art emphasized by Applicants during prosecution of the '764 Patent, without objection by the Examiner. Moreover, Koga discloses each and every feature claimed in the '764 Patent. Accordingly, none of claims 1-18 can be patentable over Koga.

Thus, by virtue of disclosing all limitations set forth in claims 1-18, Koga raises a Reasonable Likelihood under 35 U.S.C. § 102 as to those claims.

L. Reasonable Likelihood #12: The '761 Publication and Laing

As noted above, each claim in the '764 Patent is entitled to an effective filing date no earlier than the actual filing date of the '764 Patent. For example, as explained above, the '761 Publication lacks sufficient written description under Section 112 for the vertically spaced pump chamber and thermal exchange chamber features claimed in claims 1-18 for those claims to enjoy priority from the filing date of the '761 Publication. To be clear, Requester does not presently raise the Section 112 issue as a basis for this Request, for that would be improper in a Request for *Inter Partes* Reexamination.

Rather, the Section 112 "written description" deficiency is raised to emphasize that none of the claims in the '764 Patent may be back dated to the filing date of the '761 Publication, regardless of whether the disclosure in the '761 Publication might have enabled one of ordinary skill in the art to make use the alleged "invention" ultimately claimed in the '764 Patent. See, e.g., Tronzo v. BioMet, Inc., 156

F.3d 1154 (Fed. Cir. 1998); Lockwood v. American Airlines, Inc., 107 F.3d 1565, 1572 (Fed. Cir. 1997) (patent claims anticipated by foreign counterpart to an ancestor patent because claimed invention was distinct from invention disclosed in specification); Chester v. Miller, 906 F.2d 1574 (Fed. Cir. 1990) (patent claims held anticipated by a published parent patent application, even though those claims were not supported by that parent disclosure under Section 112); Rasmusson (Fed. Cir. 06/27/05) (a reference may be enabling for anticipation purposes without being enabling for Sec. 112 support purposes; "a prior art reference need not demonstrate utility in order to serve as an anticipating reference under section 102"); In re Lukach, 442 F.2d 967 (C.C.P.A. 1971) (publication of a British counterpart to a grandparent patent application anticipated claims even though those claims were not supported under Section 112 by that grandparent application). Cf. Encyclopaedia Britannica (Fed. Cir. 06/18/10) (claims anticipated by published foreign counterpart patent application where chain of continuity broken by failure of intermediate application, as filed or amended, to refer to antecedent application in chain.)

The '761 Publication, published on November 16, 2006, qualifies as prior art to claims 1-18 under 35 U.S.C. § 102(b) and § 103(a).

Laing qualifies as prior art to the '764 Patent under Section 102(b) and Section 103(a), regardless of whether any claims in the '764 Patent might be backdated to an earlier application.

As described above, some years after the International Application (also referred to as the '761 Publication) published, Paragraph [0166] was amended as follows (emphasis added to show new text):

> [0166]The reservoir housing 14 has a recess 40 in the centre on the upper side of the reservoir. The recess 37 is intended for accommodating a stator 37 of an electrical motor driving an impeller 33 of the pump, said impeller being attached to a shaft 38 of a rotor 39 of the electrical motor. The recess 40 has an orifice 41, four sidewalls 42, a bottom 43 and a circular jacket 44 extending from the bottom 43 of the recess 40 and outwards towards the orifice 41 of the recess 40. The interior (not shown) of the jacket 44 is intended for encompassing the rotor 39 of the pump. As shown in FIG. 20, the impeller 33 is housed in a recess on the underside of the reservoir housing 14, the recess being an extension of the interior of the jacket 44.

As well, Paragraph [0172] of the specification was amended as follows (emphasis added to show amendments):

> [0172]An impeller 33 of the pump of the cooling system is provided in direct communication with a pump chamber 46 having an outlet 34 provided tangentially to the circumference of the impeller 33. Thus, the pump functions as a centrifugal pump. The inlet if of the pump chamber 46 is the entire opening into the cavity that the pump chamber configures, said cavity being in direct communication with the interior of the reservoir housing 14 as such. An intermediate member 47 is provided between the pump chamber 46 together with the interior of the reservoir and a heat exchanging interface 4. The intermediate member 47 is provided with a first passage 48 for leading
>
> ...
>
> cooling liquid from the pump chamber 46 to a thermal exchange chamber 47A provided at the opposite of the intermediate member 47. The intermediate member 47 is provided also with a second passage 49 for leading cooling liquid from the thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47 to the interior of the reservoir housing 14. Thus, the area enclosed between the underside of the reservoir housing 14 and the heat exchange surface 4 constitutes an enclosed space for circulating the cooling liquid therethrough. The enclosed spaced is divided into two separate chambers by the impeller cover 46A and the intermediate member 47, as shown in FIG. 20. The impeller cover 46A interfaces with the recess on the underside of the reservoir 14 to define the pump chamber 46 which houses the impeller 33, while the intermediate member 47 and the heat exchange surface 4 together define the thermal exchange chamber 47A.

Yet those features described by the added text appear to form the basis on which the Examiner allowed the claims to issue. Indeed, the Examiner alleged that "thermal exchange chamber formed below the pump chamber and vertically space [*sic*: spaced] apart from the pump chamber" are lacking from the applied references. Appendix D, Notice of Allowability dated May 23, 2012, Reason for Allowance, pp. 2-3.

However, the newly found Laing reference discloses each of those features, namely vertically separated pump and thermal exchange chambers.

Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; or (III) " some teaching, suggestion, or motivation to combine.

All of these rationale apply here as detailed below. First, combining Laing's vertically separated pump and thermal exchange chambers with the reservoir discussed in the '761 Publication yields predictable results. Second, simply substituting Laing's reservoir for the reservoir discussed in the '761 Publication achieves predictable results. Third, Laing suggests providing a pump chamber vertically spaced apart from a thermal exchange chamber, as claimed.

Thus, Laing overcomes the deficiencies of the '761 Publication. Accordingly, one of ordinary skill in the art would have found the purportedly "patentable" combination of features recited in the claims to have been obvious from a review of the '761 Publication and Laing at the time of the purported "invention."

Accordingly, by virtue of rendering claims 1-18 sufficiently obvious to one of ordinary skill in the art, the '761 Publication combined with Laing raises a Reasonable Likelihood under 35 U.S.C. § 103(a) as to those claims.

X. DETAILED EXPLANATION OF THE PERTINENCE AND MANNER OF APPLYING THE PRIOR ART TO EACH ELEMENT CLAIMED IN THE '764 PATENT (PROPOSED REJECTIONS)

Pursuant to 37 C.F.R. § 1.195(b)(3), this section presents a detailed explanation of the pertinence and manner of applying the prior art that forms the basis of this Request. This explanation takes the form of proposed rejections, fully set forth below, based on (A) Laing (§ 102); (B) Laing (§ 103); (C) Laing and Cheon; (D) Laing and Hamman; (E) Laing, Cheon and Hamman; (F) Hamman and Cheon; (G) Duan alone; (H) Duan and Cheon; and (I) Duan, Cheon and Hamman.

A. CLAIMS 10-12 AND 14 ARE ANTICIPATED BY LAING

As the claim chart below illustrates, Laing discloses each and every feature arranged as claimed in claims 10-12 and 14 in the '764 Patent. Thus, Laing anticipates claims 10-12 and 14.

U.S. Patent No. 8,245,764 Claim Language	Correspondence to Laing
10. A cooling system for a computer system, comprising:	Laing discloses exactly the type of cooling system claimed in the '234 Application. Laing's title states it clearly: "Device for the Local Cooling or Heating of an Object." Laing, Title. An example of an object cooled by Laing's device is a processor positioned on a circuit board 16. Laing, ¶ [0044].
a centrifugal pump adapted to circulate a cooling liquid, the pump including:	"In the exemplary embodiment shown in FIG. 1, the circulation pump 12 is formed as a centrifugal pump …." Laing, ¶ [0058].
an impeller exposed to the cooling liquid; and	"Then, liquid is guided through the circulation pump 12 via the through-flow space 66, and a swirl is imparted to the liquid which is conducted through by the paddle wheel 46; the pressure required to pump the liquid through the loop 28 is then produced." Laing, ¶ [0064]. Laing's "paddle wheel 46" is a form of "impeller."
a stator isolated from the cooling liquid;	"Between the rotor 42 and the stator 54 there is a substantially spherical wall 72 …." Laing, ¶ [0068]. The wall 72 isolates the stator 54 from the cooling liquid in the through-flow region 66. Laing, FIG. 1.

a reservoir configured to be thermally coupled to a heat-generating component of the computer system, the reservoir including: **<u>Construction of "reservoir"</u>**: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." ['764 Patent, 10:45-49.] Applicant purports that a "reservoir" is not a "reservoir housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and "reservoir housing").	Laing's housing 18 defines an interior space 36 constituting a chamber for holding excess liquid not capable of being contained in the remaining components. The interior space 36 is configured to be thermally coupled to an object 14, such as a processor mounted to a motherboard 16. "An interior space 36 … is formed in the housing 18 of the circulation pump 12. … A swirl chamber 44, in which a swirl is imparted to liquid which has been supplied via the feed line 20, using an impeller 46 (paddle wheel) which is connected in a rotationally fixed manner to the rotor 42, and in which swirling liquid flows, is formed in the interior space 36 of the housing 18. … The liquid is also guided past the thermal contact element 32 in order to transfer heat. … The swirl chamber 44 is formed in the interior space 36 between walls 48 …." Laing, ¶¶ [0052]-[0056]. The thermal contact element 32 is configured to be thermally coupled to a processor mounted to a motherboard. "To form the thermal contact, the thermal contact element 32 touches the object 14 over the largest possible surface area." Laing, ¶ [0051] and FIG. 1. The interior space 36 constitutes a chamber for holding excess liquid not capable of being contained in the remaining components. "In particular, it is provided that the circulation pump has a housing part which is formed flexibly and/or is movable, and in particular is disposed movably on the housing, in such a manner that it is possible to exert a positive pressure on the system. … By way of example, the housing part may be a flexible plate, a flexible diaphragm or a bellows." Laing, ¶ [0029]; see also, Laing, ¶¶ [0082]-[0086] (***describing a flexible thermal contact element 32 to accommodate fluctuations in fluid volume without requiring a separate expansion vessel***).
a thermal exchange chamber adapted to be positioned in thermal contact with the heat-generating component;	A portion of the interior space 36 shown between the thermal contact element 32 and the plate 76 defines a thermal exchanger chamber. Laing, ¶ [0055] (stating "[t]he liquid is also guided past the thermal contact element 32 in order to transfer heat").
a separate pump chamber	Shown in FIG. 1 of Laing, the region between thermal contact element 32 and plate 76 is separate from the volume occupied by the impeller 46 or the impeller 46 and rotor 42.

vertically spaced apart from the thermal exchange chamber and **Construction of "vertically"** Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertically" is taken to mean "in a direction parallel to a rotational axis of the impeller."	Region shown between thermal contact element 32 and plate 76 is spaced apart from the volume occupied by the impeller 46 or the impeller 46 and rotor 42 in a direction parallel to a rotational axis of Laing's impeller 46. Laing, FIG. 1.
coupled with the thermal exchange chamber through one or more passages configured for fluid communication between the pump chamber and the thermal exchange chamber, and **Construction of "coupled"** The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." <u>Bradford v. ConTeyor North</u>	The region shown between thermal contact element 32 and plate 76 is coupled with the volume occupied by the impeller 46 or the impeller 46 and rotor 42 by at least the passages 44. Laing, FIG. 1. The region and volume are also coupled with each other through Laing's feed line 20 and Laing's discharge line 26. *See* Appendix C, Laing FIG. 2; ¶ [0049] (stating "The discharge line 26 and the feed line 20 are connected to one another outside the housing 18 of the circulation pump 12, in order to form a loop 28 for the liquid.").

America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	
wherein at least one of the one or more passages is offset from a center of the impeller.	In Laing, the passages 44 are offset from a center of the impeller 46. Laing, FIG. 2.
11. The cooling system of claim 10, wherein a top wall of the reservoir physically separates the impeller from the stator.	Laing's chassis 18 defines an interior space 36 constituting a chamber for holding excess liquid not capable of being contained in the remaining components. "Between the [unitary] rotor 42 [and impeller 46 assembly] and the stator 54 there is a substantially spherical wall 72 …." Laing, ¶ [0068]. The wall 72, a top wall of the interior space 36, physically separates the impeller from the stator. Laing, FIG. 1.
12. The cooling system of claim 10, wherein the thermal exchange chamber includes a heat-exchange interface configured to be placed in thermal contact with the heat-generating component.	Thermal contact element 32 defines a heat-exchanging interface. See Laing, ¶ [0050] (stating "The thermal contact between the fluid and the object 14 is provided by a thermal contact element 32...").
14. The cooling system of claim 10, wherein the fluid passage that is offset from the center of the impeller is positioned tangentially to the circumference of the impeller. **Construction of "tangentially to the circumference of the**	Laing's pump is a centrifugal pump. Laing states: "In the exemplary embodiment shown in FIG. 1, the circulation pump 12 is formed as a centrifugal pump …." Appendix C, Laing, ¶ [0058]. Laing also states it is "particularly advantageous if the circulation pump is a centrifugal pump". Id. at ¶ [0018]. Laing's passages 44 are positioned tangentially to the circumference of the impeller 46. Id. at FIG. 1.

impeller" The Patent Owner amended FIG. 17 to include "a corrected leader lien for reference no. 34." Appendix E, Preliminary Amendment dated January 9, 2011, p. 4. As the specification explains: "An impeller 33 of the pump of the cooling system is provided in direct fluid communication with a pump chamber 46 formed by an impeller cover 46A ***having an outlet 34 provided tangentially to the circumference of the impeller 33***. Thus, the pump functions as a centrifugal pump. " Appendix A, '764 Patent, 22:26-30.	

B. CLAIM 13 IS OBVIOUS FROM LAING

To the extent that Laing might not anticipate claim 13, Laing renders claim 13 unpatentable for obviousness, as described in detail in the following claim chart:

U.S. Patent No. 8,245,764 Claim Language	**Correspondence to Laing**
13. The cooling system of claim 10, further including a heat radiator fluidly coupled to the reservoir using flexible conduits, wherein the heat radiator is	Laing states: "The discharge line 26 and the feed line 20 are connected to one another outside the housing 18 of the circulation pump 12, in order to form a loop 28 for the liquid. This loop 28 has a cooling section or heating section 30 which is arranged outside the housing 18 ...." Laing, ¶ [0049] and FIG. 2. Flexible conduit, as claimed, would have been obvious to one of ordinary skill in the art because it provides flexibility in positioning Laing's radiator 30

configured to be positioned remote from the reservoir.	outside the housing 18. To the extent that such a conduit might not be expressly disclosed in Laing, Requester notes that "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007). Thus, using a "flexible" conduit would have been obvious from a review of Laing.

C. CLAIM 13 IS OBVIOUS FROM LAING AND HAMMAN

The combination of features claimed in claim 13 in the '764 Patent would have been obvious from Laing and Hamman to one of ordinary skill in the art at the time of the purported invention disclosed in the '764 Patent, as set forth in detail in the following claim chart.

U.S. Patent No. 8,245,764 Claim Language	Correspondence to Laing and Hamman
13. The cooling system of claim 10, further including a heat radiator fluidly coupled to the reservoir using flexible conduits, wherein the heat radiator is configured to be positioned remote from the reservoir.	As noted above, Laing discloses each and every limitation of claim 10, arranged as claimed in claim 10. Moreover, Laing states: "The discharge line 26 and the feed line 20 are connected to one another outside the housing 18 of the circulation pump 12, in order to form a loop 28 for the liquid. This loop 28 has a cooling section or heating section 30 which is arranged outside the housing 18 ...." Laing, ¶ [0049] and FIG. 2. Thus, Laing's radiator 30 is positioned remote from the reservoir. As a matter of course, one of ordinary skill in the art would have found the use of flexible conduit as claimed obvious to provide flexibility in positioning Laing's radiator 30 in a wide variety of computers. "A person of ordinary skill is also a person of ordinary creativity, not an automaton." KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007). However, to the extent that using "flexible conduits" to fluidly couple Laing's heat radiator to the reservoir might somehow have escaped one of ordinary skill based on a review of Laing alone, such flexible conduits would have been obvious from a review of Laing and Hamman. Hamman discloses using flexible conduits to fluidly couple a heat radiator to a reservoir in thermal contact with a heat generating component. Appendix F, Hamman, FIG. 7; 9:12-14 ("Conduits 701 and 702 may comprise a number of suitable rigid, semi-rigid, or flexible materials (e.g., copper tubing, metallic flex tubing, or plastic tubing) depending upon desired cost and performance

	characteristics.”). Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" - choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or motivation to combine. All of these rationale apply here. First, combining Hamman’s flexible conduits with Laing's system yields predictable results. Second, simply substituting Hamman’s flexible conduits for Laing’s conduits provides predictable results. Third, a designer of conduit has essentially three choices from which to choose for conduit, as set forth in Hamman: rigid, semi-rigid, or flexible materials, so it would have been obvious to try flexible conduit in Laing’s system. Fourth, Hamman suggests using flexible conduit to enhance fluidic movement.

D. CLAIMS 1-9 AND 15-18 ARE OBVIOUS FROM LAING AND CHEON

Each combination of features claimed in claims 1-9 and 15-18 in the ‘764 Patent would have been obvious from Laing and Cheon to one of ordinary skill in the art at the time of the purported invention disclosed in the ‘764 Patent, as set forth in detail in the following claim chart:

U.S. Patent No. 8,245,764 Claim Language	**Correspondence to Laing and Cheon**

1. A cooling system for a heat-generating component, comprising:	Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" - choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or motivation to combine. All of these rationale apply here as detailed below. First, combining Cheon's reservoir and heat exchange surface with Laing's circulation pump to cool a heat generating device yields predictable results. Second, simply substituting Cheon's reservoir and heat exchange assembly for Laing's pump and thermal contact element to cool a heat generating device achieves predictable results. Third, considering the well-known fact that energy in the form of heat always flows from a region of relatively higher temperature to a region of relatively lower temperature absent the addition of work, any heat exchanger, including Cheon's reservoir and heat exchange surface, can either promote heat transfer to or heat transfer from the heat exchanger; Cheon describes transferring heat from the reservoir, leaving transferring heat to Cheon's reservoir to cool a heat generating component as the sole other alternative use of Cheon's system. Fourth, both Laing and Cheon suggest providing a reservoir to provide an expansion volume for a coolant. Each of Laing and Cheon disclose cooling systems for heat-generating components. Laing discloses exactly the type of cooling system claimed in the '234 Application. Laing's title states it clearly: "Device for the Local Cooling or Heating of an Object." Laing, Title.

a double-sided chassis adapted to mount a pump configured to circulate a cooling liquid,	Each of Laing and Cheon discloses exactly this limitation. FIG. 1 in Laing illustrates a "circulation pump 12, by means of which a fluid, such as water or other liquids, can be guided in a loop (FIG. 2) as a heat transfer medium. The heat transfer medium can be used as a cooling medium." Laing, ¶ [0044]. The wall of Laing's housing 18 constitutes a double sided chassis as claimed. "An interior space 36, in which an electric motor denoted overall by 38, is accommodated, is formed in the housing 18 of the circulation pump 12." Laing, ¶ [0052]. Cheon's casing 50 has two sides and is adapted to mount the Pump P. See FIGS. 2, 4, 5 and 7; col. 5, lines 58-65 (" … The pump P is powered by a brushless motor M mounted on the casing 50. …"); and col. 6, lines 33-41 ("A dome-like rounded cover and fluid guide 90 substantially surrounds the propeller 82, magnet 84, and stem 86. The cover and guide 90 is preferably made of molded plastic and preferably is an integral part of the casing 50. The cover and guide 90 may be integrally molded with the casing 50 or, to facilitate assembly of the elements of the system, may be molded separately from the casing 50 and then integrally joined with the casing 50 and then integrally joined with the casing 50 by use of an adhesive or other bonding procedure.").
the pump comprising a stator and an impeller,	Each of Laing and Cheon discloses exactly this limitation. Laing's Stator 54, Rotor 42 are shown in FIG. 1. "[A]n impeller 46 (paddle wheel) … is connected in a rotationally fixed manner to the rotor 42 …." Laing, ¶ [0055]. Cheon's pump P has an impeller 82 (FIG. 5) or an impeller 100 (FIG. 7). Cheon's pump P has a stator 94 (FIG. 5) or a stator 108 (FIG. 7).

the impeller being positioned in a recess on the underside of the chassis and the stator being positioned on the upper side of the chassis and isolated from the cooling liquid;	Each of Laing and Cheon discloses exactly this limitation. In Laing, the impeller 46 is positioned in a recess on the underside of the housing 18 and the wall 72. Laing, FIG. 1. The stator 54 is positioned on the upper side of wall. Id. "Between the rotor 42 and the stator 54 there is a substantially spherical wall 72 …." Laing, ¶ [0068]. The wall 72 isolates the stator 54 from the cooling liquid in the through-flow region 66. Cheon's impeller 82 (FIG. 5) is positioned in a recess formed by the fluid guide 90 (FIG. 5) on the underside of the casing 50. The corresponding stator, or coil 94, is positioned on the upper side of the chassis 50 and is isolated from the cooling liquid (e.g., inside the casing 50). Cheon's impeller 100 (FIG. 7) is positioned in a recess formed by the fluid guide 116 (FIG. 7) on the underside of the casing. The corresponding stator coil and core 108 is positioned on the underside of the chassis 50 and is isolated from the cooling liquid (e.g., inside the casing 50).
a reservoir adapted to pass the cooling liquid therethrough, the reservoir including: **<u>Construction of "reservoir"</u>**: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." ['764 Patent, 10:45-49.] Applicant purports that a "reservoir" is not a "reservoir housing."*See* AppendixD, Amendment dated April 6, 2012	Each of Laing and Cheon discloses exactly this limitation. Laing's housing 18 defines an interior space 36 constituting a chamber for holding excess liquid not capable of being contained in the remaining components. The interior space 36 is adapted to pass the cooling liquid therethrough. As Laing explains, "An interior space 36 … is formed in the housing 18 of the circulation pump 12. … A swirl chamber 44, in which a swirl is imparted to liquid which has been supplied via the feed line 20, using an impeller 46 (paddle wheel) which is connected in a rotationally fixed manner to the rotor 42, and in which swirling liquid flows, is formed in the interior space 36 of the housing 18. … The liquid is also guided past the thermal contact element 32 in order to transfer heat. … The swirl chamber 44 is formed in the interior space 36 between walls 48 …." Laing, ¶¶ [0052]-[0056]. In Laing, the interior space 36 constitutes a chamber for holding excess liquid not capable of being contained in the remaining components. "In particular, it is provided that the circulation pump has a housing part which is formed flexibly and/or is movable, and in particular is disposed movably on the housing, in such a manner that it is possible to exert a positive pressure on the system. … By way of example, the housing part may be a flexible plate, a flexible diaphragm or a bellows." Laing, ¶ [0029]; see also, Laing, ¶¶ [0082]-[0086] (describing a flexible thermal contact element 32 to accommodate fluctuations in volumes without requiring a separate expansion vessel). Cheon explains, "The reservoir has a casing, an inlet opening in the casing, and an

(amending specification to emphasize the distinction between "reservoir" and "reservoir housing").	outlet opening in the casing spaced from the inlet opening. A pump is positioned in the casing of the reservoir adjacent to the outlet opening to pump liquid coolant from the reservoir ...." Cheon, col. 1, lines 49-58. "Preferably, the interior space defined by the reservoir casing includes an upstream portion and a downstream portion. An internal divider wall substantially separates the upstream and downstream portions. The upstream portion is in communication with the inlet opening, and the downstream portion is in communication with the outlet opening. A plurality of heat-gathering fins are located in the upstream portion. The divider wall has a passage therethrough communicating the upstream portion and the downstream portion. The passage is positioned so that liquid coolant entering the interior space through the inlet opening passes through the upstream portion by and through the heat-gathering fins and then flows through the passage into the downstream portion and out the outlet opening." Cheon, col. 2, lines 2-15. Also, see Cheon's FIGS. 2 and 4. "The interior space of the reservoir 48 is divided into an upstream portion 58 in communication with the inlet opening 54 and a downstream portion 60 in communication with the outlet opening 56. An internal divider wall 62 substantially separates the two interior portions 58, 60. As can best be seen in FIG. 4, the upstream portion 58 is in the rectangular reservoir portion exterior to the computer housing 7, and the downstream portion 60 is in the cylindrical reservoir portion inside the computer housing 7." Col. 4, line 67 - Col. 5, line 8.
a pump chamber formed by the recess and including the impeller and formed below the chassis,	Each of Laing and Cheon discloses exactly this limitation. In Laing, the impeller 46 occupies a portion of the interior space 36, defining a pump chamber formed below Laing's chassis (wall 72). Laing, FIG. 1 and ¶ [0068]. Cheon's impeller 82 (FIG. 5) or impeller 100 (FIG. 7) is positioned within a respective fluid guide 90, 116 in the downstream portion 60.

the pump chamber being defined by at least an impeller cover having one or more passages for the cooling liquid to pass through;	Each of Laing and Cheon discloses this limitation. In Laing, the portion of the interior space 36 occupied by the impeller 36 is defined by at least the housing 18 (e.g., the wall 72) extending over the impeller (e.g., as an impeller cover). Laing, FIG. 1 and ¶ [0068]. The housing 18 defines an inflow region 68 for cooling liquid to pass through. Id. Laing's rotor 42 defines a number of through flow passages 66. Laing's rotor also defines an impeller cover. In any event, Cheon explains that "The divider wall 62 has a passage 66 extending therethrough and communicating the upstream portion 58 with the downstream portion 60. The passage 66 is positioned so that liquid coolant C entering the interior space of the reservoir through the inlet opening 54 passes through the upstream portion 58 by and through the heat-gathering fins 64 and then flows through the passage 66 into the downstream portion 60 and out the outlet opening 56." Col. 5, lines 13-20. In Cheon, each respective fluid guide 90, 116 defines a corresponding opening 92, 118 for cooling liquid to pass through. For example, Cheon states "A central opening 92 in the cover and guide 90 allows coolant C that has entered the downstream portion 60 of the interior space of the reservoir 48 from the upstream portion 58 to enter the space inside the cover and guide 90 and be directed by the propeller 82 out through the outlet opening 56." Col. 6, lines 41-46. "A central opening 118 in the cover and fluid guide 116 draws coolant C into the space defined by the cover and guide 116 to efficiently direct coolant C out through the outlet opening 56, which opens through the casing 50 into the space inside the cover and guide 90." Col. 7, lines 11-16. Thus, Each respective fluid guide 90, 116 defines a corresponding opening 92, 118 for cooling liquid to pass through.

a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber, **Construction of "vertically"** Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertically" is taken to mean "in a direction parallel to a rotational axis of the impeller."	Each of Laing and Cheon discloses exactly this limitation. In Laing, a portion of the interior space 36 shown between the thermal contact element 32 and the plate 76 is below and vertically spaced from the volume occupied by the impeller 46 or the impeller 46 and rotor 42. Laing, FIG. 1; see also, Id. at ¶ [0074] (stating "it is possible for this inner side [of thermal contact element 32] to have fins"). Cheon's upstream portion 58 defines a thermal exchange chamber formed below the downstream portion 60 and the interior portion of either fluid guide 90, 116. The upstream portion 58 is vertically spaced from the downstream portion 60 and the interior of either fluid guide 90, 116. Appendix G, Cheon, FIGS. 2, 4, 5, 7. In Cheon, "The internal structure of the reservoir 48 can be seen in FIGS. 2, 4, and 5. The reservoir 48 has an inlet opening 54 and an outlet opening 56 extending through the casing 50 at spaced-apart locations. As can be seen by a comparison of FIGS. 4 and 5, the orientation of the outlet opening 56 may be varied. The interior space of the reservoir 48 is divided into an upstream portion 58 in communication with the inlet opening 54 and a downstream portion 60 in communication with the outlet opening 56. An internal divider wall 62 substantially separates the two interior portions 58, 60. As can best be seen in FIG. 4, the upstream portion 58 is in the rectangular reservoir portion exterior to the computer housing 7, and the downstream portion 60 is in the cylindrical reservoir portion inside the computer housing 7. A plurality of spaced-apart heat-gathering fins 64 extend inwardly toward the computer housing from the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46. The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 4:62-5:13.

the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages; and **Construction of "coupled"** The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	Laing and Cheon disclose exactly this limitation. In Laing, the region shown between thermal contact element 32 and plate 76 is coupled with the volume occupied by the impeller 46 or the impeller 46 and rotor 42 by at least the passages 44. Laing, FIG. 1. The region and the volume are also coupled with each other through the remainder of Laing's feed line 20 and Laing's discharge line 26. *See* Appendix C, Laing FIG. 2. Thus, Laing's pump chamber and thermal exchange chamber must also be coupled together by the through-flow passages 66. In any event, Cheon's upstream portion 58 defines a thermal exchange chamber separate from and fluidly coupled to the downstream portion 60 and the interior portion of either fluid guide 90, 116. Cheon's divider wall 62 defines a passage 66 thermally coupling the upstream portion with the downstream portion and the interior portion of either fluid guide 90, 116. As well, each respective fluid guide 90, 116 defines a corresponding opening 92, 118 for cooling liquid to pass through.
a heat-exchanging interface,	Each of Laing and Cheon discloses exactly this limitation. In Laing, the thermal contact element 32 defines a heat-exchanging interface. See Laing, ¶ [0050] (stating "The thermal contact between the fluid and the object 14 is provided by a thermal contact element 32..."). Cheon states: "A plurality of spaced-apart heat-gathering fins 64 extend inwardly toward the computer housing from the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46." Appendix C, Cheon 5:8-10.

the heat-exchanging interface forming a boundary wall of the thermal exchange chamber, and	Each of Laing and Cheon discloses exactly this limitation. In Laing, thermal contact element 32 defines a boundary wall between the heated object 14 (e.g., processor) and the interior space 36. Laing, FIG. 1 and ¶ [0050]. Cheon's molded plastic casing 50 has an outer metal wall for providing thermal contact. Appendix G, Cheon, 4:49-51. As can best be seen in FIG. 4, the upstream portion 58 is in the rectangular reservoir portion exterior to the computer housing 7, and the downstream portion 60 is in the cylindrical reservoir portion inside the computer housing 7. A plurality of spaced-apart heat-gathering fins 64 extend inwardly toward the computer housing from the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46. The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:3-10.
configured to be placed in thermal contact with a surface of the heat-generating component; and	Laing and Cheon disclose exactly this limitation. In Laing, thermal contact element 32 is configured to be placed in contact with the heated object 14. Laing, FIG. 1 and ¶ [0050]. Cheon states "the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46." Col. 5, lines 10-11. Cheon does not explicitly disclose that the metal outer reservoir wall is placed in thermal contact with a heat-generating component. However, this missing teaching in Cheon is clearly disclosed in Laing. Laing's thermal contact element 32 defines a boundary wall between a heated object 14 (e.g., a processor) and the interior space 36 of Laing's circulation pump. Laing's thermal contact element 32 is configured to be placed in contact with a heated object 14 (e.g., a processor). Laing, FIG. 2; ¶ [0050]. Considering the common knowledge that energy in the form of heat inherently flows from relatively warmer regions to relatively cooler regions absent the addition of work, simply substituting Laing's thermal contact element 32 for Cheon's metal outer reservoir wall to permit Cheon's reservoir and pump assembly to be placed in thermal contact with Laing's heated object 14 (e.g., a processor) would have taken no more than ordinary skill.

a heat radiator fluidly coupled to the reservoir and configured to dissipate heat from the cooling liquid.	Laing and Cheon disclose exactly this limitation. Laing states: "This loop 28 has a cooling section or heating section 30 which is arranged outside the housing 18 and along which heated cooling liquid can be cooled, for example by means of air cooling …. The cooling section … 30 for this purpose has a suitable surface area to allow effective cooling ...." Laing, ¶ [0049] and FIG. 2. As shown in FIG. 2, Laing's feed line 20 receives coolant from the heat radiator 30 and Laing's discharge line 26 delivers heated coolant to the radiator 30. As noted above, simply substituting Laing's thermal contact element 32 for Cheon's metal outer reservoir wall to permit Cheon's reservoir and pump assembly to be placed in thermal contact with Laing's heated object 14 (e.g., a processor) would have taken no more than ordinary skill. With such a configuration, Laing's radiator 30 would dissipate heat from the cooling liquid exactly as it does in Laing's disclosed system.
2. The cooling system of claim 1, wherein the chassis shields the stator from the cooling liquid in the reservoir.	Each of Laing and Cheon discloses exactly this limitation. Laing states: "Between the rotor 42 and the stator 54 there is a substantially spherical wall 72 …." Laing, ¶ [0068]. The wall 72 shields the stator from the cooling liquid in the interior space 36. FIG. 1. As shown in Cheon's FIGS. 4-6, the wall of the chassis 50 isolates the coolant C in the reservoir 48 from the stator coil 94. Appendix G, Cheon, 6:51-53; FIGS. 4-6. As well, in another of Cheon's embodiments, the "stator coil and core 108 of the motor M-2 is located to isolate the coil and core 108 from the coolant …." Id. at 6:66-67.
3. The cooling system of claim 1,	
wherein the heat-exchanging interface includes a first side and a second side opposite the first side, and	Each of Laing and Cheon discloses exactly this limitation. Laing's thermal contact element 32 has opposed inner side 78 positioned opposite the outer surface (not numbered) adjoining the contact surface 34. Laing, FIG. 1. Cheon states that the "casing 50 has an outer metal wall" to provide heat exchanging contact. Appendix G, Cheon, 4:49-61. As shown in Cheon's FIG. 4, fins 64 extend inwardly of the outer metal wall.

wherein the heat-exchanging interface contacts the cooling liquid in the thermal exchange chamber on the first side and	Each of Laing and Cheon discloses exactly this limitation. Laing's thermal contact element 32 is in contact with the cooling liquid in the chamber adjacent the inner side 78 of the element. Laing, FIG. 1. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12.
the heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component on the second side.	Laing and Cheon disclose exactly this limitation. In Laing, the outer surface (not numbered) of the thermal contact element 32 adjoins the contact surface 34 of the object 14. Laing, FIG. 1 As noted above, simply substituting Laing's thermal contact element 32 for Cheon's metal outer reservoir wall to permit Cheon's reservoir and pump assembly to be placed in thermal contact with Laing's heated object 14 (e.g., a processor) would have taken no more than ordinary skill. The resulting system would have the heat exchanging interface in contact with the cooling liquid in the thermal exchange chamber on the first side and in thermal contact with the surface of the heat-generating component on the second side, as claimed.
4. The cooling system of claim 3, wherein the first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber.	Each of Laing and Cheon discloses exactly this limitation. In Laing, the inner side 78 can "have fins in order to increase the surface area" and thereby increase heat transfer from the heat-exchanging interface to the cooling liquid in the chamber between the thermal contact element 32 and the plate 76. Laing, ¶ [0074]. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12.
5. The cooling system of claim 4, wherein the features include at least one of pins or fins.	Each of Laing and Cheon discloses exactly this limitation. In Laing, the inner side 78 can "have fins in order to increase the surface area" and thereby increase heat transfer from the heat-exchanging interface to the cooling liquid in the chamber between the thermal contact element 32 and the plate 76. Appendix C, Laing, ¶ [0074]. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12.

6. The cooling system of claim 1, wherein a passage of the one or more passages that fluidly couple the pump chamber and the thermal exchange chamber is offset from a center of the impeller. **Construction of "coupled"** The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	Each of Laing and Cheon discloses exactly this limitation. In Laing, the passages 44 are offset from a center of the impeller 46, as are the feed line 20 and the discharge line 26. Laing, FIG. 1. As well, the passage 66 in the divider wall 62 is offset from a center of each impeller 82 (one embodiment) and impeller 100 (alternative embodiment). Appendix G, Cheon, FIG. 4. Moreover, as shown in FIG. 2, Cheon's upstream portion 58 and downstream portion 60 are fluidly coupled to each other through other passages, e.g., passages 70, 72 and 74.
7. The cooling system of claim 1, wherein the impeller includes a plurality of curved blades.	Laing discloses curved blades. Appendix C, Laing, FIG. 1. Laing's rotor 42 is curved (e.g., "spherical", see ¶ [0063]; "The rotor 42 forms a single unit with the paddle wheel 46."); ¶ [0027] states "In a variant …, blades are arranged on the rotor, in order in particular to generate additional swirl in the liquid. The blades are disposed in such a way that the spherical geometry is substantially retained."
8. The cooling system of claim 1, wherein the heat-exchanging interface includes one of copper and aluminum.	Laing and Cheon disclose exactly this limitation. Laing states: "In the exemplary embodiment shown in FIG. 1, the thermal contact element 32 is formed as a rigid plate which is made from a material with a good thermal conductivity, such as copper." Laing, ¶ [0081]. Also, Cheon notes that the exterior of the casing 5 can be metal to provide heat exchanging contact. Appendix G, Cheon, 4:49-61.

9. The cooling system of claim 1, wherein the heat radiator is fluidly coupled to the reservoir using flexible conduits, and the heat radiator is configured to be positioned remote from the reservoir.	Laing states: "The discharge line 26 and the feed line 20 are connected to one another outside the housing 18 of the circulation pump 12, in order to form a loop 28 for the liquid. This loop 28 has a cooling section or heating section 30 which is arranged outside the housing 18 ...." Laing, ¶ [0049] and FIG. 2. Cheon states: "It is intended to be understood that the system may be used in connection with a wide variety of computers and heat-producing components. In addition, the system may be used to cool a single component or two or more components in accordance with the needs in a particular installation. As a matter of course, one of ordinary skill in the art would have found the use of flexible conduit as claimed obvious to provide flexibility in positioning Laing's radiator 30 in a wide variety of computers. "A person of ordinary skill is also a person of ordinary creativity, not an automaton." KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007).
15. A cooling system for a heat-generating component, comprising:	Each of Laing and Cheon discloses exactly this type of system. Laing's title states it clearly: "Device for the Local Cooling or Heating of an Object." Appendix C, Laing, Title.
a pump adapted to circulate a cooling liquid, the pump including:	Each of Laing and Cheon discloses exactly limitation. In Laing, FIG. 1 illustrates a "circulation pump 12, by means of which a fluid, such as water or other liquids, can be guided in a loop (FIG. 2) as a heat transfer medium. The heat transfer medium can be used as a cooling medium." Appendix C, Laing, ¶ [0044]. Cheon discloses a pump adapted to circulate a coolant C. Appendix G, Cheon, FIGS. 2 and 4.
an impeller exposed to the cooling liquid; and	Each of Laing and Cheon discloses exactly limitation. In Laing, "[A]n impeller 46 (paddle wheel) … is connected in a rotationally fixed manner to the rotor 42 …." Appendix C, Laing, ¶ [0055]; FIG. 1. Cheon's pump P has an impeller 82 (FIG. 5) or an impeller 100 (FIG. 7) exposed to the coolant C. Appendix G, Cheon, FIGS. 2 and 4.
a stator isolated from the cooling liquid;	Each of Laing and Cheon discloses exactly limitation. Laing states: "Between the rotor 42 and the stator 54 there is a substantially spherical wall 72 …." Laing, ¶ [0068]. The wall 72 isolates the stator 54 from the cooling liquid. Appendix C, Laing, FIG. 1.

	Cheon's pump P has a stator 94 (FIG. 5) The stator, or coil 94, is isolated from the cooling liquid inside the casing 50. In another embodiment, Cheon's pump P has a stator 108 (FIG. 7). The stator coil and core 108 is isolated from the cooling liquid inside the casing 50.
a reservoir including an impeller cover, an intermediate member and a heat exchange interface, **<u>Construction of "reservoir"</u>**: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." ['764 Patent, 10:45-49.] Applicant purports that a "reservoir" is not a "reservoir housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and "reservoir housing").	Each of Laing and Cheon discloses exactly limitation. Laing: **"Reservoir."** Laing's housing 18 defines an interior space 36. "An interior space 36 … is formed in the housing 18 of the circulation pump 12. … A swirl chamber 44, in which a swirl is imparted to liquid which has been supplied via the feed line 20, using an impeller 46 (paddle wheel) which is connected in a rotationally fixed manner to the rotor 42, and in which swirling liquid flows, is formed in the interior space 36 of the housing 18. … The liquid is also guided past the thermal contact element 32 in order to transfer heat. … The swirl chamber 44 is formed in the interior space 36 between walls 48 …." Appendix C, Laing, ¶¶ [0052]-[0056]. The interior space 36 constitutes a chamber for holding excess liquid not capable of being contained in the remaining components. "In particular, it is provided that the circulation pump has a housing part which is formed flexibly and/or is movable, and in particular is disposed movably on the housing, in such a manner that it is possible to exert a positive pressure on the system. … By way of example, the housing part may be a flexible plate, a flexible diaphragm or a bellows." <u>Id.</u> at ¶ [0029]; see also, Laing, ¶¶ [0082]-[0086] (describing a flexible thermal contact element 32 to accommodate fluctuations in volumes without requiring a separate expansion vessel). **"Impeller cover."** In Laing, the portion of the interior space 36 occupied by the impeller 36 is defined by at least the housing 18 extending over the impeller (e.g., as an impeller cover). <u>Id.</u> at FIG. 1. Laing's rotor 42 also defines an impeller cover. <u>Id.</u> **"Intermediate member."** A plate 76 is positioned between the impeller 46 and the thermal contact element 32, forming an intermediate member. <u>Id.</u> at FIG. 1. **"Heat exchange interface."** The thermal contact element 32 defines a heat-exchanging interface. See Laing, ¶ [0050] (stating "The thermal contact between the fluid and the object 14 is provided by a thermal contact element 32....").

<table>
<tr><td></td><td>Cheon:

“Reservoir.” Reservoir 48. Appendix G, Cheon, FIG. 4.

“Impeller cover.” Each respective fluid guide 90, 116 defines a corresponding impeller cover. <u>Id.</u> at FIGS. 4, 5 and 7.

“Intermediate member.” "The divider wall 62 has a passage 66 extending therethrough and communicating the upstream portion 58 with the downstream portion 60. The passage 66 is positioned so that liquid coolant C entering the interior space of the reservoir through the inlet opening 54 passes through the upstream portion 58 by and through the heat-gathering fins 64 and then flows through the passage 66 into the downstream portion 60 and out the outlet opening 56." <u>Id.</u> at 5:13-20; FIG. 4.

“Heat exchange interface.” Cheon’s molded plastic casing 50 has an outer metal wall for providing thermal contact. Appendix G, Cheon, 4:49-51. Cheon also states: "A plurality of spaced-apart heat-gathering fins 64 extend inwardly toward the computer housing from the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46.” <u>Id.</u> at 5:8-10.</td></tr>
<tr><td>wherein a top wall of the reservoir and the impeller cover define a pump chamber for housing the impeller, and</td><td>Each of Laing and Cheon discloses exactly limitation.

Laing’s top wall 72 and the outer wall of the housing 18 overlie the impeller 46 and the rotor, defining a pump chamber for housing the impeller 46. Appendix C, Laing, FIG. 1.

In Cheon, each respective fluid guide 90, 116 defines a corresponding impeller cover, and the casing 50 forms a wall of the reservoir. Each fluid guide and the casing defines a respective pump chamber for housing the impeller of the respective pump embodiment. Appendix G, Cheon, FIGS. 4, 5 and 7.</td></tr>
<tr><td>the intermediate member and the heat exchange interface define a thermal exchange chamber,</td><td>Each of Laing and Cheon discloses exactly limitation.

In Laing, the plate 76 (intermediate member) and the thermal contact element 32 define a chamber through which a coolant passes to absorb heat from the thermal contact element 32, forming a thermal exchange chamber. Appendix C, Laing, ¶ [0055] (stating "[t]he liquid is also guided past the thermal contact element 32 in order to transfer heat”); FIG. 1.

In Cheon, the upstream portion 58 of Cheon’s reservoir 48 defines a thermal exchange chamber between the internal divider wall 62 and the fins 64 extending inwardly from the outer metal wall of the casing 50. Appendix G, Cheon, 4:49-51; 5:3-10; FIG. 4.</td></tr>
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the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together; and Construction of "vertical" Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertical" is taken to mean "in a direction parallel to a rotational axis of the impeller." Construction of "coupled" The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	Each of Laing and Cheon discloses exactly limitation. In Laing, a portion of the interior space 36 shown between the thermal contact element 32 and the plate 76 is below and vertically spaced from the volume occupied by the impeller 46. Appendix C, Laing, FIG. 1; see also, Id. at ¶ [0074] (stating "it is possible for this inner side [of thermal contact element 32] to have fins"). In Laing, the volume occupied by the impeller 46 is fluidly coupled with the portion of the interior space 36 between the thermal contact element 32 and the plate through passages 44, as shown in FIG. 1, as well as through the feed line 20 and discharge line 26, as shown in FIG. 2. Id. Cheon's thermal exchange chamber 58 is spaced apart from the pump chamber in a vertical direction. Appendix G, Cheon, FIG. 4. They are fluidly coupled together through the passage 66, as well as by the inlet opening 54 and the outlet opening 56. Id.

wherein a first side of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and	Each of Laing and Cheon discloses exactly this limitation. Laing states: "The thermal contact between the fluid and the object 14 is provided by a thermal contact element 32…." Appendix C, Laing, ¶ [0050]. "The liquid is also guided past the thermal contact element 32 in order to transfer heat." Id. at ¶ [0055]. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12.
a second side of the heat-exchanging interface opposite the first side is configured to be placed in thermal contact with a surface of the heat-generating component; and	Laing and Cheon disclose exactly this limitation. In Laing, the outer surface (not numbered) of the thermal contact element 32 adjoins the contact surface 34 of the object 14. Appendix C, Laing, FIG. 1 As noted above, simply substituting Laing's thermal contact element 32 for Cheon's metal outer reservoir wall to permit Cheon's reservoir and pump assembly to be placed in thermal contact with Laing's heated object 14 (e.g., a processor) would have taken no more than ordinary skill. The resulting system would have the heat exchanging interface in thermal contact with the surface of the heat-generating component, as claimed.
a liquid-to-air heat exchanger fluidly coupled to the reservoir using flexible conduits, the heat exchanger being configured to be positioned remote from the reservoir.	Laing and Cheon each disclose a liquid-to-air heat exchanger fluidly coupled to the reservoir using conduits, the heat exchanger being configured to be positioned remote from the reservoir. Laing states: "This loop 28 has a cooling section or heating section 30 which is arranged outside the housing 18 and along which heated cooling liquid can be cooled, for example by means of air cooling …. The cooling section … 30 for this purpose has a suitable surface area to allow effective cooling ...." Appendix C, Laing, ¶ [0049]; FIG. 2. As shown in FIG. 2, Laing's feed line 20 receives coolant from the liquid-to-air heat exchanger 30 and Laing's discharge line 26 delivers heated coolant to the liquid-to-air heat exchanger 30, fluidly coupling Laing's liquid-to-air heat exchanger 30 and reservoir. As noted above, simply substituting Laing's thermal contact element 32 for Cheon's metal outer reservoir wall to permit Cheon's reservoir and pump assembly to be placed in thermal contact with Laing's heated object 14 (e.g., a processor) would have taken no more than ordinary skill. With such a configuration, Laing's liquid-to-air heat exchanger 30 would be fluidly coupled to Cheon's reservoir and pump assembly to be positioned remote from the reservoir. Moreover, Cheon states: "It is intended to be understood that the system may be used in connection with a wide variety of computers and heat-producing

	components. In addition, the system may be used to cool a single component or two or more components in accordance with the needs in a particular installation. Flexible conduit, as claimed, would have been obvious to one of ordinary skill in the art because it provides flexibility in positioning Laing's radiator 30 in a wide variety of computers, as suggested by Cheon. To the extent that such a conduit might not be expressly disclosed in Cheon or Laing, Requester notes that "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007). Thus, using a "flexible" conduit would have been obvious.
16. The cooling system of claim 15, wherein the impeller cover includes a first opening radially offset from a center of the impeller and	Laing and Cheon disclose exactly this limitation. In Laing, the inflow region 68 is radially offset from a center (e.g., an axis of rotation 40) of the impeller 46. Appendix C, Laing, FIG. 1. In Cheon, the outlet opening 56 is radially offset from a center of the impeller. Appendix G, Cheon, FIG. 5.
the intermediate member includes a second passage that is aligned with the first opening,	Laing and Cheon disclose exactly this limitation. In Laing, the plate 76 defining the intermediate member extends outwardly of the impeller 46, defining a passage radially outward of the impeller between the cover plate 76 and the cross-hatched portion of the rotor 42. The passage also extends radially inward between impeller blades and is aligned with the through-flow region 66. Appendix C, Laing, FIG. 1. In Cheon, the wall 62 has a passage 66 aligned with the outlet opening 56. For example, both are shown on the same wall of the casing 50. Appendix G, Cheon, FIG. 5.
the first and the second opening being configured to direct the cooling liquid from the pump chamber into the thermal exchange chamber. Construction of "second opening" For purposes of this Request, the recited "second opening" is	To the extent that the term "second opening" can be construed for purposes of this Request, Laing and Cheon disclose exactly this limitation. In Laing, FIG. 1 illustrates that the passage 44 fluidly couples the passage extending radially inward between impeller blades (e.g., the pump chamber) and the region between the cover plate 76 and the thermal contact element 32 (the thermal exchanger chamber). Appendix C, Laing, FIG. 1. In Cheon, coolant passages from the pump chamber, through the outlet opening 56 and through the inlet opening 54 and into the thermal exchange chamber 58. Appendix G, Cheon, FIGS. 2 and 5. Coolant passes from the thermal exchange chamber 58 through the passage 66 in proportion to the amount of coolant entering through the inlet opening 54. Accordingly, Cheon discloses that the

assumed to mean the previously recited "second passage."	outlet opening 56 and the passage 66 "are configured" as claimed.
17. The cooling system of claim 15, wherein the first side of the heat-exchanging interface includes at least one of pins or fins.	Each of Laing and Cheon discloses exactly this limitation. In Laing, the inner side 78 can "have fins in order to increase the surface area" and thereby increase heat transfer from the heat-exchanging interface to the cooling liquid in the chamber between the thermal contact element 32 and the plate 76. Appendix C, Laing, ¶ [0074]. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12.
18. The cooling system of claim 15, wherein the top wall of the reservoir extends between the stator and the impeller and shields the stator from the cooling liquid in the reservoir. Construction of "reservoir" As noted above, Applicant purports that a "reservoir" is not a "reservoir housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and "reservoir housing"). Thus, claim 18 is nonsensical since a "reservoir" has no physical structure (i.e., the claimed "top wall"). Nonetheless, solely for purposes of	Each of Laing and Cheon discloses exactly limitation. Laing's wall 72 extends between the stator 54 and the impeller 46, shielding the stator from the cooling liquid. Appendix C, Laing, ¶ [0068]; FIG. 1. Cheon's pump P has a stator 94 (FIG. 5) or a stator 108 (FIG. 7). Appendix G, Cheon, FIGS. 5 and 7. The casing 50 extends between each respective stator 94, 108 and the corresponding impeller 82, 100. Id. The casing 50 shields each respective stator from the cooling liquid in the reservoir 48. Id. at FIG. 4.

construing claim 18 in this Request, the recited "top wall" will be construed to mean a "top wall" of a housing positioned adjacent the claimed reservoir.	

E. CLAIMS 7, 9 AND 15-18 ARE OBVIOUS FROM LAING, CHEON AND HAMMAN

Each combination of features claimed in claims 7, 9 and 15-18 in the '764 Patent would have been obvious from a review of Laing, Cheon and Hamman to one of ordinary skill in the art at the time of the purported invention disclosed in the '764 Patent, as set forth in detail in the following claim chart:

U.S. Patent No. 8,245,764 Claim Language	Correspondence to Laing, Cheon and Hamman
7. The cooling system of claim 1, wherein the impeller includes a plurality of curved blades.	For the reasons stated above, Laing and Cheon render independent claim 1 obvious. Laing discloses curved blades. Appendix C, Laing, FIG. 1. Laing's rotor 42 is curved (e.g., "spherical", see ¶ [0063]; "The rotor 42 forms a single unit with the paddle wheel 46."); ¶ [0027] states "In a variant …, blades are arranged on the rotor, in order in particular to generate additional swirl in the liquid. The blades are disposed in such a way that the spherical geometry is substantially retained." To the extent that Laing, Cheon, or both, might be interpreted as not disclosing an impeller including a plurality of curved blades, Hamman cures such a deficiency. In particular, Hamman discloses an impeller having "co-radially curved blades 508" configured "to enhance fluidic movement induced by the [impeller] assembly 500." Appendix F, Hamman, 10:6-11; FIG. 5. Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" -

	choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or motivation to combine. All of these rationale apply here. First, combining Hamman's curved blades with Laing's or Cheon's impeller yields predictable results. Second, simply substituting Hamman's impeller for Laing's or Cheon's impeller provides predictable results. Third, a designer of impeller blades essentially has two choices from which to choose – straight blades or curved blades, and to the extent Laing or Cheon might not disclose curved blades, it would have been obvious to try Hamman's curved blades. Fourth, Hamman suggests curved blades to enhance fluidic movement. Based on the foregoing, one of ordinary skill would have found the combination of limitations claimed in claim 7 to be obvious.
9. The cooling system of claim 1, wherein the heat radiator is fluidly coupled to the reservoir using flexible conduits, and the heat radiator is configured to be positioned remote from the reservoir.	As noted above, Laing and Cheon render claim 1 unpatentable. Laing, Cheon and Hamman disclose exactly the combination of features recited in claim 9. For example, Laing discloses a radiator 30 positioned remove from the reservoir. Appendix C, Laing, FIG. 2. To the extent that Laing and Cheon might not render claim 9 obvious as a matter of course, Hamman discloses using flexible conduits to fluidly couple a heat radiator to a reservoir in thermal contact with a heat generating component. Appendix F, Hamman, FIG. 7; 9:12-14 ("Conduits 701 and 702 may comprise a number of suitable rigid, semi-rigid, or flexible materials (e.g., copper tubing, metallic flex tubing, or plastic tubing) depending upon desired cost and performance characteristics."). Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" - choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or motivation to combine. All of these rationale apply here. First, combining Hamman's flexible with Laing's or Cheon's system yields predictable results. Second, simply

	substituting Hamman's flexible conduits for Laing's or Cheon's conduits provides predictable results. Third, a designer of conduit has essentially three choices from which to choose for conduit, as set forth in Hamman: rigid, semi-rigid, or flexible materials, so it would have been obvious to try flexible conduit. Fourth, Hamman suggests using flexible conduit according to particular cost size and performance criteria of the particular application. Appendix F, Hamman, 8:65-9:1.
15. A cooling system for a heat-generating component, comprising:	Each of Laing and Cheon discloses exactly this type of system. Laing's title states it clearly: "Device for the Local Cooling or Heating of an Object." Appendix C, Laing, Title.
a pump adapted to circulate a cooling liquid, the pump including:	Each of Laing and Cheon discloses exactly limitation. In Laing, FIG. 1 illustrates a "circulation pump 12, by means of which a fluid, such as water or other liquids, can be guided in a loop (FIG. 2) as a heat transfer medium. The heat transfer medium can be used as a cooling medium." Appendix C, Laing, ¶ [0044]. Cheon discloses a pump adapted to circulate a coolant C. Appendix G, Cheon, FIGS. 2 and 4.
an impeller exposed to the cooling liquid; and	Each of Laing and Cheon discloses exactly limitation. In Laing, "[A]n impeller 46 (paddle wheel) … is connected in a rotationally fixed manner to the rotor 42 …." Appendix C, Laing, ¶ [0055]; FIG. 1. Cheon's pump P has an impeller 82 (FIG. 5) or an impeller 100 (FIG. 7) exposed to the coolant C. Appendix G, Cheon, FIGS. 2 and 4.
a stator isolated from the cooling liquid;	Each of Laing and Cheon discloses exactly limitation. Laing states: "Between the rotor 42 and the stator 54 there is a substantially spherical wall 72 …." Laing, ¶ [0068]. The wall 72 isolates the stator 54 from the cooling liquid. Appendix _C, Laing, FIG. 1. Cheon's pump P has a stator 94 (FIG. 5) The stator, or coil 94, is isolated from the cooling liquid inside the casing 50. In another embodiment, Cheon's pump P has a stator 108 (FIG. 7). The stator coil and core 108 is isolated from the cooling liquid inside the casing 50.

a reservoir including an impeller cover, an intermediate member and a heat exchange interface, **<u>Construction of “reservoir”</u>**: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." [‘764 Patent, 10:45-49.] Applicant purports that a “reservoir” is not a “reservoir housing.” *See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between “reservoir” and “reservoir housing”).	Each of Laing and Cheon discloses exactly limitation. Laing: **“Reservoir.”** Laing’s housing 18 defines an interior space 36. “An interior space 36 … is formed in the housing 18 of the circulation pump 12. … A swirl chamber 44, in which a swirl is imparted to liquid which has been supplied via the feed line 20, using an impeller 46 (paddle wheel) which is connected in a rotationally fixed manner to the rotor 42, and in which swirling liquid flows, is formed in the interior space 36 of the housing 18. … The liquid is also guided past the thermal contact element 32 in order to transfer heat. … The swirl chamber 44 is formed in the interior space 36 between walls 48 ….” Appendix C, Laing, ¶¶ [0052]-[0056]. The interior space 36 constitutes a chamber for holding excess liquid not capable of being contained in the remaining components. “In particular, it is provided that the circulation pump has a housing part which is formed flexibly and/or is movable, and in particular is disposed movably on the housing, in such a manner that it is possible to exert a positive pressure on the system. … By way of example, the housing part may be a flexible plate, a flexible diaphragm or a bellows.” <u>Id.</u> at ¶ [0029]; see also, Laing, ¶¶ [0082]-[0086] (describing a flexible thermal contact element 32 to accommodate fluctuations in volumes without requiring a separate expansion vessel). **“Impeller cover.”** In Laing, the portion of the interior space 36 occupied by the impeller 36 is defined by at least the housing 18 extending over the impeller (e.g., as an impeller cover). <u>Id.</u> at FIG. 1. Laing’s rotor 42 also defines an impeller cover. <u>Id.</u> **“Intermediate member.”** A plate 76 is positioned between the impeller 46 and the thermal contact element 32, forming an intermediate member. <u>Id.</u> at FIG. 1. **“Heat exchange interface.”** The thermal contact element 32 defines a heat-exchanging interface. See Laing, ¶ [0050] (stating “The thermal contact between the fluid and the object 14 is provided by a thermal contact element 32...”). Cheon: **“Reservoir.”** Reservoir 48. Appendix G, Cheon, FIG. 4. **“Impeller cover.”** Each respective fluid guide 90, 116 defines a corresponding

	impeller cover. Id. at FIGS. 4, 5 and 7. **"Intermediate member."** "The divider wall 62 has a passage 66 extending therethrough and communicating the upstream portion 58 with the downstream portion 60. The passage 66 is positioned so that liquid coolant C entering the interior space of the reservoir through the inlet opening 54 passes through the upstream portion 58 by and through the heat-gathering fins 64 and then flows through the passage 66 into the downstream portion 60 and out the outlet opening 56." Id. at 5:13-20; FIG. 4. **"Heat exchange interface."** Cheon's molded plastic casing 50 has an outer metal wall for providing thermal contact. Appendix G, Cheon, 4:49-51. Cheon also states: "A plurality of spaced-apart heat-gathering fins 64 extend inwardly toward the computer housing from the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46." Id. at 5:8-10.
wherein a top wall of the reservoir and the impeller cover define a pump chamber for housing the impeller, and	Each of Laing and Cheon discloses exactly limitation. Laing's top wall 72 and the outer wall of the housing 18 overlie the impeller 46 and the rotor, defining a pump chamber for housing the impeller 46. Appendix C, Laing, FIG. 1. In Cheon, each respective fluid guide 90, 116 defines a corresponding impeller cover, and the casing 50 forms a wall of the reservoir. Each fluid guide and the casing defines a respective pump chamber for housing the impeller of the respective pump embodiment. Appendix G, Cheon, FIGS. 4, 5 and 7.
the intermediate member and the heat exchange interface define a thermal exchange chamber,	Each of Laing and Cheon discloses exactly limitation. In Laing, the plate 76 (intermediate member) and the thermal contact element 32 define a chamber through which a coolant passes to absorb heat from the thermal contact element 32, forming a thermal exchange chamber. Appendix C, Laing, ¶ [0055] (stating "[t]he liquid is also guided past the thermal contact element 32 in order to transfer heat"); FIG. 1. In Cheon, the upstream portion 58 of Cheon's reservoir 48 defines a thermal exchange chamber between the internal divider wall 62 and the fins 64 extending inwardly from the outer metal wall of the casing 50. Appendix G, Cheon, 4:49-51; 5:3-10; FIG. 4.

the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together; and Construction of "vertical" Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertical" is taken to mean "in a direction parallel to a rotational axis of the impeller." Construction of "coupled" The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	Each of Laing and Cheon discloses exactly limitation. In Laing, a portion of the interior space 36 shown between the thermal contact element 32 and the plate 76 is below and vertically spaced from the volume occupied by the impeller 46. Appendix C, Laing, FIG. 1; see also, Id. at ¶ [0074] (stating "it is possible for this inner side [of thermal contact element 32] to have fins"). In Laing, the volume occupied by the impeller 46 is fluidly coupled with the portion of the interior space 36 between the thermal contact element 32 and the plate through passages 44, as shown in FIG. 1, as well as through the feed line 20 and discharge line 26, as shown in FIG. 2. Id. Cheon's thermal exchange chamber 58 is spaced apart from the pump chamber in a vertical direction. Appendix G, Cheon, FIG. 4. They are fluidly coupled together through the passage 66, as well as by the inlet opening 54 and the outlet opening 56. Id.

wherein a first side of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and	Each of Laing and Cheon discloses exactly this limitation. Laing states: "The thermal contact between the fluid and the object 14 is provided by a thermal contact element 32…." Appendix C, Laing, ¶ [0050]. "The liquid is also guided past the thermal contact element 32 in order to transfer heat." Id. at ¶ [0055]. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12.
a second side of the heat-exchanging interface opposite the first side is configured to be placed in thermal contact with a surface of the heat-generating component; and	To the extent that Laing and Cheon might not disclose this limitation. In Laing, the outer surface (not numbered) of the thermal contact element 32 adjoins the contact surface 34 of the object 14. Appendix C, Laing, FIG. 1 As noted above, simply substituting Laing's thermal contact element 32 for Cheon's metal outer reservoir wall to permit Cheon's reservoir and pump assembly to be placed in thermal contact with Laing's heated object 14 (e.g., a processor) would have taken no more than ordinary skill. The resulting system would have the heat exchanging interface in thermal contact with the surface of the heat-generating component, as claimed.
a liquid-to-air heat exchanger fluidly coupled to the reservoir using flexible conduits, the heat exchanger being configured to be positioned remote from the reservoir.	Laing and Cheon each disclose a liquid-to-air heat exchanger fluidly coupled to the reservoir using conduits, the heat exchanger being configured to be positioned remote from the reservoir. Laing states: "This loop 28 has a cooling section or heating section 30 which is arranged outside the housing 18 and along which heated cooling liquid can be cooled, for example by means of air cooling …. The cooling section … 30 for this purpose has a suitable surface area to allow effective cooling ...." Appendix C, Laing, ¶ [0049]; FIG. 2. As shown in FIG. 2, Laing's feed line 20 receives coolant from the liquid-to-air heat exchanger 30 and Laing's discharge line 26 delivers heated coolant to the liquid-to-air heat exchanger 30, fluidly coupling Laing's liquid-to-air heat exchanger 30 and reservoir. As noted above, simply substituting Laing's thermal contact element 32 for Cheon's metal outer reservoir wall to permit Cheon's reservoir and pump assembly to be placed in thermal contact with Laing's heated object 14 (e.g., a processor) would have taken no more than ordinary skill. With such a configuration, Laing's liquid-to-air heat exchanger 30 would be fluidly coupled to Cheon's reservoir and pump assembly to be positioned remote from the reservoir. Moreover, Cheon states: "It is intended to be understood that the system may be used in connection with a wide variety of computers and heat-producing

	components. In addition, the system may be used to cool a single component or two or more components in accordance with the needs in a particular installation. Flexible conduit, as claimed, would have been obvious to one of ordinary skill in the art because it provides flexibility in positioning Laing's radiator 30 in a wide variety of computers, as suggested by Cheon. To the extent that such a conduit might not be expressly disclosed in Cheon or Laing, Requester notes that "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007). In any event, to the extent that using "flexible conduits" to fluidly couple Laing's heat radiator to the reservoir might somehow have escaped one of ordinary skill based on a review of Laing alone, such flexible conduits would surely have been obvious from a review of Hamman. Hamman discloses using flexible conduits to fluidly couple a heat radiator to a reservoir in thermal contact with a heat generating component. Appendix F, Hamman, FIG. 7; 9:12-14 ("Conduits 701 and 702 may comprise a number of suitable rigid, semi-rigid, or flexible materials (e.g., copper tubing, metallic flex tubing, or plastic tubing) depending upon desired cost and performance characteristics."). Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" - choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or motivation to combine. All of these rationale apply here. First, combining Hamman's flexible conduits with a system according to Laing and Cheon yields predictable results. Second, simply substituting Hamman's flexible conduits for conduits in a system according to Laing and Cheon provides predictable results. Third, a designer of conduit has essentially three choices from which to choose for conduit, as set forth in Hamman: rigid, semi-rigid, or flexible materials, so it would have been obvious to try flexible conduit in a system according to Laing and Cheon. Fourth, Hamman suggests using flexible conduit according to desired costs and characteristics.

16. The cooling system of claim 15, wherein the impeller cover includes a first opening radially offset from a center of the impeller and	Laing and Cheon disclose exactly this limitation. In Laing, the inflow region 68 is radially offset from a center (e.g., an axis of rotation 40) of the impeller 46. Appendix C, Laing, FIG. 1. In Cheon, the outlet opening 56 is radially offset from a center of the impeller. Appendix G, Cheon, FIG. 5.
the intermediate member includes a second passage that is aligned with the first opening,	Laing and Cheon disclose exactly this limitation. In Laing, the plate 76 defining the intermediate member extends outwardly of the impeller 46, defining a passage radially outward of the impeller between the cover plate 76 and the cross-hatched portion of the rotor 42. The passage also extends radially inward between impeller blades and is aligned with the through-flow region 66. Appendix C, Laing, FIG. 1. In Cheon, the wall 62 has a passage 66 aligned with the outlet opening 56. For example, both are shown on the same wall of the casing 50. Appendix G, Cheon, FIG. 5.
the first and the second opening being configured to direct the cooling liquid from the pump chamber into the thermal exchange chamber. Construction of "second opening" For purposes of this Request, the recited "second opening" is assumed to mean the previously recited "second passage."	To the extent that the term "second opening" can be construed for purposes of this Request, Laing and Cheon disclose exactly this limitation. In Laing, FIG. 1 illustrates that the passage 44 fluidly couples the passage extending radially inward between impeller blades (e.g., the pump chamber) and the region between the cover plate 76 and the thermal contact element 32 (the thermal exchanger chamber). Appendix C, Laing, FIG. 1. In Cheon, coolant passages from the pump chamber, through the outlet opening 56 and through the inlet opening 54 and into the thermal exchange chamber 58. Appendix G, Cheon, FIGS. 2 and 5. Coolant passes from the thermal exchange chamber 58 through the passage 66 in proportion to the amount of coolant entering through the inlet opening 54. Accordingly, Cheon discloses that the outlet opening 56 and the passage 66 "are configured" as claimed.
17. The cooling system of claim 15, wherein the first side of the heat-exchanging interface includes at least one of pins or fins.	Each of Laing and Cheon discloses exactly this limitation. In Laing, the inner side 78 can "have fins in order to increase the surface area" and thereby increase heat transfer from the heat-exchanging interface to the cooling liquid in the chamber between the thermal contact element 32 and the

	plate 76. Appendix C, Laing, ¶ [0074]. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12.
18. The cooling system of claim 15, wherein the top wall of the reservoir extends between the stator and the impeller and shields the stator from the cooling liquid in the reservoir. Construction of "reservoir" As noted above, Applicant purports that a "reservoir" is not a "reservoir housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and "reservoir housing"). Thus, claim 18 is nonsensical since a "reservoir" has no physical structure (i.e., the claimed "top wall"). Nonetheless, solely for purposes of construing claim 18 in this Request, the recited "top wall" will be construed to mean a "top wall" of a housing positioned adjacent the claimed reservoir.	Each of Laing and Cheon discloses exactly limitation. Laing's wall 72 extends between the stator 54 and the impeller 46, shielding the stator from the cooling liquid. Appendix C, Laing, ¶ [0068]; FIG. 1. Cheon's pump P has a stator 94 (FIG. 5) or a stator 108 (FIG. 7). Appendix G, Cheon, FIGS. 5 and 7. The casing 50 extends between each respective stator 94, 108 and the corresponding impeller 82, 100. Id. The casing 50 shields each respective stator from the cooling liquid in the reservoir 48. Id. at FIG. 4.

F. CLAIMS 1-18 ARE OBVIOUS FROM HAMMAN AND CHEON

Each combination of features claimed in claims 1-18 in the '764 Patent would have been obvious from a review of Hamman and Cheon to one of ordinary skill in the art at the time of the purported invention disclosed in the '764 Patent, as set forth in detail in the following claim chart:

U.S. Patent No. 8,245,764 Claim Language	Correspondence to Hamman and Cheon
1. A cooling system for a heat-generating component, comprising:	Each of Hamman and Cheon disclose cooling systems for heat-generating components. Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" - choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or motivation to combine. All of these rationale apply here as detailed below. First, combining Cheon's reservoir and heat exchange surface with Hamman's reservoir to cool a processor yields predictable results. Second, simply substituting Cheon's reservoir and heat exchange assembly for Hamman's reservoir to cool a processor achieves predictable results. Third, considering the well-known fact that energy in the form of heat always flows from a region of relatively higher temperature to a region of relatively lower temperature absent the addition of work, any heat exchanger, including Cheon's reservoir and heat exchange surface, can either promote heat transfer to or heat transfer from the heat exchanger; Cheon describes transferring heat from the reservoir, leaving transferring heat to Cheon's reservoir to cool a heat generating component as the sole other alternative use of Cheon's system. Fourth, both Hamman and Cheon suggest providing a reservoir to provide an expansion volume for a coolant.

a double-sided chassis adapted to mount a pump configured to circulate a cooling liquid,	Each of Hamman and Cheon discloses exactly this limitation. Hamman discloses a reservoir 711 adapted to house a pump assembly 712. Appendix F, Hamman, FIG. 7; 9:28-32 (stating "Assembly 712 may comprise a motor 710 disposed upon an upper surface of reservoir 711, and an impeller assembly720 which extends from the motor 710 to the bottom portion of the reservoir 711"). Similarly, Cheon's casing 50 has two sides and is adapted to mount the Pump P. See FIGS. 2, 4, 5 and 7; col. 5, lines 58-65 (" … The pump P is powered by a brushless motor M mounted on the casing 50. …"); and col. 6, lines 33-41 ("A dome-like rounded cover and fluid guide 90 substantially surrounds the propeller 82, magnet 84, and stem 86. The cover and guide 90 is preferably made of molded plastic and preferably is an integral part of the casing 50. The cover and guide 90 may be integrally molded with the casing 50 or, to facilitate assembly of the elements of the system, may be molded separately from the casing 50 and then integrally joined with the casing 50 and then integrally joined with the casing 50 by use of an adhesive or other bonding procedure.").
the pump comprising a stator and an impeller,	Hamman and Cheon disclose exactly this limitation. Hamman's pump assembly 712 includes an impeller assembly 720 and a motor 710. Cheon's pump P has an impeller 82 (FIG. 5) or an impeller 100 (FIG. 7). Cheon's pump P has a stator 94 (FIG. 5) or a stator 108 (FIG. 7).
the impeller being positioned in a recess on the underside of the chassis and the stator being positioned on the upper side of the chassis and isolated from the cooling liquid;	Cheon discloses exactly this limitation. Cheon's impeller 82 (FIG. 5) is positioned in a recess formed by the fluid guide 90 (FIG. 5) on the underside of the casing 50. The corresponding stator, or coil 94, is positioned on the upper side of the chassis 50 and is isolated from the cooling liquid (e.g., inside the casing 50). Cheon's impeller 100 (FIG. 7) is positioned in a recess formed by the fluid guide 116 (FIG. 7) on the underside of the casing. The corresponding stator coil and core 108 is positioned on the underside of the chassis 50 and is isolated from the cooling liquid (e.g., inside the casing 50).

a reservoir adapted to pass the cooling liquid therethrough, the reservoir including: **<u>Construction of "reservoir"</u>**: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." ['764 Patent, 10:45-49.] Applicant purports that a "reservoir" is not a "reservoir housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and "reservoir housing").	Each of Hamman and Cheon discloses exactly this limitation. Hamman discloses a reservoir 711 adapted to house a pump assembly 712. Appendix F, Hamman, FIG. 7; 9:28-32 (stating "Assembly 712 may comprise a motor 710 disposed upon an upper surface of reservoir 711, and an impeller assembly720 which extends from the motor 710 to the bottom portion of the reservoir 711"). Cheon explains, "The reservoir has a casing, an inlet opening in the casing, and an outlet opening in the casing spaced from the inlet opening. A pump is positioned in the casing of the reservoir adjacent to the outlet opening to pump liquid coolant from the reservoir ...." Cheon, col. 1, lines 49-58. "Preferably, the interior space defined by the reservoir casing includes an upstream portion and a downstream portion. An internal divider wall substantially separates the upstream and downstream portions. The upstream portion is in communication with the inlet opening, and the downstream portion is in communication with the outlet opening. A plurality of heat-gathering fins are located in the upstream portion. The divider wall has a passage therethrough communicating the upstream portion and the downstream portion. The passage is positioned so that liquid coolant entering the interior space through the inlet opening passes through the upstream portion by and through the heat-gathering fins and then flows through the passage into the downstream portion and out the outlet opening." Cheon, col. 2, lines 2-15. Also, see Cheon's FIGS. 2 and 4. "The interior space of the reservoir 48 is divided into an upstream portion 58 in communication with the inlet opening 54 and a downstream portion 60 in communication with the outlet opening 56. An internal divider wall 62 substantially separates the two interior portions 58, 60. As can best be seen in FIG. 4, the upstream portion 58 is in the rectangular reservoir portion exterior to the computer housing 7, and the downstream portion 60 is in the cylindrical reservoir portion inside the computer housing 7." Col. 4, line 67 - Col. 5, line 8.
a pump chamber formed by the recess and including the impeller and formed below the chassis,	Hamman and Cheon disclose exactly this limitation. Hamman's reservoir 711 has a pump chamber. FIG. 7. Cheon's impeller 82 (FIG. 5) or impeller 100 (FIG. 7) is positioned within a respective fluid guide 90, 116 in the downstream portion 60.

the pump chamber being defined by at least an impeller cover having one or more passages for the cooling liquid to pass through;	Cheon discloses this limitation. Cheon explains that "The divider wall 62 has a passage 66 extending therethrough and communicating the upstream portion 58 with the downstream portion 60. The passage 66 is positioned so that liquid coolant C entering the interior space of the reservoir through the inlet opening 54 passes through the upstream portion 58 by and through the heat-gathering fins 64 and then flows through the passage 66 into the downstream portion 60 and out the outlet opening 56." Col. 5, lines 13-20. In Cheon, each respective fluid guide 90, 116 defines a corresponding opening 92, 118 for cooling liquid to pass through. For example, Cheon states "A central opening 92 in the cover and guide 90 allows coolant C that has entered the downstream portion 60 of the interior space of the reservoir 48 from the upstream portion 58 to enter the space inside the cover and guide 90 and be directed by the propeller 82 out through the outlet opening 56." Col. 6, lines 41-46. "A central opening 118 in the cover and fluid guide 116 draws coolant C into the space defined by the cover and guide 116 to efficiently direct coolant C out through the outlet opening 56, which opens through the casing 50 into the space inside the cover and guide 90." Col. 7, lines 11-16. Thus, Each respective fluid guide 90, 116 defines a corresponding opening 92, 118 for cooling liquid to pass through.

a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber,	Cheon discloses exactly this limitation. Cheon's upstream portion 58 defines a thermal exchange chamber formed below the downstream portion 60 and the interior portion of either fluid guide 90, 116. The upstream portion 58 is vertically spaced from the downstream portion 60 and the interior of either fluid guide 90, 116. Appendix G, Cheon, FIGS. 2, 4, 5, 7.
Construction of "vertically" Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertically" is taken to mean "in a direction parallel to a rotational axis of the impeller."	In Cheon, "The internal structure of the reservoir 48 can be seen in FIGS. 2, 4, and 5. The reservoir 48 has an inlet opening 54 and an outlet opening 56 extending through the casing 50 at spaced-apart locations. As can be seen by a comparison of FIGS. 4 and 5, the orientation of the outlet opening 56 may be varied. The interior space of the reservoir 48 is divided into an upstream portion 58 in communication with the inlet opening 54 and a downstream portion 60 in communication with the outlet opening 56. An internal divider wall 62 substantially separates the two interior portions 58, 60. As can best be seen in FIG. 4, the upstream portion 58 is in the rectangular reservoir portion exterior to the computer housing 7, and the downstream portion 60 is in the cylindrical reservoir portion inside the computer housing 7. A plurality of spaced-apart heat-gathering fins 64 extend inwardly toward the computer housing from the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46. The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 4:62-5:13.

the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages; and Construction of "coupled" The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	Cheon discloses exactly this limitation. Cheon's upstream portion 58 defines a thermal exchange chamber separate from and fluidly coupled to the downstream portion 60 and the interior portion of either fluid guide 90, 116. Cheon's divider wall 62 defines a passage 66 thermally coupling the upstream portion with the downstream portion and the interior portion of either fluid guide 90, 116. As well, each respective fluid guide 90, 116 defines a corresponding opening 92, 118 for cooling liquid to pass through.
a heat-exchanging interface,	Each of Hamman and Cheon discloses exactly this limitation. In Hamman, the reservoir 711 is in contact with the processor 707 and serves as a heat transfer unit. Appendix F, Hamman, 9:57-59. Cheon states: "A plurality of spaced-apart heat-gathering fins 64 extend inwardly toward the computer housing from the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46." Appendix G, Cheon 5:8-10.

the heat-exchanging interface forming a boundary wall of the thermal exchange chamber, and	Each of Hamman and Cheon discloses exactly this limitation. Hamman's FIG. 7 shows a lower boundary of the reservoir 711 defining a heat-exchanging interface between the processor 707 and the coolant in the reservoir. Cheon's molded plastic casing 50 has an outer metal wall for providing thermal contact. Appendix G, Cheon, 4:49-51. As can best be seen in FIG. 4, the upstream portion 58 is in the rectangular reservoir portion exterior to the computer housing 7, and the downstream portion 60 is in the cylindrical reservoir portion inside the computer housing 7. A plurality of spaced-apart heat-gathering fins 64 extend inwardly toward the computer housing from the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46. The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:3-10.
configured to be placed in thermal contact with a surface of the heat-generating component; and	Hamman and Cheon disclose exactly this limitation. Cheon states "the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46." Col. 5, lines 10-11. Cheon does not explicitly disclose that the metal outer reservoir wall is placed in thermal contact with a heat-generating component. However, this missing teaching in Cheon is clearly disclosed in Hamman. In Hamman, the reservoir 711 is in contact with the processor 707 and serves as a heat transfer unit. Appendix F, Hamman, 9:57-59. Considering the common knowledge that energy in the form of heat inherently flows from relatively warmer regions to relatively cooler regions absent the addition of work, simply substituting Hamman's reservoir 711 for Cheon's reservoir to permit Cheon's reservoir and pump assembly to be placed in thermal contact with the processor 707 in Hamman would have taken no more than ordinary skill.

a heat radiator fluidly coupled to the reservoir and configured to dissipate heat from the cooling liquid.	Hamman and Cheon disclose exactly this limitation. Hamman's radiator 703 is fluidly coupled to the reservoir 711 by conduits 701 and 702, and is configured to dissipate heat from the cooling liquid. Appendix F, Hamman, 9:9-15; FIG. 7. As noted above, simply substituting Hamman's reservoir 711 for Cheon's reservoir 48 wall to permit Cheon's reservoir and pump assembly to be placed in thermal contact with Hamman's processor 707 would have taken no more than ordinary skill. With such a configuration, Hamman's radiator 703 would dissipate heat from the cooling liquid exactly as it does in Hamman's disclosed system.
2. The cooling system of claim 1, wherein the chassis shields the stator from the cooling liquid in the reservoir.	Cheon discloses exactly this limitation. As shown in Cheon's FIGS. 4-6, the wall of the chassis 50 isolates the coolant C in the reservoir 48 from the stator coil 94. Appendix G, Cheon, 6:51-53; FIGS. 4-6. As well, in another of Cheon's embodiments, the "stator coil and core 108 of the motor M-2 is located to isolate the coil and core 108 from the coolant …." Id. at 6:66-67.
3. The cooling system of claim 1,	
wherein the heat-exchanging interface includes a first side and a second side opposite the first side, and	Cheon discloses exactly this limitation. Cheon states that the "casing 50 has an outer metal wall" to provide heat exchanging contact. Appendix G, Cheon, 4:49-61. As shown in Cheon's FIG. 4, fins 64 extend inwardly of the outer metal wall.
wherein the heat-exchanging interface contacts the cooling liquid in the thermal exchange chamber on the first side and	Cheon discloses exactly this limitation. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12.
the heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component on the	Hamman and Cheon disclose exactly this limitation. As noted above, simply substituting Cheon's reservoir 48 for Hamman's reservoir 711 to permit Cheon's reservoir and pump assembly to be placed in thermal contact with Hamman's processor 707 would have taken no more than ordinary skill. The resulting system would have the heat exchanging interface

second side.	of Cheon's reservoir (e.g., the metal outer wall of the casing 50) in thermal contact with the surface of the heat-generating component on the second side, as claimed.
4. The cooling system of claim 3, wherein the first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber.	Cheon discloses exactly this limitation. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12. The fins increase heat transfer from the heat exchanging interface to the cooling liquid in the thermal exchange chamber.
5. The cooling system of claim 4, wherein the features include at least one of pins or fins.	Cheon discloses exactly this limitation. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12.
6. The cooling system of claim 1, wherein a passage of the one or more passages that fluidly couple the pump chamber and the thermal exchange chamber is offset from a center of the impeller. Construction of "coupled" The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." <u>Bradford v. ConTeyor North America, Inc.</u> 2010 U.S.	Cheon discloses exactly this limitation. Cheon's passage 66 in the divider wall 62 is offset from a center of each impeller 82 (one embodiment) and impeller 100 (alternative embodiment). Appendix G, Cheon, FIG. 4. Moreover, as shown in FIG. 2, Cheon's upstream portion 58 and downstream portion 60 are fluidly coupled to each other through other passages, e.g., passages 70, 72 and 74.

App. LEXIS 8869 (Fed. Cir., April 29, 2010).	
7. The cooling system of claim 1, wherein the impeller includes a plurality of curved blades.	Hamman and Cheon disclose exactly this limitation. Hamman's impeller assembly can include a plurality of curved blades 508 ("co-radially curved" members 508). Appendix F, Hamman, 10:5-6; FIG. 5. Using Hamman's curved blades to enhance fluidic movement (Hamman, 10:10) through Cheon's system would have been obvious.
8. The cooling system of claim 1, wherein the heat-exchanging interface includes one of copper and aluminum.	Hamman and Cheon disclose exactly this limitation. Cheon discloses that the molded plastic casing 50 has an outer metal wall to permit the casing of reservoir 48 to be placed in thermal contact with another device. Cheon, 4:49-51. Hamman discloses that the heat exchange unit 703 "may be formed or assembled from a suitable thermal [*sic:* thermally] conductive material (e.g., brass or copper)." Appendix _F, Hamman, 9:40-42. One of ordinary skill in the art would have found a heat-exchanging interface including one of copper and aluminum obvious following a review of Cheon and Hamman.
9. The cooling system of claim 1, wherein the heat radiator is fluidly coupled to the reservoir using flexible conduits, and the heat radiator is configured to be positioned remote from the reservoir.	Hamman and Cheon disclose exactly this limitation. Hamman discloses using flexible conduits to fluidly couple a remote heat radiator 703 to a reservoir 711 in thermal contact with a heat generating component 707. Appendix F, Hamman, FIG. 7; 9:12-14 ("Conduits 701 and 702 may comprise a number of suitable rigid, semi-rigid, or flexible materials (e.g., copper tubing, metallic flex tubing, or plastic tubing) depending upon desired cost and performance characteristics."). Cheon states: "It is intended to be understood that the system may be used in connection with a wide variety of computers and heat-producing components. In addition, the system may be used to cool a single component or two or more components in accordance with the needs in a particular installation.

10. A cooling system for a computer system, comprising:	Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" - choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or motivation to combine. All of these rationale apply here as detailed below. First, combining Cheon's reservoir and heat exchange surface with Hamman's reservoir to cool a processor yields predictable results. Second, simply substituting Cheon's reservoir and heat exchange assembly for Hamman's reservoir to cool a processor achieves predictable results. Third, considering the well-known fact that energy in the form of heat always flows from a region of relatively higher temperature to a region of relatively lower temperature absent the addition of work, any heat exchanger, including Cheon's reservoir and heat exchange surface, can either promote heat transfer to or heat transfer from the heat exchanger; Cheon describes transferring heat from the reservoir, leaving transferring heat to Cheon's reservoir to cool a heat generating component as the sole other alternative use of Cheon's system. Fourth, both Hamman and Cheon suggest providing a reservoir to provide an expansion volume for a coolant. Each of Hamman and Cheon disclose cooling systems for heat-generating components.
a centrifugal pump adapted to circulate a cooling liquid, the pump including:	Hamman and Cheon disclose exactly this limitation. Hamman discloses a centrifugal pump adapted to circulate a cooling liquid. Hamman's pump assembly 712 includes an impeller assembly 720 and a motor 710. Appendix F, Hamman, FIG. 7. Cheon discloses a centrifugal pump adapted to circulate a coolant C through Cheon's system. Appendix G, Cheon, 5:58-6:50; FIGS. 4, 5 and 7.
an impeller exposed to the cooling liquid; and	Hamman and Cheon disclose exactly this limitation. Hamman discloses a reservoir 711 adapted to house a pump assembly 712. Appendix F, Hamman, FIG. 7; 9:28-32 (stating "Assembly 712 may comprise a motor 710 disposed upon an upper surface of reservoir 711, and an impeller

	assembly720 which extends from the motor 710 to the bottom portion of the reservoir 711"). Cheon's impeller 82 (FIG. 5) is positioned in a recess formed by the fluid guide 90 (FIG. 5) on the underside of the casing 50, and exposed to the Coolant C. Appendix G, Cheon, 6:33-50; FIG. 4.
a stator isolated from the cooling liquid;	Cheon discloses exactly this limitation. The corresponding stator, or coil 94, is positioned on the upper side of the chassis 50 and is isolated from the cooling liquid (e.g., inside the casing 50). Appendix G, Cheon, 6:51-57; FIG. 4.
a reservoir configured to be thermally coupled to a heat-generating component of the computer system, the reservoir including: **<u>Construction of "reservoir"</u>**: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." ['764 Patent, 10:45-49.] Applicant purports that a "reservoir" is not a "reservoir housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and	Hamman and Cheon disclose exactly this limitation. Hamman discloses a reservoir 711 configured to be thermally coupled to a heat generating processor 707. In Hamman, the reservoir 711 is in contact with the processor 707 and serves as a heat transfer unit. Appendix F, Hamman, 9:57-59. Cheon's molded plastic casing 50 has an outer metal wall for providing thermal contact. Appendix G, Cheon, 4:49-51. Cheon does not explicitly disclose that the metal outer reservoir wall is placed in thermal contact with a heat-generating component. However, this missing teaching in Cheon is clearly disclosed in Hamman. Considering the common knowledge that energy in the form of heat inherently flows from relatively warmer regions to relatively cooler regions absent the addition of work, simply substituting Hamman's reservoir 711 for Cheon's reservoir to permit Cheon's reservoir and pump assembly to be placed in thermal contact with the processor 707 in Hamman would have taken no more than ordinary skill.

"reservoir housing").	
a thermal exchange chamber adapted to be positioned in thermal contact with the heat-generating component;	Cheon's upstream portion 58 defines a thermal exchange chamber adapted to be positioned in thermal contact with a thermal exchange interface. Appendix G, Cheon, FIGS. 2, 4, 5, 7. As noted, Cheon dies not expressly disclose that the heat exchange interface is a heat generating component. However, this missing teaching in Cheon is clearly disclosed in Hamman.
a separate pump chamber	Cheon's impeller 82 (FIG. 5) or impeller 100 (FIG. 7) is positioned within a respective fluid guide 90, 116 in the downstream portion 60.
vertically spaced apart from the thermal exchange chamber and Construction of "vertically" Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertically" is taken to mean "in a direction parallel to a	Cheon's thermal exchange chamber 58 is spaced apart from the pump chamber in a vertical direction. Appendix G, Cheon, FIG. 4.

rotational axis of the impeller."	
coupled with the thermal exchange chamber through one or more passages configured for fluid communication between the pump chamber and the thermal exchange chamber, and Construction of "coupled" The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	Cheon's pump chamber and thermal exchange chamber 58 are fluidly coupled together through the passage 66 and the corresponding opening 92, 118 for cooling liquid to pass through the fluid guide 90, 116, as well as by the inlet opening 54 and the outlet opening 56. Id.
wherein at least one of the one or more passages is offset from a center of the impeller.	At least each of Cheon's passages 66 and the inlet opening 54 and the outlet opening 56 is offset from a center of the impeller. Cheon, FIGS. 4, 5 and 7.
11. The cooling system of claim 10, wherein a top wall of the reservoir physically separates the impeller from the stator.	As shown in Cheon's FIGS. 4-6, the wall of the chassis 50 is positioned between the impeller 82, 100 and the stator 94, 108. Appendix G, Cheon, 6:51-53, 66-67; FIGS. 4-6.

12. The cooling system of claim 10, wherein the thermal exchange chamber includes a heat-exchange interface configured to be placed in thermal contact with the heat-generating component.	Cheon states that the "casing 50 has an outer metal wall" to provide heat exchanging contact. Appendix G, Cheon, 4:49-61. Cheon does not explicitly disclose that the metal outer reservoir wall is placed in thermal contact with a heat-generating component. However, this missing teaching in Cheon is clearly disclosed in Hamman. In Hamman, the reservoir 711 is in contact with the processor 707 and serves as a heat transfer unit. Appendix F, Hamman, 9:57-59. Considering the common knowledge that energy in the form of heat inherently flows from relatively warmer regions to relatively cooler regions absent the addition of work, simply substituting Hamman's reservoir 711 for Cheon's reservoir to permit Cheon's reservoir and pump assembly to be placed in thermal contact with the processor 707 in Hamman would have taken no more than ordinary skill.
13. The cooling system of claim 10, further including a heat radiator fluidly coupled to the reservoir using flexible conduits, wherein the heat radiator is configured to be positioned remote from the reservoir.	Hamman discloses using flexible conduits 701 and 702 to fluidly couple a remotely positioned heat radiator 703 to a reservoir 711 in thermal contact with a process 707. Appendix F, Hamman, FIG. 7; 9:12-14 ("Conduits 701 and 702 may comprise a number of suitable rigid, semi-rigid, or flexible materials (e.g., copper tubing, metallic flex tubing, or plastic tubing) depending upon desired cost and performance characteristics.").
14. The cooling system of claim 10, wherein the fluid passage that is offset from the center of the impeller is positioned tangentially to the circumference of the impeller. Construction of "tangentially to the circumference of the impeller" The Patent Owner amended FIG. 17 to include "a corrected leader lien for	Cheon's pump is a centrifugal pump having a fluid passage 56 offset from the center of the impeller 82 (FIG. 5) and impeller 100 (FIG. 7).

reference no. 34." Appendix E, Preliminary Amendment dated January 9, 2009, p. 4. As the specification explains: "An impeller 33 of the pump of the cooling system is provided in direct fluid communication with a pump chamber 46 formed by an impeller cover 46A ***having an outlet 34 provided tangentially to the circumference of the impeller 33***. Thus, the pump functions as a centrifugal pump. " Appendix A, '764 Patent, 22:26-30.	
15. A cooling system for a heat-generating component, comprising:	Each of Hamman and Cheon disclose cooling systems for heat-generating components. Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" - choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or motivation to combine. All of these rationale apply here as detailed below. First, combining Cheon's reservoir and heat exchange surface with Hamman's reservoir to cool a processor yields predictable results. Second, simply substituting Cheon's reservoir and heat exchange assembly for Hamman's reservoir to cool a processor achieves predictable results. Third, considering the well-known fact that energy in the form of heat always flows from a region of relatively higher temperature to a region of relatively lower temperature absent the addition of work, any heat exchanger, including Cheon's reservoir and heat exchange surface, can either promote heat transfer to or heat transfer from the heat

	exchanger; Cheon describes transferring heat from the reservoir, leaving transferring heat to Cheon's reservoir to cool a heat generating component as the sole other alternative use of Cheon's system. Fourth, both Hamman and Cheon suggest providing a reservoir to provide an expansion volume for a coolant.
a pump adapted to circulate a cooling liquid, the pump including:	Hamman and Cheon disclose exactly this limitation. Hamman discloses a centrifugal pump adapted to circulate a cooling liquid. Hamman's pump assembly 712 includes an impeller assembly 720 and a motor 710. Appendix F, Hamman, FIG. 7. Cheon discloses a centrifugal pump adapted to circulate a coolant C through Cheon's system. Appendix G, Cheon, 5:58-6:50; FIGS. 4, 5 and 7.
an impeller exposed to the cooling liquid; and	Each of Hamman and Cheon discloses exactly limitation. Hamman discloses a reservoir 711 adapted to house a pump assembly 712. Appendix F, Hamman, FIG. 7; 9:28-32 (stating "Assembly 712 may comprise a motor 710 disposed upon an upper surface of reservoir 711, and an impeller assembly720 which extends from the motor 710 to the bottom portion of the reservoir 711"). Cheon's pump P has an impeller 82 (FIG. 5) or an impeller 100 (FIG. 7) exposed to the coolant C. Appendix G, Cheon, FIGS. 2 and 4.
a stator isolated from the cooling liquid;	Cheon discloses exactly limitation. Cheon's pump P has a stator 94 (FIG. 5) The stator, or coil 94, is isolated from the cooling liquid inside the casing 50. In another embodiment, Cheon's pump P has a stator 108 (FIG. 7). The stator coil and core 108 is isolated from the cooling liquid inside the casing 50.
a reservoir including an impeller cover, an intermediate member and a heat exchange interface, <u>**Construction of "reservoir"**</u>: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**.	Hamman discloses a reservoir 711 having a heat exchange (e.g., where the reservoir 711 is in contact with the processor 707). Cheon discloses exactly limitation. **"Reservoir."** Reservoir 48. Appendix G, Cheon, FIG. 4. **"Impeller cover."** Each respective fluid guide 90, 116 defines a corresponding impeller cover. <u>Id.</u> at FIGS. 4, 5 and 7. **"Intermediate member."** "The divider wall 62 has a passage 66 extending therethrough and communicating the upstream portion 58 with the downstream portion 60. The passage 66 is positioned so that liquid coolant C entering the interior space of the reservoir through the inlet opening 54 passes through the

The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." ['764 Patent, 10:45-49.] Applicant purports that a "reservoir" is not a "reservoir housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and "reservoir housing").	upstream portion 58 by and through the heat-gathering fins 64 and then flows through the passage 66 into the downstream portion 60 and out the outlet opening 56." Id. at 5:13-20; FIG. 4. **"Heat exchange interface."** Cheon's molded plastic casing 50 has an outer metal wall for providing thermal contact. Appendix G, Cheon, 4:49-51. Cheon also states: "A plurality of spaced-apart heat-gathering fins 64 extend inwardly toward the computer housing from the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46." Id. at 5:8-10.
wherein a top wall of the reservoir and the impeller cover define a pump chamber for housing the impeller, and	Cheon discloses exactly limitation. In Cheon, each respective fluid guide 90, 116 defines a corresponding impeller cover, and the casing 50 forms a wall of the reservoir. Each fluid guide and the casing defines a respective pump chamber for housing the impeller of the respective pump embodiment. Appendix G, Cheon, FIGS. 4, 5 and 7.
the intermediate member and the heat exchange interface define a thermal exchange chamber,	Cheon discloses exactly limitation. In Cheon, the upstream portion 58 of Cheon's reservoir 48 defines a thermal exchange chamber between the internal divider wall 62 and the fins 64 extending inwardly from the outer metal wall of the casing 50. Appendix G, Cheon, 4:49-51; 5:3-10; FIG. 4.
the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together; and Construction of "vertical"	Cheon discloses exactly limitation. Cheon's thermal exchange chamber 58 is spaced apart from the pump chamber in a vertical direction. Appendix G, Cheon, FIG. 4. They are fluidly coupled together through the passage 66, as well as by the inlet opening 54 and the outlet opening 56. Id.

Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertical" is taken to mean "in a direction parallel to a rotational axis of the impeller." Construction of "coupled" The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	
wherein a first side of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and	Each of Hamman and Cheon discloses exactly this limitation. As shown in Hamman's FIG. 7, the cooling liquid in the reservoir 711 is in contact with the heat exchanging interface. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12.

a second side of the heat-exchanging interface opposite the first side is configured to be placed in thermal contact with a surface of the heat-generating component; and	Cheon disclose exactly this limitation. Cheon states "the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46." Col. 5, lines 10-11. Cheon does not explicitly disclose that the metal outer reservoir wall is placed in thermal contact with a heat-generating component. However, this missing teaching in Cheon is clearly disclosed in Hamman. In Hamman, the reservoir 711 is in contact with the processor 707 and serves as a heat transfer unit. Appendix F, Hamman, 9:57-59. Considering the common knowledge that energy in the form of heat inherently flows from relatively warmer regions to relatively cooler regions absent the addition of work, simply substituting Hamman's reservoir 711 for Cheon's reservoir to permit Cheon's reservoir and pump assembly to be placed in thermal contact with the processor 707 in Hamman would have taken no more than ordinary skill.
a liquid-to-air heat exchanger fluidly coupled to the reservoir using flexible conduits, the heat exchanger being configured to be positioned remote from the reservoir.	Hamman discloses exactly this limitation. Hamman discloses a liquid-to-air heat exchanger 703 fluidly coupled to the reservoir 711 using flexible conduits 701 and 702, the heat exchanger being configured to be positioned remote from the reservoir, as shown in FIG. 7. Appendix F, Hamman, FIG. 7; 9:12-14 ("Conduits 701 and 702 may comprise a number of suitable rigid, semi-rigid, or flexible materials (e.g., copper tubing, metallic flex tubing, or plastic tubing) depending upon desired cost and performance characteristics."). As noted above, simply substituting Cheon's reservoir and pump assembly for Hamman's reservoir 711 in thermal contact with Hamman's processor 707 would have taken no more than ordinary skill. With such a configuration, Hamman's liquid-to-air heat exchanger 703 would be fluidly coupled to Cheon's reservoir and pump assembly to be positioned remote from the reservoir. Moreover, Cheon states: "It is intended to be understood that the system may be used in connection with a wide variety of computers and heat-producing components. In addition, the system may be used to cool a single component or two or more components in accordance with the needs in a particular installation. Flexible conduit, as claimed, would have been obvious to one of ordinary skill in the art because it provides flexibility in positioning Hamman's radiator 703 in a wide variety of computers, as suggested by Cheon. Requester notes that

	"[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007). Thus, using a "flexible" conduit would have been obvious.
16. The cooling system of claim 15, wherein the impeller cover includes a first opening radially offset from a center of the impeller and	Cheon discloses exactly this limitation. In Cheon, the outlet opening 56 is radially offset from a center of the impeller. Appendix G, Cheon, FIG. 5.
the intermediate member includes a second passage that is aligned with the first opening,	Cheon disclose exactly this limitation. In Cheon, the wall 62 has a passage 66 aligned with the outlet opening 56. For example, both are shown on the same wall of the casing 50. Appendix G, Cheon, FIG. 5.
the first and the second opening being configured to direct the cooling liquid from the pump chamber into the thermal exchange chamber. **Construction of "second opening"** For purposes of this Request, the recited "second opening" is assumed to mean the previously recited "second passage."	To the extent that the term "second opening" can be construed for purposes of this Request, Hamman and Cheon disclose exactly this limitation. In Cheon, coolant passages from the pump chamber, through the outlet opening 56 and through the inlet opening 54 and into the thermal exchange chamber 58. Appendix G, Cheon, FIGS. 2 and 5. Coolant passes from the thermal exchange chamber 58 through the passage 66 in proportion to the amount of coolant entering through the inlet opening 54. Accordingly, Cheon discloses that the outlet opening 56 and the passage 66 "are configured" as claimed.
17. The cooling system of claim 15, wherein the first side of the heat-exchanging interface includes at least one of pins or fins.	Cheon discloses exactly this limitation. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12.

18. The cooling system of claim 15, wherein the top wall of the reservoir extends between the stator and the impeller and shields the stator from the cooling liquid in the reservoir. Construction of "reservoir" As noted above, Applicant purports that a "reservoir" is not a "reservoir housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and "reservoir housing"). Thus, claim 18 is nonsensical since a "reservoir" has no physical structure (i.e., the claimed "top wall"). Nonetheless, solely for purposes of construing claim 18 in this Request, the recited "top wall" will be construed to mean a "top wall" of a housing positioned adjacent the claimed reservoir.	Cheon discloses exactly limitation. Cheon's pump P has a stator 94 (FIG. 5) or a stator 108 (FIG. 7). Appendix G, Cheon, FIGS. 5 and 7. The casing 50 extends between each respective stator 94, 108 and the corresponding impeller 82, 100. Id. The casing 50 shields each respective stator from the cooling liquid in the reservoir 48. Id. at FIG. 4.

G. CLAIMS 1-7, 10-12 AND 14 ARE ANTICIPATED BY DUAN

As the claim chart below illustrates, Duan discloses each and every feature arranged as claimed in claims 1-7, 10-12 and 14. Thus, Duan anticipates claims 1-7, 10-12 and 14.

U.S. Patent No. 8,245,764 Claim Language	Correspondence to Duan
1. A cooling system for a heat-generating component, comprising:	Duan discloses cooling systems for heat-generating components. Appendix H, Duan, Abstract.
a double-sided chassis adapted to mount a pump configured to circulate a cooling liquid,	Duan discloses exactly this limitation. Duan discloses a liquid-cooling heat dissipation apparatus 100 having a casing defining a first compartment for assembling a pump, a cooling plate configured to be placed in thermal contact with a process, the plate positioned on the bottom of the casing, a second compartment defined between the inner space of the casing and the cooling plate containing a cooling liquid. Appendix H, Duan, Abstract; FIGS. 2 and 7 (reproduced above).
the pump comprising a stator and an impeller,	Duan discloses exactly this limitation. Duan's pump has a stator (coil stage 21) and an impeller stage 23. Id. at 62-64; FIG. 7.
the impeller being positioned in a recess on the underside of the chassis and the stator being positioned on the upper side of the chassis and isolated from the cooling liquid;	Duan discloses exactly this limitation. Duan's impeller 23 is positioned in an annular recess defined by the casing 1 on its underside. *See* Appendix H, Duan, FIGS. 2 and 7. Duan's stator coil 21 is positioned on the upper side of the casing 1 (e.g., in the first compartment 13) and is isolated from the cooling liquid filling the second compartment 14. Id. at 2:53-61.
a reservoir adapted to pass the cooling liquid therethrough, the reservoir including: **Construction of "reservoir"**: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**. The reservoir is also	Duan discloses exactly this limitation. Duan discloses a liquid-cooling heat dissipation apparatus 100 having a casing defining a first compartment for assembling a pump, a cooling plate configured to be placed in thermal contact with a process, the plate positioned on the bottom of the casing, a second compartment defined between the inner space of the casing and the cooling plate containing a cooling liquid. Appendix H, Duan, Abstract; FIGS. 2 and 7 (reproduced below for convenience). Duan's pump urges the cooling liquid through the heat dissipation apparatus 100. Duan states: "Moreover, the present invention provides a liquid-cooling heat dissipation apparatus with overall structure achieves liquid storing, circulating

intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." [‘764 Patent, 10:45-49.] Applicant purports that a “reservoir” is not a “reservoir housing.”*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between “reservoir” and “reservoir housing”).	and heat conveying function.” Appendix H, Duan, 1:57-59 (*sic*).
a pump chamber formed by the recess and including the impeller and formed below the chassis,	Duan discloses exactly this limitation. Duan’s impeller 23 is positioned in the annular recess defined by the casing 1 on its underside. *See* Appendix H, Duan, FIGS. 2 and 7. As shown in FIG. 7, an outer periphery of the casing 1 extends below the impeller, defining the recess below the casing 1 and forming the pump chamber.
the pump chamber being defined by at least an impeller cover having one or more passages for the cooling liquid to pass through;	Duan discloses exactly this limitation Duan’s casing 1 defines an impeller cover insofar as it extends over the impeller 23. *See* Appendix H, Duan, FIGS. 2 and 7. The casing has one or more passages 11, 12 for the cooling liquid to pass through.

a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber, Construction of "vertically" Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertically" is taken to mean "in a direction parallel to a rotational axis of the impeller."	Duan discloses exactly this limitation A region between Duan's cooling plate 31 and cover 24 defines a thermal exchange chamber. *See* Appendix H, Duan, FIGS. 2 and 7. The thermal exchange chamber is formed below the region occupied by the impeller 23. The region between Duan's cooling plate 31 and cover is vertically spaced apart from the region occupied by the impeller 23 by a thickness of the cover 24.

the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages; and Construction of "coupled" The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	Duan discloses exactly this limitation. As noted above, Duan discloses separate pump and thermal exchange chambers. The chambers are fluidly coupled together by the inlet 11 and outlet 12, as shown for example in FIG. 6, as well as an opening defined in the cover 24 (FIG. 7) and the runner 241 (FIGS. 7 and 8). Appendix H, Duan, 3:30-38, FIGS. 6, 7 and 8.
a heat-exchanging interface,	Duan discloses exactly this limitation. Duan's cooling plate 31 defines a heat exchanging interface between the cooling liquid in the second compartment 14 and the processor 200. Appendix H, Duan, FIG. 7.
the heat-exchanging interface forming a boundary wall of the thermal exchange chamber, and	Duan discloses exactly this limitation. Duan's cooling plate 31 forms a boundary wall of the region between the cooling plate and the cover 24. Appendix H, Duan, FIGS. 2, 3, 4 and 7.

configured to be placed in thermal contact with a surface of the heat-generating component; and	Duan discloses exactly this limitation. Duan's cooling plate 31 is configured to be placed in thermal contact with a surface of the processor 200. FIG. 7. Duan explains that a plurality of heat-dissipating fins 33 are provided atop bottom plate 31. Appendix H, Duan, 3:4-5. A plate 32 is arranged on the center of the bottom plate 31. Id. at 3:2-3. Heat conducts from the processor 200 into the bottom plate 31, spreading to the heat-dissipating fins 33. Thus, the bottom plate 31 is configured to be placed in thermal contact with a surface of a heat-generating component, as claimed.
a heat radiator fluidly coupled to the reservoir and configured to dissipate heat from the cooling liquid.	Duan discloses exactly this limitation. A radiator 20 is remotely positioned from the heat dissipation apparatus 100. Appendix H, Duan, 3:18-29; FIG. 6. The radiator 20 is configured to dissipate heat from the cooling liquid. Id.
2. The cooling system of claim 1, wherein the chassis shields the stator from the cooling liquid in the reservoir.	Duan discloses exactly this limitation. As shown in Duan's FIG. 7, the wall of the casing shields the stator coil 21 from the cooling liquid in the second compartment 14. Appendix H, Duan, FIG. 7.
3. The cooling system of claim 1,	
wherein the heat-exchanging interface includes a first side and a second side opposite the first side, and	Duan discloses exactly this limitation. Duan's bottom plate 31 has a first side and a second side opposite the first side. Appendix H, Duan, FIG. 7.
wherein the heat-exchanging interface contacts the cooling liquid in the thermal exchange chamber on the first side and	Duan discloses exactly this limitation. As shown, cooling liquid can contact the first side of the bottom plate 31 in the region between the bottom plate 31 and the cover 24. Appendix H, Duan, FIG. 7.

the heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component on the second side.	Duan discloses exactly this limitation. When assembled as shown in FIG. 7, heat conducts from the processor 200 into the second side of the bottom plate 31, spreading to the heat-dissipating fins 33 extending upwardly from the first side of the bottom plate. Thus, heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component, as claimed. Appendix H, Duan, FIG. 7.
4. The cooling system of claim 3, wherein the first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber.	Duan discloses exactly this limitation. Duan discloses a plurality of heat-dissipating fins 33 extending inwardly of the casing in the second compartment. Appendix H, Duan at 3:3; FIG. 7.
5. The cooling system of claim 4, wherein the features include at least one of pins or fins.	Duan discloses exactly this limitation. Duan discloses a plurality of heat-dissipating fins 33 extending inwardly of the casing in the second compartment. Appendix H, Duan at 3:3; FIG. 7.
6. The cooling system of claim 1, wherein a passage of the one or more passages that fluidly couple the pump chamber and the thermal exchange chamber is offset from a center of the impeller.	Duan discloses exactly this limitation. Each of the passages 11, 12 (FIG. 7) and 241 (FIG. 8), which couple the pump chamber and the thermal exchange chamber to each other (FIG. 6), is offset from a center of the impeller 23. Appendix H, Duan, 3:38; FIGS. 6, 7 and 8.

Construction of "coupled" The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	
7. The cooling system of claim 1, wherein the impeller includes a plurality of curved blades.	Duan discloses exactly this limitation. Duan's impeller 23 has a plurality of curved blades. Appendix H, Duan, FIG. 3.
10. A cooling system for a computer system, comprising:	Duan discloses cooling systems for heat-generating components. Appendix H, Duan, Abstract.
a centrifugal pump adapted to circulate a cooling liquid, the pump including:	Duan discloses exactly this limitation. Duan's pump has a stator (coil stage 21) and an impeller stage 23. Id. at 62-64; FIG. 7. Duan's pump impeller is configured to impart momentum to a cooling liquid by rotating about a central axis.
an impeller exposed to the cooling liquid; and	Duan discloses exactly this limitation. Duan's impeller 23 is positioned in an annular recess defined by the casing 1. *See* Appendix H, Duan, FIGS. 2 and 7. The annular recess forms a portion of the second compartment 14 filled with cooling liquid, and thus the impeller 23 is exposed to the cooling liquid. Id. at 2:53-61.
a stator isolated from the cooling liquid;	Duan discloses exactly this limitation. Duan's stator coil 21 is positioned on the upper side of the casing 1

	(e.g., in the first compartment 13) and is isolated from the cooling liquid filling the second compartment 14. Appendix H, Duan, 2:53-61.
a reservoir configured to be thermally coupled to a heat-generating component of the computer system, the reservoir including: **<u>Construction of "reservoir"</u>**: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." ['764 Patent, 10:45-49.] Applicant purports that a "reservoir" is not a "reservoir housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and "reservoir housing").	Duan discloses exactly this limitation. Duan discloses a liquid-cooling heat dissipation apparatus 100 having a casing defining a first compartment for assembling a pump, a cooling plate configured to be placed in thermal contact with a process, the plate positioned on the bottom of the casing, a second compartment defined between the inner space of the casing and the cooling plate containing a cooling liquid. Appendix H, Duan, Abstract; FIGS. 2 and 7 (reproduced below for convenience). Duan's pump urges the cooling liquid through the heat dissipation apparatus 100. Duan states: "Moreover, the present invention provides a liquid-cooling heat dissipation apparatus with overall structure achieves liquid storing, circulating and heat conveying function." Appendix H, Duan, 1:57-59 (*sic*). Duan's apparatus 100 is configured to be thermally coupled to a processor 200. Appendix H, Duan, Fig. 7.
a thermal exchange chamber adapted to be positioned in thermal contact with the heat-generating component;	Duan discloses exactly this limitation. A region between Duan's cooling plate 31 and cover 24 defines a thermal exchange chamber containing cooling liquid. *See* Appendix H, Duan,

	FIGS. 2 and 7. Duan's cooling plate 31 has upwardly extending heat-dissipating fins 33 to transfer heat from the processor 200 to the cooling liquid in the thermal exchange chamber. Appendix H, Duan, 3:4-5; FIG. 7.
a separate pump chamber	Duan discloses exactly this limitation. Duan's impeller 23 is positioned in the annular recess defined by the casing 1 on its underside. *See* Appendix H, Duan, FIGS. 2 and 7. The cover 24 separates Duan's pump chamber and thermal exchange chamber. Id. at FIG. 7.
vertically spaced apart from the thermal exchange chamber and Construction of "vertically" Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertically" is taken to mean "in a direction parallel to a rotational axis of the impeller."	Duan discloses exactly this limitation. Duan's pump chamber is positioned above and spaced apart from thermal exchange chamber by a thickness of the cover 24. Id. at FIG. 7.
coupled with the thermal exchange chamber through one or more passages configured for fluid communication between the	Duan discloses exactly this limitation. As noted above, Duan discloses separate pump and thermal exchange chambers. The chambers are fluidly coupled together by the inlet 11 and outlet 12, as shown for example in FIG. 6, as well as an opening defined in the

pump chamber and the thermal exchange chamber, and Construction of "coupled" The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	cover 24 (FIG. 7) and the runner 241 (FIGS. 7 and 8). Appendix H, Duan, 3:30-38, FIGS. 6, 7 and 8.
wherein at least one of the one or more passages is offset from a center of the impeller.	Duan discloses exactly this limitation. Each of the passages 11, 12 (FIG. 7) and 241 (FIG. 8), which couple the pump chamber and the thermal exchange chamber to each other (FIG. 6), is offset from a center of the impeller 23. Appendix H, Duan, 3:38; FIGS. 6, 7 and 8.
11. The cooling system of claim 10, wherein a top wall of the reservoir physically separates the impeller from the stator.	Duan discloses exactly this limitation. Duan's impeller 23 is positioned in an annular recess defined by the casing 1 on its underside. *See* Appendix H, Duan, FIGS. 2 and 7. Duan's stator coil 21 is positioned on the upper side of the casing 1 (e.g., in the first compartment 13) and is isolated from the cooling liquid filling the second compartment 14. Id. at 2:53-61.

12. The cooling system of claim 10, wherein the thermal exchange chamber includes a heat-exchange interface configured to be placed in thermal contact with the heat-generating component.	Duan discloses exactly this limitation. Duan's cooling plate 31 is configured to be placed in thermal contact with a surface of the processor 200. FIG. 7. Duan explains that a plurality of heat-dissipating fins 33 are provided atop bottom plate 31. Appendix H, Duan, 3:4-5. A plate 32 is arranged on the center of the bottom plate 31. Id. at 3:2-3. Heat conducts from the processor 200 into the bottom plate 31, spreading to the heat-dissipating fins 33. Thus, the bottom plate 31 is configured to be placed in thermal contact with a surface of a heat-generating component, as claimed.
13. The cooling system of claim 10, further including a heat radiator fluidly coupled to the reservoir using flexible conduits, wherein the heat radiator is configured to be positioned remote from the reservoir.	Duan discloses this limitation. A radiator 20 is remotely positioned from the heat dissipation apparatus 100. Appendix H, Duan, 3:18-29; FIG. 6. The radiator 20 is configured to dissipate heat from the cooling liquid. Id. Duan discloses that the heat radiator 20 is fluidly coupled to the second compartment 14 using conduits, and placing the radiator remotely from the reservoir. Appendix H, Duan, 3:18-38; FIG. 6. Thus, the only trivial limitation potentially missing from Laing is whether the disclosed conduits might be "flexible." Indeed, the Supreme Court has addressed such a "deficiency" in KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007), stating "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." One of ordinary skill in the art would have found using a flexible conduit obvious from a review of Duan so the placement of the reservoir could be flexible.
14. The cooling system of claim 10, wherein the fluid passage that is offset from the center of the impeller is positioned tangentially to the	Duan discloses exactly this limitation. Each of the passages 11, 12 (FIG. 7) and 241 (FIG. 8), which couple the pump chamber and the thermal exchange chamber to each other (FIG. 6), is

circumference of the impeller. Construction of "tangentially to the circumference of the impeller" The Patent Owner amended FIG. 17 to include "a corrected leader lien for reference no. 34." Appendix E, Preliminary Amendment dated January 9, 2009, p. 4. As the specification explains: "An impeller 33 of the pump of the cooling system is provided in direct fluid communication with a pump chamber 46 formed by an impeller cover 46A ***having an outlet 34 provided tangentially to the circumference of the impeller 33***. Thus, the pump functions as a centrifugal pump. " Appendix A, '764 Patent, 22:26-30.	offset from a center of the impeller 23. Appendix H, Duan, 3:38; FIGS. 6, 7 and 8. Moreover, at least the runner 241 is positioned tangentially to the circumference of the impeller. Appendix H, Duan, FIG. 3 (e.g., recess formed in the cover 24 is positioned circumferentially outward of the impeller and thus is tangential to the impeller, as is the gap (not numbered) in the recess).

H. Claims 8, 9, 13 and 15-18 are Obvious from Duan

Each combination of features claimed in claims 8, 9, 13 and 15-18 in the '764 Patent would have been obvious from a review of Duan to one of ordinary skill in the art at the time of the purported invention disclosed in the '764 Patent, as set forth in detail in the following claim chart:

U.S. Patent No. 8,245,764 Claim Language	Correspondence to Duan
8. The cooling system of claim 1, wherein the heat-exchanging interface includes one of copper and aluminum.	Duan discloses the cooling plate 31 has a plurality of heat-dissipating fins 33 extending inwardly of the casing in the second compartment. Appendix H, Duan at 3:3; FIG. 7. Thus, the only trivial limitation potentially missing from Duan is whether the cooling plate 31 includes copper or aluminum, well-known materials commonly used by designers of thermal devices because of their relatively high thermal conductivities (e.g., about 400 W/m-K for copper and about 200 W/m-K for aluminum, respectively). The Supreme Court has addressed such a "deficiency" in KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007), stating "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." One of ordinary skill in the art would have found using copper or aluminum in the cooling plate to be obvious.
9. The cooling system of claim 1, wherein the heat radiator is fluidly coupled to the reservoir using flexible conduits, and the heat radiator is configured to be positioned remote from the reservoir.	Duan discloses a heat radiator fluidly coupled to the second compartment 14 using conduits, and placing the radiator remotely from the reservoir. Appendix H, Duan, 3:18-38; FIG. 6. Thus, the only trivial limitation potentially missing from Laing is whether the disclosed conduits might be "flexible." Indeed, the Supreme Court has addressed such a "deficiency" in KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007), stating "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." One of ordinary skill in the art would have found using a flexible conduit obvious from a review of Duan so the placement of the reservoir could be flexible.
13. The cooling system of claim 10, further including a heat radiator fluidly coupled to the reservoir using flexible conduits, wherein	Duan discloses a heat radiator fluidly coupled to the second compartment 14 using conduits, and placing the radiator remotely from the reservoir. Appendix H, Duan, 3:18-38; FIG. 6. Thus, the only trivial limitation potentially missing from Laing is whether the disclosed conduits might be "flexible." Indeed, the Supreme Court has addressed such a "deficiency" in KSR Int'l Co. v. Teleflex

the heat radiator is configured to be positioned remote from the reservoir.	Inc., 550 U.S. 398, 421 (2007), stating "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." One of ordinary skill in the art would have found using a flexible conduit obvious from a review of Duan so the placement of the reservoir could be flexible.
15. A cooling system for a heat-generating component, comprising:	Duan discloses cooling systems for heat-generating components. Appendix H, Duan, Abstract.
a pump adapted to circulate a cooling liquid, the pump including:	Duan discloses exactly this limitation. Duan discloses a liquid-cooling heat dissipation apparatus 100 having a casing defining a first compartment for assembling a pump, a cooling plate configured to be placed in thermal contact with a processor, the plate positioned on the bottom of the casing, a second compartment defined between the inner space of the casing and the cooling plate containing a cooling liquid. Appendix H, Duan, Abstract; FIGS. 2 and 7 (reproduced above).
an impeller exposed to the cooling liquid; and	Duan discloses exactly this limitation. Duan's impeller 23 is positioned in an annular recess defined by the casing 1. *See* Appendix H, Duan, FIGS. 2 and 7. The annular recess forms a portion of the second compartment 14 filled with cooling liquid, and thus the impeller 23 is exposed to the cooling liquid. Id. at 2:53-61.
a stator isolated from the cooling liquid;	Duan discloses exactly this limitation. Duan's stator coil 21 is positioned on the upper side of the casing 1 (e.g., in the first compartment 13) and is isolated from the cooling liquid filling the second compartment 14. Id. at 2:53-61.
a reservoir including an impeller cover, an intermediate member and a heat exchange interface, **Construction of "reservoir"**: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**.	Duan discloses exactly this limitation. Duan discloses a liquid-cooling heat dissipation apparatus 100 having a casing defining a recessed region in which the impeller 23 is positioned (impeller cover). A cooling plate 31 (heat exchange interface) is configured to be placed in thermal contact with a processor; the plate positioned on the bottom of the casing. A cover 24 (intermediate member) is positioned between the bottom plate and the impeller 23. Appendix H, Duan, Abstract; FIGS. 2 and 7.

The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." ['764 Patent, 10:45-49.] Applicant purports that a "reservoir" is not a "reservoir housing." *See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and "reservoir housing").	
wherein a top wall of the reservoir and the impeller cover define a pump chamber for housing the impeller, and	Duan discloses exactly limitation. The horizontal wall of the casing 1 positioned between the stator coil 21 and the impeller 23 and the recessed region of the casing defining the impeller cover define a pump chamber for housing the impeller.
the intermediate member and the heat exchange interface define a thermal exchange chamber,	Duan discloses exactly limitation. A region between Duan's cooling plate 31 and cover 24 defines a thermal exchange chamber. *See* Appendix H, Duan, FIGS. 2 and 7.
the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together; and Construction of "vertical" Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is	Duan discloses exactly limitation. As noted above, Duan discloses vertically spaced apart pump and thermal exchange chambers. The chambers are fluidly coupled together by the inlet 11 and outlet 12, as shown for example in FIG. 6, as well as an opening defined in the cover 24 (FIG. 7) and the runner 241 (FIGS. 7 and 8). Appendix H, Duan, 3:30-38, FIGS. 6, 7 and 8.

different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertical" is taken to mean "in a direction parallel to a rotational axis of the impeller." Construction of "coupled" The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	
wherein a first side of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and	Duan discloses exactly this limitation. Duan's bottom plate 31 has a first side and a second side opposite the first side. Appendix H, Duan, FIG. 7. As shown, cooling liquid can contact the first side of the bottom plate 31 in the region between the bottom plate 31 and the cover 24. Appendix H, Duan, FIG. 7.
a second side of the heat-exchanging interface opposite the first side is configured to be placed in thermal contact with a surface of the heat-generating component; and	Duan discloses exactly this limitation. When assembled as shown in FIG. 7, heat conducts from the processor 200 into the second side of the bottom plate 31, spreading to the heat-dissipating fins 33 extending upwardly from the first side of the bottom plate. Thus, heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component, as claimed. Appendix H, Duan, FIG. 7.

a liquid-to-air heat exchanger fluidly coupled to the reservoir using flexible conduits, the heat exchanger being configured to be positioned remote from the reservoir.	Duan discloses this limitation. A radiator 20 is fluidly coupled to the heat dissipation apparatus 100 using conduits 6 and 6'. Appendix H, Duan, 3:18-29; FIG. 6. The radiator 20 would have been understood by one of ordinary skill in the art as being configured to dissipate heat from the cooling liquid to air. Id. Duan explicitly discloses that the radiator 20 is a heat exchanger for rejecting heat from the cooling liquid. Id. Thus, the only possible trivial difference is whether Duan explicitly discloses that the heat is rejected to "air" and the conduits are "flexible." Requester notes that "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007). One of ordinary skill in the art would interpret the radiator 20 shown in FIG. 6 as being a "liquid-to-air" heat exchanger, at least based on the intended application being for computers, which traditionally have been air cooled. As well, one of ordinary skill in the art would have found using a flexible conduit obvious from a review of Duan so the placement of the reservoir could be flexible. Thus, passing "air" through the radiator 20 and using "flexible" conduits would have been obvious following a review of Duan.
16. The cooling system of claim 15, wherein the impeller cover includes a first opening radially offset from a center of the impeller and	Duan discloses exactly this limitation. As noted above, Duan's casing 1 defines the recessed region in which the impeller 23 is positioned, forming an impeller cover. A first opening 11 extending through the casing 1 is radially offset from a center of the impeller. Appendix H, Duan, FIG. 7.
the intermediate member includes a second passage that is aligned with the first opening,	Duan discloses exactly this limitation. Duan's cover 24 includes a second passage (runner 241) aligned with the opening 11. Appendix H, Duan, FIGS. 7 and 8 (in the section shown in FIG. 7, the inlet 11 is aligned with the runner 241).

the first and the second opening being configured to direct the cooling liquid from the pump chamber into the thermal exchange chamber. Construction of "second opening" For purposes of this Request, the recited "second opening" is assumed to mean the previously recited "second passage."	To the extent that claim 16 can be interpreted, Duan discloses exactly this limitation. As indicated by the dashed arrows in Duan's FIG. 7, coolant flows from the pump chamber (region partially occupied by the impeller 23) into the thermal exchange chamber after passing through the inlet 11 and runner 241. Appendix H, Duan, FIG. 7. Accordingly, inlet 11 and runner 241 are configured to direct cooling liquid as claimed.
17. The cooling system of claim 15, wherein the first side of the heat-exchanging interface includes at least one of pins or fins.	Duan discloses exactly this limitation. Duan discloses a plurality of heat-dissipating fins 33 extending inwardly of the casing in the second compartment. Appendix H, Duan at 3:3; FIG. 7.
18. The cooling system of claim 15, wherein the top wall of the reservoir extends between the stator and the impeller and shields the stator from the cooling liquid in the reservoir. Construction of "reservoir" As noted above, Applicant purports that a "reservoir" is not a "reservoir housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between	Duan discloses exactly this limitation. Duan's impeller 23 is positioned in an annular recess defined by the casing 1. *See* Appendix H, Duan, FIGS. 2 and 7. Duan's stator coil 21 is positioned on the upper side of the casing 1 (e.g., in the first compartment 13) and is isolated from the cooling liquid filling the second compartment 14 by the casing. Id. at 2:53-61. Thus, Duan discloses that the top wall of the reservoir extends between the stator and the impeller, as claimed.

"reservoir" and "reservoir housing"). Thus, claim 18 is nonsensical since a "reservoir" has no physical structure (i.e., the claimed "top wall"). Nonetheless, solely for purposes of construing claim 18 in this Request, the recited "top wall" will be construed to mean a "top wall" of a housing positioned adjacent the claimed reservoir.	

I. CLAIMS 1-18 ARE OBVIOUS FROM DUAN AND CHEON

Each combination of features claimed in claims 1-18 in the '764 Patent would have been obvious to one of ordinary skill in the art from a review of Duan and Cheon at the time of the purported invention disclosed in the '764 Patent, as set forth in detail in the following claim chart:

U.S. Patent No. 8,245,764 Claim Language	Correspondence to Duan and Cheon
1. A cooling system for a heat-generating component, comprising:	Each of Duan and Cheon disclose cooling systems for heat-generating components. Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" - choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or motivation to combine. All of these rationale apply here as detailed below. First, combining Cheon's reservoir and heat exchange surface with Duan's reservoir to cool a processor

	yields predictable results. Second, simply substituting Cheon's reservoir and heat exchange assembly for Duan's reservoir to cool a processor achieves predictable results. Third, considering the well-known fact that energy in the form of heat always flows from a region of relatively higher temperature to a region of relatively lower temperature absent the addition of work, any heat exchanger, including Cheon's reservoir and heat exchange surface, can either promote heat transfer to or heat transfer from the heat exchanger; Cheon describes transferring heat from the reservoir, leaving transferring heat to Cheon's reservoir to cool a heat generating component as the sole other alternative use of Cheon's system. Fourth, Cheon suggests providing a reservoir to provide an expansion volume for a coolant.
a double-sided chassis adapted to mount a pump configured to circulate a cooling liquid,	Each of Duan and Cheon discloses exactly this limitation. Duan discloses exactly this limitation. Duan discloses a liquid-cooling heat dissipation apparatus 100 having a casing defining a first compartment for assembling a pump, a cooling plate configured to be placed in thermal contact with a process, the plate positioned on the bottom of the casing, a second compartment defined between the inner space of the casing and the cooling plate containing a cooling liquid. Appendix H, Duan, Abstract; FIGS. 2 and 7 (reproduced above). Similarly, Cheon's casing 50 has two sides and is adapted to mount the Pump P. See FIGS. 2, 4, 5 and 7; col. 5, lines 58-65 (" … The pump P is powered by a brushless motor M mounted on the casing 50. …"); and col. 6, lines 33-41 ("A dome-like rounded cover and fluid guide 90 substantially surrounds the propeller 82, magnet 84, and stem 86. The cover and guide 90 is preferably made of molded plastic and preferably is an integral part of the casing 50. The cover and guide 90 may be integrally molded with the casing 50 or, to facilitate assembly of the elements of the system, may be molded separately from the casing 50 and then integrally joined with the casing 50 and then integrally joined with the casing 50 by use of an adhesive or other bonding procedure.").
the pump comprising a stator and an impeller,	Duan and Cheon disclose exactly this limitation. Duan's pump has a stator (coil stage 21) and an impeller stage 23. <u>Id.</u> at 62-64; FIG. 7. Cheon's pump P has an impeller 82 (FIG. 5) or an impeller 100 (FIG. 7). Cheon's pump P has a stator 94 (FIG. 5) or a stator 108 (FIG. 7).

the impeller being positioned in a recess on the underside of the chassis and the stator being positioned on the upper side of the chassis and isolated from the cooling liquid;	Duan and Cheon disclose exactly this limitation. Duan's impeller 23 is positioned in an annular recess defined by the casing 1 on its underside. *See* Appendix H, Duan, FIGS. 2 and 7. Duan's stator coil 21 is positioned on the upper side of the casing 1 (e.g., in the first compartment 13) and is isolated from the cooling liquid filling the second compartment 14. Id. at 2:53-61. Cheon's impeller 82 (FIG. 5) is positioned in a recess formed by the fluid guide 90 (FIG. 5) on the underside of the casing 50. The corresponding stator, or coil 94, is positioned on the upper side of the chassis 50 and is isolated from the cooling liquid (e.g., inside the casing 50). Cheon's impeller 100 (FIG. 7) is positioned in a recess formed by the fluid guide 116 (FIG. 7) on the underside of the casing. The corresponding stator coil and core 108 is positioned on the underside of the chassis 50 and is isolated from the cooling liquid (e.g., inside the casing 50).

a reservoir adapted to pass the cooling liquid therethrough, the reservoir including: **<u>Construction of "reservoir"</u>**: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." ['764 Patent, 10:45-49.] Applicant purports that a "reservoir" is not a "reservoir housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and "reservoir housing").	Each of Duan and Cheon discloses exactly this limitation. Duan discloses a liquid-cooling heat dissipation apparatus 100 having a casing defining a first compartment for assembling a pump, a cooling plate configured to be placed in thermal contact with a process, the plate positioned on the bottom of the casing, a second compartment defined between the inner space of the casing and the cooling plate containing a cooling liquid. Appendix H, Duan, Abstract; FIGS. 2 and 7 (reproduced below for convenience). Duan's pump urges the cooling liquid through the heat dissipation apparatus 100. Duan states: "Moreover, the present invention provides a liquid-cooling heat dissipation apparatus with overall structure achieves liquid storing, circulating and heat conveying function." Appendix H, Duan, 1:57-59 (*sic*). Cheon explains, "The reservoir has a casing, an inlet opening in the casing, and an outlet opening in the casing spaced from the inlet opening. A pump is positioned in the casing of the reservoir adjacent to the outlet opening to pump liquid coolant from the reservoir ...." Cheon, col. 1, lines 49-58. "Preferably, the interior space defined by the reservoir casing includes an upstream portion and a downstream portion. An internal divider wall substantially separates the upstream and downstream portions. The upstream portion is in communication with the inlet opening, and the downstream portion is in communication with the outlet opening. A plurality of heat-gathering fins are located in the upstream portion. The divider wall has a passage therethrough communicating the upstream portion and the downstream portion. The passage is positioned so that liquid coolant entering the interior space through the inlet opening passes through the upstream portion by and through the heat-gathering fins and then flows through the passage into the downstream portion and out the outlet opening." Cheon, col. 2, lines 2-15. Also, see Cheon's FIGS. 2 and 4. "The interior space of the reservoir 48 is divided into an upstream portion 58 in communication with the inlet opening 54 and a downstream portion 60 in communication with the outlet opening 56. An internal divider wall 62 substantially separates the two interior portions 58, 60. As can best be seen in FIG. 4, the upstream portion 58 is in the rectangular reservoir portion exterior to the computer housing 7, and the downstream portion 60 is in the cylindrical reservoir portion inside the computer housing 7." Col. 4, line 67 - Col. 5, line 8.

a pump chamber formed by the recess and including the impeller and formed below the chassis,	Duan and Cheon disclose exactly this limitation. Duan's impeller 23 is positioned in the annular recess defined by the casing 1 on its underside. *See* Appendix H, Duan, FIGS. 2 and 7. As shown in FIG. 7, an outer periphery of the casing 1 extends below the impeller, defining the recess below the casing 1 and forming the pump chamber. Cheon's impeller 82 (FIG. 5) or impeller 100 (FIG. 7) is positioned within a respective fluid guide 90, 116 in the downstream portion 60.
the pump chamber being defined by at least an impeller cover having one or more passages for the cooling liquid to pass through;	Each of Duan and Cheon discloses this limitation. Duan's casing 1 defines an impeller cover insofar as it extends over the impeller 23. *See* Appendix H, Duan, FIGS. 2 and 7. The casing has one or more passages 11, 12 for the cooling liquid to pass through. Cheon explains that "The divider wall 62 has a passage 66 extending therethrough and communicating the upstream portion 58 with the downstream portion 60. The passage 66 is positioned so that liquid coolant C entering the interior space of the reservoir through the inlet opening 54 passes through the upstream portion 58 by and through the heat-gathering fins 64 and then flows through the passage 66 into the downstream portion 60 and out the outlet opening 56." Col. 5, lines 13-20. In Cheon, each respective fluid guide 90, 116 defines a corresponding opening 92, 118 for cooling liquid to pass through. For example, Cheon states "A central opening 92 in the cover and guide 90 allows coolant C that has entered the downstream portion 60 of the interior space of the reservoir 48 from the upstream portion 58 to enter the space inside the cover and guide 90 and be directed by the propeller 82 out through the outlet opening 56." Col. 6, lines 41-46. "A central opening 118 in the cover and fluid guide 116 draws coolant C into the space defined by the cover and guide 116 to efficiently direct coolant C out through the outlet opening 56, which opens through the casing 50 into the space inside the cover and guide 90." Col. 7, lines 11-16. Thus, Each respective fluid guide 90, 116 defines a corresponding opening 92, 118 for cooling liquid to pass through.

a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber,	Each of Duan and Cheon discloses exactly this limitation. A region between Duan's cooling plate 31 and cover 24 defines a thermal exchange chamber. *See* Appendix H, Duan, FIGS. 2 and 7. The thermal exchange chamber is formed below the region occupied by the impeller 23. The region between Duan's cooling plate 31 and cover is vertically spaced apart from the region occupied by the impeller 23 by a thickness of the cover 24.
Construction of "vertically" Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertically" is taken to mean "in a direction parallel to a rotational axis of the impeller."	Cheon's upstream portion 58 defines a thermal exchange chamber formed below the downstream portion 60 and the interior portion of either fluid guide 90, 116. The upstream portion 58 is vertically spaced from the downstream portion 60 and the interior of either fluid guide 90, 116. Appendix G, Cheon, FIGS. 2, 4, 5, 7. In Cheon, "The internal structure of the reservoir 48 can be seen in FIGS. 2, 4, and 5. The reservoir 48 has an inlet opening 54 and an outlet opening 56 extending through the casing 50 at spaced-apart locations. As can be seen by a comparison of FIGS. 4 and 5, the orientation of the outlet opening 56 may be varied. The interior space of the reservoir 48 is divided into an upstream portion 58 in communication with the inlet opening 54 and a downstream portion 60 in communication with the outlet opening 56. An internal divider wall 62 substantially separates the two interior portions 58, 60. As can best be seen in FIG. 4, the upstream portion 58 is in the rectangular reservoir portion exterior to the computer housing 7, and the downstream portion 60 is in the cylindrical reservoir portion inside the computer housing 7. A plurality of spaced-apart heat-gathering fins 64 extend inwardly toward the computer housing from the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46. The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 4:62-5:13.

the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages; and Construction of "coupled" The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	Each of Duan and Cheon discloses exactly this limitation. As noted above, Duan discloses separate pump and thermal exchange chambers. The chambers are fluidly coupled together by the inlet 11 and outlet 12, as shown for example in FIG. 6, as well as an opening defined in the cover 24 (FIG. 7) and the runner 241 (FIGS. 7 and 8). Appendix H, Duan, 3:30-38, FIGS. 6, 7 and 8. Cheon's upstream portion 58 defines a thermal exchange chamber separate from and fluidly coupled to the downstream portion 60 and the interior portion of either fluid guide 90, 116. Cheon's divider wall 62 defines a passage 66 thermally coupling the upstream portion with the downstream portion and the interior portion of either fluid guide 90, 116. As well, each respective fluid guide 90, 116 defines a corresponding opening 92, 118 for cooling liquid to pass through.
a heat-exchanging interface,	Each of Duan and Cheon discloses exactly this limitation. Duan's cooling plate 31 defines a heat exchanging interface between the cooling liquid in the second compartment 14 and the processor 200. Appendix H, Duan, FIG. 7. Cheon states: "A plurality of spaced-apart heat-gathering fins 64 extend inwardly toward the computer housing from the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46." Appendix G, Cheon 5:8-10.

the heat-exchanging interface forming a boundary wall of the thermal exchange chamber, and	Each of Duan and Cheon discloses exactly this limitation. Duan's cooling plate 31 forms a boundary wall of the region between the cooling plate and the cover 24. Appendix H, Duan, FIGS. 2, 3, 4 and 7. Cheon's molded plastic casing 50 has an outer metal wall for providing thermal contact. Appendix G, Cheon, 4:49-51. As can best be seen in FIG. 4, the upstream portion 58 is in the rectangular reservoir portion exterior to the computer housing 7, and the downstream portion 60 is in the cylindrical reservoir portion inside the computer housing 7. A plurality of spaced-apart heat-gathering fins 64 extend inwardly toward the computer housing from the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46. The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:3-10.
configured to be placed in thermal contact with a surface of the heat-generating component; and	Duan and Cheon disclose exactly this limitation. Duan's cooling plate 31 is configured to be placed in thermal contact with a surface of the processor 200. FIG. 7. Duan explains that a plurality of heat-dissipating fins 33 are provided atop bottom plate 31. Appendix H, Duan, 3:4-5. A plate 32 is arranged on the center of the bottom plate 31. Id. at 3:2-3. Heat conducts from the processor 200 into the bottom plate 31, spreading to the heat-dissipating fins 33. Thus, the bottom plate 31 is configured to be placed in thermal contact with a surface of a heat-generating component, as claimed. Cheon states "the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46." Col. 5, lines 10-11. Cheon does not explicitly disclose that the metal outer reservoir wall is placed in thermal contact with a heat-generating component. However, this missing teaching in Cheon is clearly disclosed in Duan, as noted above. Considering the common knowledge that energy in the form of heat inherently flows from relatively warmer regions to relatively cooler regions absent the addition of work, simply substituting Duan's reservoir device 100 for Cheon's reservoir to permit Cheon's reservoir and pump assembly to be placed in thermal contact with the processor 200 in Duan would have taken no more than ordinary skill.

a heat radiator fluidly coupled to the reservoir and configured to dissipate heat from the cooling liquid.	Duan and Cheon disclose exactly this limitation. Duan's radiator 20 is remotely positioned from the heat dissipation apparatus 100. Appendix H, Duan, 3:18-29; FIG. 6. The radiator 20 is configured to dissipate heat from the cooling liquid. Id. As noted above, simply substituting Cheon's reservoir for Duan's reservoir and pump assembly to be placed in thermal contact with Duan's processor 200 would have taken no more than ordinary skill. With such a configuration, Duan's radiator 20 would dissipate heat from the cooling liquid exactly as it does in Duan's disclosed system.
2. The cooling system of claim 1, wherein the chassis shields the stator from the cooling liquid in the reservoir.	Each of Duan and Cheon discloses exactly this limitation. As shown in Duan's FIG. 7, the wall of the casing shields the stator coil 21 from the cooling liquid in the second compartment 14. Appendix H, Duan, FIG. 7. As shown in Cheon's FIGS. 4-6, the wall of the chassis 50 isolates the coolant C in the reservoir 48 from the stator coil 94. Appendix G, Cheon, 6:51-53; FIGS. 4-6. As well, in another of Cheon's embodiments, the "stator coil and core 108 of the motor M-2 is located to isolate the coil and core 108 from the coolant …." Id. at 6:66-67.
3. The cooling system of claim 1,	
wherein the heat-exchanging interface includes a first side and a second side opposite the first side, and	Each of Duan and Cheon discloses exactly this limitation. Duan's bottom plate 31 has a first side and a second side opposite the first side. Appendix H, Duan, FIG. 7. Cheon states that the "casing 50 has an outer metal wall" to provide heat exchanging contact. Appendix G, Cheon, 4:49-61. As shown in Cheon's FIG. 4, fins 64 extend inwardly of the outer metal wall.
wherein the heat-exchanging interface contacts the cooling liquid in the thermal exchange chamber on the first side and	Each of Duan and Cheon discloses exactly this limitation. As shown in Duan, cooling liquid can contact the first side of the bottom plate 31 in the region between the bottom plate 31 and the cover 24. Appendix H, Duan, FIG. 7. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir

	interior space." Appendix G, Cheon, 5:11-12.
the heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component on the second side.	Duan and Cheon disclose exactly this limitation. Duan: When assembled as shown in FIG. 7, heat conducts from the processor 200 into the second side of the bottom plate 31, spreading to the heat-dissipating fins 33 extending upwardly from the first side of the bottom plate. Thus, heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component, as claimed. Appendix H, Duan, FIG. 7. As noted above, simply substituting Cheon's reservoir 48 for Duan's device 100 to permit Cheon's reservoir and pump assembly to be placed in thermal contact with Duan's processor 200 would have taken no more than ordinary skill. The resulting system would have the heat exchanging interface of Cheon's reservoir (e.g., the metal outer wall of the casing 50) in thermal contact with the surface of the heat-generating component on the second side, as claimed.
4. The cooling system of claim 3, wherein the first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber.	Each of Duan and Cheon discloses exactly this limitation. Duan discloses a plurality of heat-dissipating fins 33 extending inwardly of the casing in the second compartment. Appendix H, Duan at 3:3; FIG. 7. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12. The fins increase heat transfer from the heat exchanging interface to the cooling liquid in the thermal exchange chamber.
5. The cooling system of claim 4, wherein the features include at least one of pins or fins.	Each of Duan and Cheon discloses exactly this limitation. Duan discloses a plurality of heat-dissipating fins 33 extending inwardly of the casing in the second compartment. Appendix H, Duan at 3:3; FIG. 7. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12.

6. The cooling system of claim 1, wherein a passage of the one or more passages that fluidly couple the pump chamber and the thermal exchange chamber is offset from a center of the impeller. **Construction of "coupled"** The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	Each of Duan and Cheon discloses exactly this limitation. Each of the passages 11, 12 (FIG. 7) and 241 (FIG. 8), which couple the pump chamber and the thermal exchange chamber to each other (FIG. 6), is offset from a center of the impeller 23. Appendix H, Duan, 3:38; FIGS. 6, 7 and 8. Cheon's passage 66 in the divider wall 62 is offset from a center of each impeller 82 (one embodiment) and impeller 100 (alternative embodiment). Appendix G, Cheon, FIG. 4. Moreover, as shown in FIG. 2, Cheon's upstream portion 58 and downstream portion 60 are fluidly coupled to each other through other passages, e.g., passages 70, 72 and 74.
7. The cooling system of claim 1, wherein the impeller includes a plurality of curved blades.	Duan and Cheon disclose exactly this limitation. Duan's impeller 23 has a plurality of curved blades. Appendix H, Duan, FIG. 3. Using Duan's impeller with its curved blades in Cheon's system would have been an obvious substitution of one known element for another known element yielding no more than predictable results.
8. The cooling system of claim 1, wherein the heat-exchanging interface includes one of copper and aluminum.	Duan and Cheon render this limitation obvious. Cheon discloses that the molded plastic casing 50 has an outer metal wall to permit the casing of reservoir 48 to be placed in thermal contact with another device. Cheon, 4:49-51. Moreover, Duan discloses the cooling plate 31 has a plurality of heat-dissipating fins 33 extending inwardly of the casing in the second compartment. Appendix H, Duan at 3:3; FIG. 7. Thus, the only trivial limitation potentially missing from Duan and Cheon is

	whether the cooling plate 31 includes copper or aluminum, well-known materials commonly used by designers of thermal devices because of their relatively high thermal conductivities (e.g., about 400 W/m-K for copper and about 200 W/m-K for aluminum, respectively). The Supreme Court has addressed such a "deficiency" in KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007), stating "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." One of ordinary skill in the art would have found using copper or aluminum in the cooling plate to be obvious to promote efficient heat transfer through the base, particularly in view of Cheon's disclosed metal base.
9. The cooling system of claim 1, wherein the heat radiator is fluidly coupled to the reservoir using flexible conduits, and the heat radiator is configured to be positioned remote from the reservoir.	Duan and Cheon render this limitation obvious. Cheon states: "It is intended to be understood that the system may be used in connection with a wide variety of computers and heat-producing components. In addition, the system may be used to cool a single component or two or more components in accordance with the needs in a particular installation. Duan discloses a heat radiator fluidly coupled to the second compartment 14 using conduits, and placing the radiator remotely from the reservoir. Appendix H, Duan, 3:18-38; FIG. 6. Thus, the only trivial limitation potentially missing from Laing is whether the disclosed conduits might be "flexible." Indeed, the Supreme Court has addressed such a "deficiency" in KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007), stating "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." One of ordinary skill in the art would have found using a flexible conduit obvious from a review of Duan and Cheon so the placement of the reservoir could be flexible and accommodate the wide variety of computers noted in Cheon.
10. A cooling system for a computer system, comprising:	Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" - choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or

	motivation to combine. All of these rationale apply here as detailed below. First, combining Cheon's reservoir and heat exchange surface with Duan's reservoir to cool a processor yields predictable results. Second, simply substituting Cheon's reservoir and heat exchange assembly for Duan's reservoir to cool a processor achieves predictable results. Third, considering the well-known fact that energy in the form of heat always flows from a region of relatively higher temperature to a region of relatively lower temperature absent the addition of work, any heat exchanger, including Cheon's reservoir and heat exchange surface, can either promote heat transfer to or heat transfer from the heat exchanger; Cheon describes transferring heat from the reservoir, leaving transferring heat to Cheon's reservoir to cool a heat generating component as the sole other alternative use of Cheon's system. Fourth, Cheon suggests providing a reservoir to provide an expansion volume for a coolant. Each of Duan and Cheon disclose cooling systems for heat-generating components.
a centrifugal pump adapted to circulate a cooling liquid, the pump including:	Duan and Cheon disclose exactly this limitation. Duan's pump has a stator (coil stage 21) and an impeller stage 23. Id. at 62-64; FIG. 7. Duan's pump impeller is configured to impart momentum to a cooling liquid by rotating about a central axis. Cheon discloses a centrifugal pump adapted to circulate a coolant C through Cheon's system. Appendix G, Cheon, 5:58-6:50; FIGS. 4, 5 and 7.
an impeller exposed to the cooling liquid; and	Duan and Cheon disclose exactly this limitation. Duan's impeller 23 is positioned in an annular recess defined by the casing 1. *See* Appendix H, Duan, FIGS. 2 and 7. The annular recess forms a portion of the second compartment 14 filled with cooling liquid, and thus the impeller 23 is exposed to the cooling liquid. Id. at 2:53-61. Cheon's impeller 82 (FIG. 5) is positioned in a recess formed by the fluid guide 90 (FIG. 5) on the underside of the casing 50, and exposed to the Coolant C. Appendix G, Cheon, 6:33-50; FIG. 4.
a stator isolated from the cooling liquid;	Each of Duan and Cheon discloses exactly this limitation. Duan's stator coil 21 is positioned on the upper side of the casing 1 (e.g., in the first compartment 13) and is isolated from the cooling liquid filling the second compartment 14. Appendix H, Duan, 2:53-61. In Cheon, the corresponding stator, or coil 94, is positioned on the upper side

	of the chassis 50 and is isolated from the cooling liquid (e.g., inside the casing 50). Appendix G, Cheon, 6:51-57; FIG. 4.
a reservoir configured to be thermally coupled to a heat-generating component of the computer system, the reservoir including: **<u>Construction of “reservoir”</u>**: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." [‘764 Patent, 10:45-49.] Applicant purports that a “reservoir” is not a “reservoir housing.”*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between “reservoir” and “reservoir housing”).	Hamman and Cheon disclose exactly this limitation. Duan discloses a liquid-cooling heat dissipation apparatus 100 having a casing defining a first compartment for assembling a pump, a cooling plate configured to be placed in thermal contact with a process, the plate positioned on the bottom of the casing, a second compartment defined between the inner space of the casing and the cooling plate containing a cooling liquid. Appendix H, Duan, Abstract; FIGS. 2 and 7 (reproduced below for convenience). Duan’s pump urges the cooling liquid through the heat dissipation apparatus 100. Duan states: “Moreover, the present invention provides a liquid-cooling heat dissipation apparatus with overall structure achieves liquid storing, circulating and heat conveying function.” Appendix H, Duan, 1:57-59 (*sic*). Duan’s apparatus 100 is configured to be thermally coupled to a processor 200. Appendix H, Duan, Fig. 7. Cheon’s molded plastic casing 50 has an outer metal wall for providing thermal contact. Appendix G, Cheon, 4:49-51. Cheon does not explicitly disclose that the metal outer reservoir wall is placed in thermal contact with a heat-generating component. However, this missing teaching in Cheon is clearly disclosed in Duan. Considering the common knowledge that energy in the form of heat inherently flows from relatively warmer regions to relatively cooler regions absent the addition of work, simply substituting Cheon's reservoir for Duan’s device to permit Cheon's reservoir and pump assembly to be placed in thermal contact with the processor 200 in Duan would have taken no more than ordinary skill.
a thermal exchange chamber adapted to be positioned in thermal contact with the heat-generating component;	Cheon's upstream portion 58 defines a thermal exchange chamber adapted to be positioned in thermal contact with a thermal exchange interface. Appendix G, Cheon, FIGS. 2, 4, 5, 7. As noted, Cheon dies not expressly disclose that the heat exchange interface is a heat generating component. However, this missing teaching in Cheon is clearly disclosed in Duan. In Duan, a region between the cooling plate 31 and cover 24 defines a thermal exchange chamber containing cooling liquid. *See* Appendix H, Duan, FIGS. 2

	and 7. Duan's cooling plate 31 has upwardly extending heat-dissipating fins 33 to transfer heat from the processor 200 to the cooling liquid in the thermal exchange chamber. Appendix H, Duan, 3:4-5; FIG. 7.
a separate pump chamber	Each of Duan and Cheon exactly discloses this limitation. Duan's impeller 23 is positioned in the annular recess defined by the casing 1 on its underside. *See* Appendix H, Duan, FIGS. 2 and 7. The cover 24 separates Duan's pump chamber and thermal exchange chamber. Id. at FIG. 7. Cheon's impeller 82 (FIG. 5) or impeller 100 (FIG. 7) is positioned within a respective fluid guide 90, 116 in the downstream portion 60.
vertically spaced apart from the thermal exchange chamber and Construction of "vertically" Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6 , 2012, pp. 8-10 For purposes of this Request, "vertically" is taken to mean "in a direction parallel to a rotational axis of the impeller."	Each of Duan and Cheon exactly discloses this limitation. Duan's pump chamber is positioned above and spaced apart from thermal exchange chamber by a thickness of the cover 24. Id. at FIG. 7. Cheon's thermal exchange chamber 58 is spaced apart from the pump chamber in a vertical direction. Appendix G, Cheon, FIG. 4.
coupled with the thermal exchange chamber through one or more passages configured for fluid communication between the	Duan and Cheon exactly disclose this limitation. Cheon's pump chamber and thermal exchange chamber 58 are fluidly coupled together through the passage 66 and the corresponding opening 92, 118 for cooling liquid to pass through the fluid guide 90, 116, as well as by the inlet opening 54 and the outlet opening 56. Id.

pump chamber and the thermal exchange chamber, and Construction of "coupled" The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	As noted above, Duan discloses separate pump and thermal exchange chambers. The chambers are fluidly coupled together by the inlet 11 and outlet 12, as shown for example in FIG. 6, as well as an opening defined in the cover 24 (FIG. 7) and the runner 241 (FIGS. 7 and 8). Appendix H, Duan, 3:30-38, FIGS. 6, 7 and 8.
wherein at least one of the one or more passages is offset from a center of the impeller.	Duan and Cheon disclose this limitation exactly. Each of the passages 11, 12 (FIG. 7) and 241 (FIG. 8), which couple the pump chamber and the thermal exchange chamber to each other (FIG. 6), is offset from a center of the impeller 23. Appendix H, Duan, 3:38; FIGS. 6, 7 and 8. At least each of Cheon's passages 66 and the inlet opening 54 and the outlet opening 56 is offset from a center of the impeller. Cheon, FIGS. 4, 5 and 7.
11. The cooling system of claim 10, wherein a top wall of the reservoir physically separates the impeller from the stator.	Each of Duan and Cheon exactly discloses this limitation. Duan's impeller 23 is positioned in an annular recess defined by the casing 1 on its underside. *See* Appendix H, Duan, FIGS. 2 and 7. Duan's stator coil 21 is positioned on the upper side of the casing 1 (e.g., in the first compartment 13) and is isolated from the cooling liquid filling the second compartment 14. Id. at 2:53-61. As shown in Cheon's FIGS. 4-6, the wall of the chassis 50 is positioned between the impeller 82, 100 and the stator 94, 108. Appendix G, Cheon, 6:51-53, 66-67; FIGS. 4-6.

12. The cooling system of claim 10, wherein the thermal exchange chamber includes a heat-exchange interface configured to be placed in thermal contact with the heat-generating component.	Duan and Cheon exactly disclose this limitation. Duan's cooling plate 31 is configured to be placed in thermal contact with a surface of the processor 200. FIG. 7. Duan explains that a plurality of heat-dissipating fins 33 are provided atop bottom plate 31. Appendix H, Duan, 3:4-5. A plate 32 is arranged on the center of the bottom plate 31. Id. at 3:2-3. Heat conducts from the processor 200 into the bottom plate 31, spreading to the heat-dissipating fins 33. Thus, the bottom plate 31 is configured to be placed in thermal contact with a surface of a heat-generating component, as claimed. Cheon states that the "casing 50 has an outer metal wall" to provide heat exchanging contact. Appendix G, Cheon, 4:49-61. Cheon does not explicitly disclose that the metal outer reservoir wall is placed in thermal contact with a heat-generating component. However, this missing teaching in Cheon is clearly disclosed in Duan, as just explained. Considering the common knowledge that energy in the form of heat inherently flows from relatively warmer regions to relatively cooler regions absent the addition of work, simply substituting Cheon's reservoir for Duan's device 100 to permit Cheon's reservoir and pump assembly to be placed in thermal contact with the processor 200 in Duan would have taken no more than ordinary skill.
13. The cooling system of claim 10, further including a heat radiator fluidly coupled to the reservoir using flexible conduits, wherein the heat radiator is configured to be positioned remote from the reservoir.	Duan and Cheon render this limitation obvious. Cheon states: "It is intended to be understood that the system may be used in connection with a wide variety of computers and heat-producing components. In addition, the system may be used to cool a single component or two or more components in accordance with the needs in a particular installation. Duan discloses a heat radiator fluidly coupled to the second compartment 14 using conduits, and placing the radiator remotely from the reservoir. Appendix H, Duan, 3:18-38; FIG. 6. Thus, the only trivial limitation potentially missing from Laing is whether the disclosed conduits might be "flexible." Indeed, the Supreme Court has addressed such a "deficiency" in KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007), stating "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." One of ordinary skill in the art would have found using a flexible conduit obvious from a review of Duan and Cheon so the placement of the reservoir could be flexible and accommodate the wide variety of computers noted in

	Cheon.
14. The cooling system of claim 10, wherein the fluid passage that is offset from the center of the impeller is positioned tangentially to the circumference of the impeller. Construction of "tangentially to the circumference of the impeller" The Patent Owner amended FIG. 17 to include "a corrected leader lien for reference no. 34." Appendix E, Preliminary Amendment dated January 9, 2009, p. 4. As the specification explains: "An impeller 33 of the pump of the cooling system is provided in direct fluid communication with a pump chamber 46 formed by an impeller cover 46A ***having an outlet 34 provided tangentially to the circumference of the impeller 33***. Thus, the pump functions as a centrifugal pump. " Appendix A, '764 Patent, 22:26-30.	Each of Duan and Cheon exactly discloses this limitation. In Duan, each of the passages 11, 12 (FIG. 7) and 241 (FIG. 8), which couple the pump chamber and the thermal exchange chamber to each other (FIG. 6), is offset from a center of the impeller 23. Appendix H, Duan, 3:38; FIGS. 6, 7 and 8. Moreover, at least the runner 241 is positioned tangentially to the circumference of the impeller. Appendix H, Duan, FIG. 3 (e.g., recess formed in the cover 24 is positioned circumferentially outward of the impeller and thus is tangential to the impeller, as is the gap (not numbered) in the recess). Cheon's pump is a centrifugal pump having a fluid passage 56 offset from the center of the impeller 82 (FIG. 5) and impeller 100 (FIG. 7).
15. A cooling system for a heat-generating component, comprising:	Each of Duan and Cheon disclose cooling systems for heat-generating components. Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82

	USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; (III) "obvious to try" - choosing from a finite number of identified predictable solutions, with a reasonable expectation of success; or (IV) some teaching, suggestion, or motivation to combine. All of these rationale apply here as detailed below. First, combining Cheon's reservoir and heat exchange surface with Duan's reservoir to cool a processor yields predictable results. Second, simply substituting Cheon's reservoir and heat exchange assembly for Duan's reservoir to cool a processor achieves predictable results. Third, considering the well-known fact that energy in the form of heat always flows from a region of relatively higher temperature to a region of relatively lower temperature absent the addition of work, any heat exchanger, including Cheon's reservoir and heat exchange surface, can either promote heat transfer to or heat transfer from the heat exchanger; Cheon describes transferring heat from the reservoir, leaving transferring heat to Cheon's reservoir to cool a heat generating component as the sole other alternative use of Cheon's system. Fourth, both Cheon suggest providing a reservoir to provide an expansion volume for a coolant.
a pump adapted to circulate a cooling liquid, the pump including:	Each of Duan and Cheon discloses exactly this limitation. Duan discloses a liquid-cooling heat dissipation apparatus 100 having a casing defining a first compartment for assembling a pump, a cooling plate configured to be placed in thermal contact with a processor, the plate positioned on the bottom of the casing, a second compartment defined between the inner space of the casing and the cooling plate containing a cooling liquid. Appendix H, Duan, Abstract; FIGS. 2 and 7 (reproduced above). Cheon discloses a centrifugal pump adapted to circulate a coolant C through Cheon's system. Appendix G, Cheon, 5:58-6:50; FIGS. 4, 5 and 7.
an impeller exposed to the cooling liquid; and	Each of Duan and Cheon discloses exactly limitation. Duan's impeller 23 is positioned in an annular recess defined by the casing 1. *See* Appendix H, Duan, FIGS. 2 and 7. The annular recess forms a portion of the second compartment 14 filled with cooling liquid, and thus the impeller 23 is exposed to the cooling liquid. Id. at 2:53-61. Cheon's pump P has an impeller 82 (FIG. 5) or an impeller 100 (FIG. 7) exposed to the coolant C. Appendix G, Cheon, FIGS. 2 and 4.

a stator isolated from the cooling liquid;	Each of Duan and Cheon discloses exactly limitation. Duan's stator coil 21 is positioned on the upper side of the casing 1 (e.g., in the first compartment 13) and is isolated from the cooling liquid filling the second compartment 14. Id. at 2:53-61. Cheon's pump P has a stator 94 (FIG. 5) The stator, or coil 94, is isolated from the cooling liquid inside the casing 50. In another embodiment, Cheon's pump P has a stator 108 (FIG. 7). The stator coil and core 108 is isolated from the cooling liquid inside the casing 50.
a reservoir including an impeller cover, an intermediate member and a heat exchange interface, **Construction of "reservoir"**: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." ['764 Patent, 10:45-49.] Applicant purports that a "reservoir" is not a "reservoir housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and "reservoir housing").	Each of Duan and Cheon discloses exactly this limitation. Duan discloses a liquid-cooling heat dissipation apparatus 100 having a casing defining a recessed region in which the impeller 23 is positioned (impeller cover). A cooling plate 31 (heat exchange interface) is configured to be placed in thermal contact with a processor; the plate positioned on the bottom of the casing. A cover 24 (intermediate member) is positioned between the bottom plate and the impeller 23. Appendix H, Duan, Abstract; FIGS. 2 and 7. Cheon discloses exactly limitation. **"Reservoir."** Reservoir 48. Appendix G, Cheon, FIG. 4. **"Impeller cover."** Each respective fluid guide 90, 116 defines a corresponding impeller cover. Id. at FIGS. 4, 5 and 7. **"Intermediate member."** "The divider wall 62 has a passage 66 extending therethrough and communicating the upstream portion 58 with the downstream portion 60. The passage 66 is positioned so that liquid coolant C entering the interior space of the reservoir through the inlet opening 54 passes through the upstream portion 58 by and through the heat-gathering fins 64 and then flows through the passage 66 into the downstream portion 60 and out the outlet opening 56." Id. at 5:13-20; FIG. 4. **"Heat exchange interface."** Cheon's molded plastic casing 50 has an outer metal wall for providing thermal contact. Appendix G, Cheon, 4:49-51. Cheon also states: "A plurality of spaced-apart heat-gathering fins 64 extend inwardly toward the computer housing from the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46." Id. at 5:8-10.

wherein a top wall of the reservoir and the impeller cover define a pump chamber for housing the impeller, and	Each of Duan and Cheon discloses exactly this limitation. The horizontal wall of the casing 1 positioned between the stator coil 21 and the impeller 23 and the recessed region of the casing defining the impeller cover define a pump chamber for housing the impeller. In Cheon, each respective fluid guide 90, 116 defines a corresponding impeller cover, and the casing 50 forms a wall of the reservoir. Each fluid guide and the casing defines a respective pump chamber for housing the impeller of the respective pump embodiment. Appendix G, Cheon, FIGS. 4, 5 and 7.
the intermediate member and the heat exchange interface define a thermal exchange chamber,	Each of Duan and Cheon discloses exactly limitation. A region between Duan's cooling plate 31 and cover 24 defines a thermal exchange chamber. *See* Appendix H, Duan, FIGS. 2 and 7. In Cheon, the upstream portion 58 of Cheon's reservoir 48 defines a thermal exchange chamber between the internal divider wall 62 and the fins 64 extending inwardly from the outer metal wall of the casing 50. Appendix G, Cheon, 4:49-51; 5:3-10; FIG. 4.
the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together; and Construction of "vertical" Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertical" is taken to mean "in a direction parallel to a rotational axis of the	Each of Duan and Cheon discloses exactly limitation. As noted above, Duan discloses vertically spaced apart pump and thermal exchange chambers. The chambers are fluidly coupled together by the inlet 11 and outlet 12, as shown for example in FIG. 6, as well as an opening defined in the cover 24 (FIG. 7) and the runner 241 (FIGS. 7 and 8). Appendix H, Duan, 3:30-38, FIGS. 6, 7 and 8. Cheon's thermal exchange chamber 58 is spaced apart from the pump chamber in a vertical direction. Appendix G, Cheon, FIG. 4. They are fluidly coupled together through the passage 66, as well as by the inlet opening 54 and the outlet opening 56. Id.

impeller." **Construction of "coupled"** The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	
wherein a first side of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and	Each of Duan and Cheon discloses exactly this limitation. Duan's bottom plate 31 has a first side and a second side opposite the first side. Appendix H, Duan, FIG. 7. As shown, cooling liquid can contact the first side of the bottom plate 31 in the region between the bottom plate 31 and the cover 24. Appendix H, Duan, FIG. 7. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12.
a second side of the heat-exchanging interface opposite the first side is configured to be placed in thermal contact with a surface of the heat-generating component; and	Duan and Cheon disclose exactly this limitation. When assembled as shown in FIG. 7, heat conducts from the processor 200 into the second side of the bottom plate 31, spreading to the heat-dissipating fins 33 extending upwardly from the first side of the bottom plate. Thus, heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component, as claimed. Appendix H, Duan, FIG. 7. Cheon states "the metal outer reservoir wall that interfaces with the Peltier effect cooling module 46." Col. 5, lines 10-11. Cheon does not explicitly disclose that the metal outer reservoir wall is placed in thermal contact with a heat-generating component. However, this missing teaching in Cheon is clearly disclosed in Duan, as noted. Considering the common knowledge that energy in the form of heat inherently flows from relatively warmer regions to relatively cooler regions absent the addition of work, simply substituting Cheon's reservoir to permit Cheon's

	reservoir for Duan's and pump assembly to be placed in thermal contact with the processor 20 in Duan would have taken no more than ordinary skill.
a liquid-to-air heat exchanger fluidly coupled to the reservoir using flexible conduits, the heat exchanger being configured to be positioned remote from the reservoir.	Duan discloses exactly this limitation, and the combination of Duan and Cheon renders this limitation obvious. Cheon states: "It is intended to be understood that the system may be used in connection with a wide variety of computers and heat-producing components. In addition, the system may be used to cool a single component or two or more components in accordance with the needs in a particular installation. Duan discloses a heat radiator fluidly coupled to the second compartment 14 using conduits, and placing the radiator remotely from the reservoir. Appendix H, Duan, 3:18-38; FIG. 6. Thus, the only trivial limitation potentially missing from Laing is whether the disclosed conduits might be "flexible." Indeed, the Supreme Court has addressed such a "deficiency" in KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007), stating "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." One of ordinary skill in the art would have found using a flexible conduit obvious from a review of Duan and Cheon so the placement of the reservoir could be flexible and accommodate the wide variety of computers noted in Cheon.
16. The cooling system of claim 15, wherein the impeller cover includes a first opening radially offset from a center of the impeller and	Each of Duan and Cheon discloses exactly this limitation. As noted above, Duan's casing 1 defines the recessed region in which the impeller 23 is positioned, forming an impeller cover. A first opening 11 extending through the casing 1 is radially offset from a center of the impeller. Appendix H, Duan, FIG. 7. In Cheon, the outlet opening 56 is radially offset from a center of the impeller. Appendix G, Cheon, FIG. 5.
the intermediate member includes a second passage that is aligned with the first opening,	Each of Duan and Cheon discloses exactly this limitation. Duan's cover 24 includes a second passage (runner 241) aligned with the opening 11. Appendix H, Duan, FIGS. 7 and 8 (in the section shown in FIG. 7, the inlet 11 is aligned with the runner 241). In Cheon, the wall 62 has a passage 66 aligned with the outlet opening 56. For example, both are shown on the same wall of the casing 50. Appendix G, Cheon, FIG. 5.

the first and the second opening being configured to direct the cooling liquid from the pump chamber into the thermal exchange chamber. Construction of "second opening" For purposes of this Request, the recited "second opening" is assumed to mean the previously recited "second passage."	To the extent that the term "second opening" can be construed for purposes of this Request, Duan and Cheon disclose exactly this limitation. As indicated by the dashed arrows in Duan's FIG. 7, coolant flows from the pump chamber (region partially occupied by the impeller 23) into the thermal exchange chamber after passing through the inlet 11 and runner 241. Appendix H, Duan, FIG. 7. Accordingly, inlet 11 and runner 241 are configured to direct cooling liquid as claimed. In Cheon, coolant passages from the pump chamber, through the outlet opening 56 and through the inlet opening 54 and into the thermal exchange chamber 58. Appendix G, Cheon, FIGS. 2 and 5. Coolant passes from the thermal exchange chamber 58 through the passage 66 in proportion to the amount of coolant entering through the inlet opening 54. Accordingly, Cheon discloses that the outlet opening 56 and the passage 66 "are configured" as claimed.
17. The cooling system of claim 15, wherein the first side of the heat-exchanging interface includes at least one of pins or fins.	Each of Duan and Cheon discloses exactly this limitation. Duan discloses a plurality of heat-dissipating fins 33 extending inwardly of the casing in the second compartment. Appendix H, Duan at 3:3; FIG. 7. Cheon states: The fins 64 extend into the upstream portion 58 of the reservoir interior space." Appendix G, Cheon, 5:11-12.
18. The cooling system of claim 15, wherein the top wall of the reservoir extends between the stator and the impeller and shields the stator from the cooling liquid in the reservoir.	Each of Duan and Cheon discloses exactly limitation. Duan's impeller 23 is positioned in an annular recess defined by the casing 1. *See* Appendix H, Duan, FIGS. 2 and 7. Duan's stator coil 21 is positioned on the upper side of the casing 1 (e.g., in the first compartment 13) and is isolated from the cooling liquid filling the second compartment 14 by the casing. Id. at 2:53-61. Thus, Duan discloses that the top wall of the reservoir extends between the stator and the impeller, as claimed. Cheon's pump P has a stator 94 (FIG. 5) or a stator 108 (FIG. 7). Appendix G, Cheon, FIGS. 5 and 7. The casing 50 extends between each respective stator 94, 108 and the corresponding impeller 82, 100. Id. The casing 50 shields each respective stator from the cooling liquid in the reservoir 48. Id. at FIG. 4.

J. CLAIMS 8, 9, 13 AND 15-18 ARE OBVIOUS FROM DUAN AND HAMMAN

Each combination of features claimed in claims 8, 9, 13 and 15-18 in the '764 in the '764 Patent would have been obvious to one of ordinary skill in the art from a review of Duan at the time of the purported invention disclosed in the '764 Patent, as set forth in detail in the following claim chart:

U.S. Patent No. 8,245,764 Claim Language	Correspondence to Duan and Hamman
8. The cooling system of claim 1, wherein the heat-exchanging interface includes one of copper and aluminum.	Duan discloses the cooling plate 31 has a plurality of heat-dissipating fins 33 extending inwardly of the casing in the second compartment for improving heat transfer. Appendix H, Duan at 3:3; FIG. 7. Thus, the only trivial limitation potentially missing from Duan is whether the cooling plate 31 includes copper or aluminum, well-known materials commonly used by designers of thermal devices because of their relatively high thermal conductivities (e.g., about 400 W/m-K for copper and about 200 W/m-K for aluminum, respectively). Hamman discloses that the heat exchange unit 703 "may be formed or assembled from a suitable thermal [*sic:* thermally] conductive material (e.g., brass or copper)." Appendix F, Hamman, 9:40-42. The Supreme Court has addressed such a "deficiency" in KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007), stating "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." One of ordinary skill in the art would have found using copper or aluminum in the cooling plate to be obvious, particularly in view of the disclosure in Hamman. First, combining Duan's cooling plate with copper or aluminum as disclosed in Hamman to cool a processor yields predictable results. Second, simply substituting copper or aluminum for the material of Duan's cooling plate to cool a processor achieves predictable results. Third, copper and aluminum are two common materials used in electronics cooling applications, so it would have been obvious to try one or both of them. Fourth, Hamman suggests using copper to form a heat exchange unit.

9. The cooling system of claim 1, wherein the heat radiator is fluidly coupled to the reservoir using flexible conduits, and the heat radiator is configured to be positioned remote from the reservoir.	Duan discloses a heat radiator fluidly coupled to the second compartment 14 using conduits, and placing the radiator remotely from the reservoir. Appendix H, Duan, 3:18-38; FIG. 6. Thus, the only trivial limitation potentially missing from Duan is whether the disclosed conduits might be "flexible." Indeed, the Supreme Court has addressed such a "deficiency" in KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007), stating "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." One of ordinary skill in the art would have found using a flexible conduit obvious from a review of Duan so the placement of the reservoir could be flexible. In any event, Hamman discloses using flexible conduits to fluidly couple a remote heat radiator 703 to a reservoir 711 in thermal contact with a heat generating component 707. Appendix F, Hamman, FIG. 7; 9:12-14 ("Conduits 701 and 702 may comprise a number of suitable rigid, semi-rigid, or flexible materials (e.g., copper tubing, metallic flex tubing, or plastic tubing) depending upon desired cost and performance characteristics."). Thus, it would have been obvious to one of ordinary skill in the art to fluidly couple a heat radiator and reservoir using flexible conduits as claimed.
15. A cooling system for a heat-generating component, comprising:	Duan and Hamman disclose cooling systems for heat-generating components. Appendix H, Duan, Abstract. Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; or (III) some teaching, suggestion, or motivation to combine. All of these rationale apply here as detailed below. First, combining Duan's reservoir with Hamman's flexible conduits, copper plate, liquid-to-air heat exchanger, or a combination thereof, to cool a processor yields predictable results. Second, simply substituting Duan's reservoir and heat exchange assembly for Hamman's reservoir to cool a processor achieves predictable results. Third, Hamman suggests using flexible conduits, copper, liquid-to-air heat exchangers, and combinations thereof.

a pump adapted to circulate a cooling liquid, the pump including:	Duan discloses exactly this limitation. Duan discloses a liquid-cooling heat dissipation apparatus 100 having a casing defining a first compartment for assembling a pump, a cooling plate configured to be placed in thermal contact with a processor, the plate positioned on the bottom of the casing, a second compartment defined between the inner space of the casing and the cooling plate containing a cooling liquid. Appendix H, Duan, Abstract; FIGS. 2 and 7 (reproduced above).
an impeller exposed to the cooling liquid; and	Duan discloses exactly this limitation. Duan's impeller 23 is positioned in an annular recess defined by the casing 1. *See* Appendix H, Duan, FIGS. 2 and 7. The annular recess forms a portion of the second compartment 14 filled with cooling liquid, and thus the impeller 23 is exposed to the cooling liquid. Id. at 2:53-61.
a stator isolated from the cooling liquid;	Duan discloses exactly this limitation. Duan's stator coil 21 is positioned on the upper side of the casing 1 (e.g., in the first compartment 13) and is isolated from the cooling liquid filling the second compartment 14. Id. at 2:53-61.
a reservoir including an impeller cover, an intermediate member and a heat exchange interface, **Construction of "reservoir"**: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." ['764 Patent, 10:45-49.] Applicant purports that a "reservoir" is not a	Duan discloses exactly this limitation. Duan discloses a liquid-cooling heat dissipation apparatus 100 having a casing defining a recessed region in which the impeller 23 is positioned (impeller cover). A cooling plate 31 (heat exchange interface) is configured to be placed in thermal contact with a processor; the plate positioned on the bottom of the casing. A cover 24 (intermediate member) is positioned between the bottom plate and the impeller 23. Appendix H, Duan, Abstract; FIGS. 2 and 7.

"reservoir housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and "reservoir housing").	
wherein a top wall of the reservoir and the impeller cover define a pump chamber for housing the impeller, and	Duan discloses exactly limitation. The horizontal wall of the casing 1 positioned between the stator coil 21 and the impeller 23 and the recessed region of the casing defining the impeller cover define a pump chamber for housing the impeller.
the intermediate member and the heat exchange interface define a thermal exchange chamber,	Duan discloses exactly limitation. A region between Duan's cooling plate 31 and cover 24 defines a thermal exchange chamber. *See* Appendix H, Duan, FIGS. 2 and 7.
the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together; and Construction of "vertical" Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertical" is taken to mean "in a direction parallel to a rotational axis of the	Duan discloses exactly limitation. As noted above, Duan discloses vertically spaced apart pump and thermal exchange chambers. The chambers are fluidly coupled together by the inlet 11 and outlet 12, as shown for example in FIG. 6, as well as an opening defined in the cover 24 (FIG. 7) and the runner 241 (FIGS. 7 and 8). Appendix H, Duan, 3:30-38, FIGS. 6, 7 and 8.

impeller." Construction of "coupled" The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	
wherein a first side of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and	Duan discloses exactly this limitation. Duan's bottom plate 31 has a first side and a second side opposite the first side. Appendix H, Duan, FIG. 7. As shown, cooling liquid can contact the first side of the bottom plate 31 in the region between the bottom plate 31 and the cover 24. Appendix H, Duan, FIG. 7.
a second side of the heat-exchanging interface opposite the first side is configured to be placed in thermal contact with a surface of the heat-generating component; and	Duan discloses exactly this limitation. When assembled as shown in FIG. 7, heat conducts from the processor 200 into the second side of the bottom plate 31, spreading to the heat-dissipating fins 33 extending upwardly from the first side of the bottom plate. Thus, heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component, as claimed. Appendix H, Duan, FIG. 7.
a liquid-to-air heat exchanger fluidly coupled to the reservoir using flexible conduits, the heat exchanger being configured to be positioned remote from the reservoir.	Duan discloses this limitation. A radiator 20 is fluidly coupled to the heat dissipation apparatus 100 using conduits 6 and 6'. Appendix H, Duan, 3:18-29; FIG. 6. The radiator 20 would have been understood by one of ordinary skill in the art as being configured to dissipate heat from the cooling liquid to air. Id. Duan explicitly discloses that the radiator 20 is a heat exchanger for rejecting heat from the cooling liquid. Id. Thus, the only possible trivial difference is whether Duan explicitly discloses

	that the heat is rejected to "air" and the conduits are "flexible." Requester notes that "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton." KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 421 (2007). One of ordinary skill in the art would interpret the radiator 20 shown in FIG. 6 as being a "liquid-to-air" heat exchanger, at least based on the intended application being for computers, which traditionally have been air cooled. As well, one of ordinary skill in the art would have found using a flexible conduit obvious from a review of Duan so the placement of the reservoir could be flexible. Thus, passing "air" through the radiator 20 and using "flexible" conduits would have been obvious following a review of Duan. In any event, Hamman discloses using flexible conduits to fluidly couple a remote heat radiator 703 to a reservoir 711 in thermal contact with a heat generating component 707. Appendix F, Hamman, FIG. 7; 9:12-14 ("Conduits 701 and 702 may comprise a number of suitable rigid, semi-rigid, or flexible materials (e.g., copper tubing, metallic flex tubing, or plastic tubing) depending upon desired cost and performance characteristics."). Thus, it would have been obvious to one of ordinary skill in the art to fluidly couple a heat radiator and reservoir using flexible conduits as claimed. Moreover Hamman discloses a liquid-to-air heat exchanger 703 fluidly coupled to the reservoir 711 using flexible conduits 701 and 702, the heat exchanger being configured to be positioned remote from the reservoir, as shown in FIG. 7 and claimed in claim 15 of the '764 Patent. Appendix F, Hamman, FIG. 7; 9:12-14 ("Conduits 701 and 702 may comprise a number of suitable rigid, semi-rigid, or flexible materials (e.g., copper tubing, metallic flex tubing, or plastic tubing) depending upon desired cost and performance characteristics.").
16. The cooling system of claim 15, wherein the impeller cover includes a first opening radially offset from a center of the impeller and	Duan discloses exactly this limitation. As noted above, Duan's casing 1 defines the recessed region in which the impeller 23 is positioned, forming an impeller cover. A first opening 11 extending through the casing 1 is radially offset from a center of the impeller. Appendix H, Duan, FIG. 7.

the intermediate member includes a second passage that is aligned with the first opening,	Duan discloses exactly this limitation. Duan's cover 24 includes a second passage (runner 241) aligned with the opening 11. Appendix H, Duan, FIGS. 7 and 8 (in the section shown in FIG. 7, the inlet 11 is aligned with the runner 241).
the first and the second opening being configured to direct the cooling liquid from the pump chamber into the thermal exchange chamber. Construction of "second opening" For purposes of this Request, the recited "second opening" is assumed to mean the previously recited "second passage."	To the extent that claim 16 can be interpreted (e.g., the recited "second opening"), Duan discloses exactly this limitation. As indicated by the dashed arrows in Duan's FIG. 7, coolant flows from the pump chamber (region partially occupied by the impeller 23) into the thermal exchange chamber after passing through the inlet 11 and runner 241. Appendix H, Duan, FIG. 7. Accordingly, inlet 11 and runner 241 are configured to direct cooling liquid as claimed.
17. The cooling system of claim 15, wherein the first side of the heat-exchanging interface includes at least one of pins or fins.	Duan discloses exactly this limitation. Duan discloses a plurality of heat-dissipating fins 33 extending inwardly of the casing in the second compartment. Appendix H, Duan at 3:3; FIG. 7.
18. The cooling system of claim 15, wherein the top wall of the reservoir extends between the stator and the impeller and shields the stator from the cooling liquid in the reservoir. Construction of "reservoir" As noted above, Applicant purports that a "reservoir" is not a "reservoir	Duan discloses exactly this limitation. Duan's impeller 23 is positioned in an annular recess defined by the casing 1. *See* Appendix H, Duan, FIGS. 2 and 7. Duan's stator coil 21 is positioned on the upper side of the casing 1 (e.g., in the first compartment 13) and is isolated from the cooling liquid filling the second compartment 14 by the casing. Id. at 2:53-61. Thus, Duan discloses that the top wall of the reservoir extends between the stator and the impeller, as claimed.

housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and "reservoir housing"). Thus, claim 18 is nonsensical since a "reservoir" has no physical structure (i.e., the claimed "top wall"). Nonetheless, solely for purposes of construing claim 18 in this Request, the recited "top wall" will be construed to mean a "top wall" of a housing positioned adjacent the claimed reservoir.	

K. CLAIMS 1-18 ARE ANTICIPATED BY KOGA

As the claim chart below illustrates, Koga discloses each and every feature arranged as claimed in claims 1-18 in the '764 Patent. Thus, Koga anticipates claims 1-18.

U.S. Patent No. 8,245,764 Claim Language	Correspondence to Koga
1. A cooling system for a heat-generating component, comprising:	Koga discloses exactly this type of system. *See*, Appendix I, Koga, FIG. 1; Specification, 8:32-39.

a double-sided chassis adapted to mount a pump configured to circulate a cooling liquid,	Koga discloses exactly this limitation. Koga's casing 15 and 16 is a double-sided chassis adapted to mount a pump 1A. *See* Koga, FIG. 7. The pump 1A is configured to circulate a coolant. Id. at 9:52-54; 10:18-21.
the pump comprising a stator and an impeller,	Koga discloses exactly this limitation. Koga's pump 1A has a stator 14 and an impeller 11. Id. at 9:48-52; FIG. 7.
the impeller being positioned in a recess on the underside of the chassis and the stator being positioned on the upper side of the chassis and isolated from the cooling liquid;	Koga discloses exactly this limitation. Koga's impeller 1 (FIG. 7) is positioned in a recess formed by the casing 16 (FIG. 7) on the underside of the casing. The corresponding stator 14, is positioned on the upper side of the casing 16 and is isolated from the coolant in the "pump room 15A".

a reservoir adapted to pass the cooling liquid therethrough, the reservoir including: **<u>Construction of "reservoir"</u>**: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." ['764 Patent, 10:45-49.] Applicant purports that a "reservoir" is not a "reservoir housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and "reservoir housing").	Koga discloses exactly this limitation. Koga's device 1A is adapted to pass the coolant 41 therethrough. <u>Id.</u> at 9:52-54; FIG. 7.
a pump chamber formed by the recess and including the impeller and formed below the chassis,	Koga discloses exactly this limitation. Koga's impeller 11, 13 (FIG. 7) is positioned in a recess formed by the casing 16 (FIG. 7) on the underside of the casing. The corresponding stator 14, is positioned on the upper side of the casing 16 and is isolated from the coolant in the "pump room 15A".

the pump chamber being defined by at least an impeller cover having one or more passages for the cooling liquid to pass through;	Koga discloses exactly this limitation. Koga's pump chamber 15A is defined by at least the casings 15 and 16, forming an impeller cover as claimed. The casings define "sucking channel" 19 and discharge channel 20 for the cooling liquid to pass through. Id.
a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber, **Construction of "vertically"** Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertically" is taken to mean "in a direction parallel to a rotational axis of the impeller."	Koga discloses exactly this limitation. An interior of the channel 19 defines a thermal exchange chamber as claimed. *See* Koga, Specification, 10:5-6; FIG. 7. The interior of the channel 19 is formed below the region occupied by the impeller 11 and is vertically spaced apart from that region. Id.

the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages; and **Construction of "coupled"** The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	Koga discloses exactly this limitation. As shown in FIG. 7, the region occupied by Koga's impeller11 is separated from the interior of the channel 19 by the upper wall of the channel 19. Koga's pump chamber 15A and thermal exchange chamber are fluidly coupled by the channels 19 and 20 (e.g., via the radiator 3). For example, the discharge channel 20 also fluidly couples the thermal exchange chamber (channel 19) and the pump chamber 15A insofar as coolant circulates from the pump chamber, through the channel 20, through the radiator 3 (FIG. 1) and returns to the thermal exchange chamber in the channel 19.
a heat-exchanging interface,	Koga discloses exactly this limitation. Koga's the lower portion of the casing 15 defines a heat-exchanging interface as claimed (e.g., the outer wall surface 15C contacts an upper surface of the component 2).
the heat-exchanging interface forming a boundary wall of the thermal exchange chamber, and	Koga discloses exactly this limitation. As shown, for example, in FIG. 7, the casing 15 forms a boundary wall of the thermal exchange chamber 19.
configured to be placed in thermal contact with a surface of the heat-generating component; and	Koga discloses exactly this limitation. The outer wall surface 15C of the casing 15 is configured to be placed in thermal contact with an upper surface of the component 2.

a heat radiator fluidly coupled to the reservoir and configured to dissipate heat from the cooling liquid.	Koga discloses exactly this limitation. As shown in FIG. 1, Koga's system includes a heat radiator 3 fluidly coupled to the reservoir 1A and configured to dissipate heat from the coolant 41. *See*, Appendix I, Koga, Specification, 10:14-21.
2. The cooling system of claim 1, wherein the chassis shields the stator from the cooling liquid in the reservoir.	Koga discloses exactly this limitation. As shown in Koga's FIG. 7, a portion of the casing 16 is positioned between the stator 14 and the impeller 11, 13, shielding the stator 14 from coolant in the reservoir.
3. The cooling system of claim 1,	
wherein the heat-exchanging interface includes a first side and a second side opposite the first side, and	Koga discloses exactly this limitation. Koga's casing 15 has a first side (e.g., interior of channel 19) and a second side 15C opposite the first side.
wherein the heat-exchanging interface contacts the cooling liquid in the thermal exchange chamber on the first side and	Koga discloses exactly this limitation. The first side of the casing 15 contacts coolant in the channel 19.
the heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component on the second side.	Koga discloses exactly this limitation. Koga's outer wall surface 15C is configured to be in thermal contact with the component 2, as shown in FIG. 7. *See*, Appendix I, Koga, Specification 10:5-7.
4. The cooling system of claim 3, wherein the first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-	Koga discloses exactly this limitation. Koga's inner surface of the casing 15 includes features adapted to increase heat transfer from the casing 15 to the coolant. *See*, Appendix I, Koga, FIG. 7 (protrusions 24, 24A), Specification, 9:34-39.

exchanging interface to the cooling liquid in the thermal exchange chamber.	
5. The cooling system of claim 4, wherein the features include at least one of pins or fins.	Koga discloses exactly this limitation. Koga's features 24, 24A are pins or fins. *See*, Id. at FIGS. 7 and 8.
6. The cooling system of claim 1, wherein a passage of the one or more passages that fluidly couple the pump chamber and the thermal exchange chamber is offset from a center of the impeller. **Construction of "coupled"** The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	Koga discloses exactly this limitation. As noted above, Koga's pump chamber 15A and thermal exchange chamber 19 are fluidly coupled by the opening adjacent the terminal end of the channel 19, as well as by the discharge channel 20. As shown in FIG. 8, the discharge channel 20 is offset from a center of the impeller 11, 13.
7. The cooling system of claim 1, wherein the impeller includes a plurality of curved blades.	Koga discloses exactly this limitation. Koga's impeller 11 can include a plurality of curved blades 12. Id. at FIG. 4.

8. The cooling system of claim 1, wherein the heat-exchanging interface includes one of copper and aluminum.	Koga discloses exactly this limitation. Koga's casing 15 can be formed of copper or aluminum. Id. at 5:14-18 and 10:24
9. The cooling system of claim 1, wherein the heat radiator is fluidly coupled to the reservoir using flexible conduits, and the heat radiator is configured to be positioned remote from the reservoir.	Koga discloses exactly this limitation. Koga's radiator 3 can be fluidly coupled to the reservoir 1A using flexible conduits. *See*, Appendix I, Koga, Specification, 4:23-26 (stating "[c]irculating channel 4 is formed of flexible rubber having a low gas-permeability, such as butyl rubber tubing because this material allows flexible piping layout as well as preventing bubbles from entering into the tube"). Koga's radiator 3 is also configured to be positioned remote from the reservoir 1A. Id. at 8:32-39; FIGS. 1, 9 and 10.
10. A cooling system for a computer system, comprising:	Koga discloses exactly such a system.
a centrifugal pump adapted to circulate a cooling liquid, the pump including:	Koga discloses exactly this limitation. Koga's Abstract states "… a radiator and a contact-heat-exchanger type centrifugal pump are provided."
an impeller exposed to the cooling liquid; and	Koga discloses exactly this limitation. Koga's impeller 1 (FIG. 7) is exposed to the coolant in the pump chamber 15A.
a stator isolated from the cooling liquid;	Koga discloses exactly this limitation. Koga's stator 14 is isolated from the coolant in the "pump room 15A" by the wall of the casing 16 positioned between the stator 14 and the impeller 11, 13.

a reservoir configured to be thermally coupled to a heat-generating component of the computer system, the reservoir including:	Koga discloses exactly this limitation. Koga's centrifugal pump 1A is configured to be thermally coupled to the heat generating component 2. *See*, Appendix I, Koga, Specification 10:5; FIG. 7.
a thermal exchange chamber adapted to be positioned in thermal contact with the heat-generating component;	Koga discloses exactly this limitation. Koga's channel 19 is adapted to be positioned in thermal contact with the component 2. Id. at FIG. 7.
a separate pump chamber	Koga discloses exactly this limitation. As shown in FIG. 7, the region occupied by Koga's impeller 11 (e.g., the "pump room 15A") is separated from the interior of the channel 19 by the upper wall of the channel 19.
vertically spaced apart from the thermal exchange chamber and **Construction of "vertically"** Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertically" is taken to mean	Koga discloses exactly this limitation. Koga's pump chamber 15A is vertically spaced from the channel 19.

"in a direction parallel to a rotational axis of the impeller."	
coupled with the thermal exchange chamber through one or more passages configured for fluid communication between the pump chamber and the thermal exchange chamber, and **Construction of "coupled"** The Federal Circuit construed the phrase "coupled to," directing that it "should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	Koga discloses exactly this limitation. Koga's pump chamber 15A and thermal exchange chamber 19 are fluidly coupled by the opening adjacent the terminal end of the channel 19, as well as by the discharge channel 20, allowing fluid communication between the pump chamber and thermal exchange chamber.
wherein at least one of the one or more passages is offset from a center of the impeller.	Koga discloses exactly this limitation. As shown in FIG. 7, the opening adjacent the terminal end of the channel 19, as well as the discharge channel 20, are offset from a center of the impeller.
11. The cooling system of claim 10, wherein a top wall of the reservoir physically separates the impeller from the stator.	Koga discloses exactly this limitation. Koga's stator 14 is isolated from the coolant in the "pump room 15A" by the top wall of the casing 16 positioned between the stator 14 and the impeller 11, 13.

12. The cooling system of claim 10, wherein the thermal exchange chamber includes a heat-exchange interface configured to be placed in thermal contact with the heat-generating component.	Koga discloses exactly this limitation. Koga's casing 15 thermally couples the interior of the channel 19 to the component 2. The outer wall 15C of the casing 15 is configured to be placed in thermal contact with the component 2.
13. The cooling system of claim 10, further including a heat radiator fluidly coupled to the reservoir using flexible conduits, wherein the heat radiator is configured to be positioned remote from the reservoir.	Koga discloses exactly this limitation. Koga's radiator 3 can be fluidly coupled to the reservoir 1A using flexible conduits. *See*, Appendix I, Koga, Specification, 4:23-26 (stating "[c]irculating channel 4 is formed of flexible rubber having a low gas-permeability, such as butyl rubber tubing because this material allows flexible piping layout as well as preventing bubbles from entering into the tube"). Koga's radiator 3 is also configured to be positioned remote from the reservoir 1A. Id. at 8:32-39; FIGS. 1, 9 and 10.
14. The cooling system of claim 10, wherein the fluid passage that is offset from the center of the impeller is positioned tangentially to the circumference of the impeller.	Koga discloses exactly this limitation. As noted above, Koga's pump chamber 15A and thermal exchange chamber 19 are fluidly coupled by the opening adjacent the terminal end of the channel 19, as well as by the discharge channel 20, allowing fluid communication between the pump chamber and thermal exchange chamber. The discharge channel is positioned tangentially to the circumference of the impeller 11. *See*, Appendix I, Koga, FIG. 8.
15. A cooling system for a heat-generating component, comprising:	Koga discloses exactly such a system.
a pump adapted to circulate a cooling liquid, the pump including:	Koga discloses exactly this limitation. Koga's Abstract states "… a radiator and a contact-heat-exchanger type centrifugal pump are provided."

an impeller exposed to the cooling liquid; and	Koga discloses exactly this limitation. Koga's impeller 1 (FIG. 7) is exposed to the coolant in the pump chamber 15A.
a stator isolated from the cooling liquid;	Koga discloses exactly this limitation. Koga's stator 14 is isolated from the coolant in the "pump room 15A" by the wall of the casing 16 positioned between the stator 14 and the impeller 11, 13.
a reservoir including an impeller cover, an intermediate member and a heat exchange interface, **<u>Construction of "reservoir"</u>**: "The reservoir serves as **a storage unit for excess liquid not capable of being contained in the remaining components**. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid." ['764 Patent, 10:45-49.] Applicant purports that a "reservoir" is not a "reservoir housing."*See* Appendix D, Amendment dated April 6, 2012 (amending specification to emphasize the distinction between "reservoir" and "reservoir housing").	Koga discloses exactly this limitation. Koga's reservoir 1A has casings 15 and 16, forming an impeller cover as claimed. An upper wall of the channel 19 defines an intermediate member. The lower portion of the casing defines a heat exchange interface of the reservoir 1A.
wherein a top wall of the reservoir and the impeller cover define a pump chamber for housing the	Koga discloses exactly this limitation. The casing 16 and the casing 15 define the claimed top wall of the reservoir and the impeller cover defining a pump chamber 15A for housing the impeller 11,

impeller, and	13.
the intermediate member and the heat exchange interface define a thermal exchange chamber,	Koga discloses exactly this limitation. The upper wall of the channel 19 defines the intermediate member, and the lower portion of the casing 15 defines the heat exchange interface. The channel 19 positioned between the upper wall (the claimed intermediate member) and the casing 15 (the claimed heat exchange interface) defines a thermal exchange chamber, as claimed.
the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together; and **Construction of "vertical"** Based on Patent Owner's remarks in the reply dated April 6, 2012, "vertically spaced apart" purportedly is different than "radially outwards" in a plane of the impeller. Appendix D, Applicant's Reply dated April 6, 2012, pp. 8-10. For purposes of this Request, "vertical" is taken to mean "in a direction parallel to a rotational axis of the impeller." **Construction of "coupled"** The Federal Circuit construed the phrase "coupled to," directing that it	Koga discloses exactly this limitation. The pump chamber 15A and the thermal exchange chamber 19 are spaced apart from each other in a vertical direction (e.g., the horizontal upper wall of the channel 19 separates the chambers from each other). The pump chamber 15A and the thermal exchange chamber 19 are fluidly coupled together by virtue of the opening adjacent the terminal end of the channel 19, as well as by the discharge channel 20, as noted above.

"should be construed broadly so as to allow an indirect attachment." Bradford v. ConTeyor North America, Inc. 2010 U.S. App. LEXIS 8869 (Fed. Cir., April 29, 2010).	
wherein a first side of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and	Koga discloses exactly this limitation. A first side of the casing 15 (the claimed heat-exchanging interface) is in contact with coolant 41 in the channel 19 (the claimed thermal exchange chamber), as claimed.
a second side of the heat-exchanging interface opposite the first side is configured to be placed in thermal contact with a surface of the heat-generating component; and	Koga discloses exactly this limitation. A second side of the casing 15 opposite the first side in contact with coolant 41 in the channel 19 (e.g., the outer wall surface 15C) is configured to be placed in thermal contact with the upper surface of the component 2.
a liquid-to-air heat exchanger fluidly coupled to the reservoir using flexible conduits, the heat exchanger being configured to be positioned remote from the reservoir.	Koga discloses exactly this limitation. Koga explains: "Radiator 3 radiates the heat collected from component 2 by coolant 41 to the outside." Id. at 4:9-11. Koga explains further: "A fan can be prepared for forcibly air-cooling radiator 3 so that a better cooling effect can be expected." Id. at 4:21-23. Thus, Koga's radiator 3 is a liquid-to-air heat exchanger. Koga's radiator 3 can be fluidly coupled to the reservoir 1A using flexible conduits. *See*, Appendix I, Koga, Specification, 4:23-26 (stating "[c]irculating channel 4 is formed of flexible rubber having a low gas-permeability, such as butyl rubber tubing because this material allows flexible piping layout as well as preventing bubbles from entering into the tube"). Koga's radiator 3 is also configured to be positioned remote from the reservoir 1A. Id. at 8:32-39; FIGS. 1, 9 and 10.
16. The cooling system of claim 15, wherein the impeller cover includes a	Koga discloses exactly this limitation. Koga's impeller cover 15, 16 includes an opening 20 radially offset from a

first opening radially offset from a center of the impeller and	center of the impeller 11, 13. Id. at FIG. 8.
the intermediate member includes a second passage that is aligned with the first opening,	Koga discloses exactly this limitation. Koga's intermediate member (e.g., the upper wall of the channel 19) defines an opening adjacent the terminal end of the channel 19, spaced from the shaft 17. The opening defines the claimed second passage, and is aligned with the radially offset opening 20. As Koga explains: "Coolant 41 is sucked through sucking channel 19 by spinning blades 12, and discharged from discharging channel 20." Id. at 9:4-5.
the first and the second opening being configured to direct the cooling liquid from the pump chamber into the thermal exchange chamber. **Construction of "second opening"** For purposes of this Request, the recited "second opening" is assumed to mean the previously recited "second passage."	To the extent that the term "second opening" can be construed for purposes of this Request, Koga discloses exactly this limitation. In Koga, coolant passes from the pump chamber 15A, through the opening 20 and into the thermal exchange chamber 19. Id. at FIGS. 1 and 7. Coolant passes from the pump chamber 15A in proportion to the amount of coolant entering the thermal exchange chamber 19. Accordingly, Koga discloses that the openings are configured as claimed.
17. The cooling system of claim 15, wherein the first side of the heat-exchanging interface includes at least one of pins or fins.	Koga discloses exactly this limitation. Koga's features 24, 24A are pins or fins. *See*, Id. at FIGS. 7 and 8.
18. The cooling system of claim 15, wherein the top wall of the reservoir extends between the stator and the impeller and shields the stator from the cooling	Koga discloses exactly this limitation. The casing 16 extends between the stator 14 and shields the stator 14 from the coolant in the reservoir 1A.

liquid in the reservoir.	

L. CLAIMS 1-18 ARE OBVIOUS FROM THE '761 PUBLICATION AND LAING

As the claim chart below illustrates, the Published International Application (also referred to herein as the '761 Publication) discloses each and every feature arranged as claimed in claims 1-18 in the '764 Patent. Thus, the Published International Application anticipates claims 1-18.

U.S. Patent No. 8,245,764 Claim Language	Correspondence to the '761 Publication and Laing
1. A cooling system for a heat-generating component, comprising:	The Published International Application discloses exactly such a cooling system. *See*, Appendix J, Published International Application, FIG. 17; Specification, 2:5-6, 7. Laing also discloses exactly the type of cooling system claimed in the '234 Application. Laing's title states it clearly: "Device for the Local Cooling or Heating of an Object." Laing, Title. An example of an object cooled by Laing's device is a processor positioned on a circuit board 16. Laing, ¶ [0044]. Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; or (III) some teaching, suggestion, or motivation to combine. All of these rationale apply here as detailed below. First, combining the '761 Publication's reservoir with Laing's reservoir having a pump chamber and a vertically separated thermal exchange chamber to cool a processor yields predictable results. Second, simply substituting Laing's reservoir for the '761 Publication's reservoir to cool a processor achieves predictable results. Third, Laing suggests providing a reservoir having a pump chamber and a vertically separated thermal exchange chamber to cool a processor.

a double-sided chassis adapted to mount a pump configured to circulate a cooling liquid,	The Published International Application discloses exactly this limitation. Reservoir 14 shown in FIG. 17. Id. at 1:21-24, 29:19 LAING FIG. 1 in Laing illustrates a "circulation pump 12, by means of which a fluid, such as water or other liquids, can be guided in a loop (FIG. 2) as a heat transfer medium. The heat transfer medium can be used as a cooling medium." Laing, ¶ [0044]. The wall of Laing's housing 18 constitutes a double sided chassis as claimed. "An interior space 36, in which an electric motor denoted overall by 38, is accommodated, is formed in the housing 18 of the circulation pump 12." Laing, ¶ [0052].
the pump comprising a stator and an impeller,	The Published International Application discloses exactly this limitation. Stator 37, impeller 33. Id. at FIG. 17. Laing's Stator 54, Rotor 42 are shown in FIG. 1. "[A]n impeller 46 (paddle wheel) … is connected in a rotationally fixed manner to the rotor 42 …." Laing, ¶ [0055].
the impeller being positioned in a recess on the underside of the chassis and the stator being positioned on the upper side of the chassis and isolated from the cooling liquid;	The Published International Application discloses exactly this limitation. Impeller 33 is positioned in the pump chamber 46 on underside of chassis 14. Id. The stator 37 is positioned on the upper side of the chassis and isolated from the cooling liquid. Id. LAING: In Laing, the impeller 46 is positioned in a recess on the underside of the housing 18 and the wall 72. Laing, FIG. 1. The stator 54 is positioned on the upper side of wall. Id. "Between the rotor 42 and the stator 54 there is a substantially spherical wall 72 …." Laing, ¶ [0068]. The wall 72 isolates the stator 54 from the cooling liquid in the through-flow region 66.

a reservoir adapted to pass the cooling liquid therethrough, the reservoir including:	The Published International Application discloses exactly this limitation. Id. at 29:6-25. Laing's housing 18 defines an interior space 36 constituting a chamber for holding excess liquid not capable of being contained in the remaining components. The interior space 36 is adapted to pass the cooling liquid therethrough. As Laing explains, "An interior space 36 … is formed in the housing 18 of the circulation pump 12. … A swirl chamber 44, in which a swirl is imparted to liquid which has been supplied via the feed line 20, using an impeller 46 (paddle wheel) which is connected in a rotationally fixed manner to the rotor 42, and in which swirling liquid flows, is formed in the interior space 36 of the housing 18. … The liquid is also guided past the thermal contact element 32 in order to transfer heat. … The swirl chamber 44 is formed in the interior space 36 between walls 48 …." Laing, ¶¶ [0052]-[0056]. In Laing, the interior space 36 constitutes a chamber for holding excess liquid not capable of being contained in the remaining components. "In particular, it is provided that the circulation pump has a housing part which is formed flexibly and/or is movable, and in particular is disposed movably on the housing, in such a manner that it is possible to exert a positive pressure on the system. … By way of example, the housing part may be a flexible plate, a flexible diaphragm or a bellows." Laing, ¶ [0029]; see also, Laing, ¶¶ [0082]-[0086] (describing a flexible thermal contact element 32 to accommodate fluctuations in volumes without requiring a separate expansion vessel).
a pump chamber formed by the recess and including the impeller and formed below the chassis,	In Laing, the impeller 46 occupies a portion of the interior space 36, defining a pump chamber formed below Laing's chassis (wall 72). Laing, FIG. 1 and ¶ [0068].
the pump chamber being defined by at least an impeller cover having one or more passages for the cooling liquid to pass through;	In Laing, the portion of the interior space 36 occupied by the impeller 36 is defined by at least the housing 18 (e.g., the wall 72) extending over the impeller (e.g., as an impeller cover). Laing, FIG. 1 and ¶ [0068]. The housing 18 defines an inflow region 68 for cooling liquid to pass through. Id. Laing's rotor 42 defines a number of through flow passages 66. Laing's rotor also defines an impeller cover.

a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber, the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages; and	In Laing, a portion of the interior space 36 shown between the thermal contact element 32 and the plate 76 is below and vertically spaced from the volume occupied by the impeller 46 or the impeller 46 and rotor 42. Laing, FIG. 1; see also, Id. at ¶ [0074] (stating "it is possible for this inner side [of thermal contact element 32] to have fins"). In Laing, the region shown between thermal contact element 32 and plate 76 is coupled with the volume occupied by the impeller 46 or the impeller 46 and rotor 42 by at least the passages 44. Laing, FIG. 1. The region and the volume are also coupled with each other through the remainder of Laing's feed line 20 and Laing's discharge line 26. *See* Appendix C, Laing FIG. 2. Thus, Laing's pump chamber and thermal exchange chamber must also be coupled together by the through-flow passages 66.
a heat-exchanging interface, the heat-exchanging interface forming a boundary wall of the thermal exchange chamber, and	In Laing, the thermal contact element 32 defines a heat-exchanging interface. See Laing, ¶ [0050] (stating "The thermal contact between the fluid and the object 14 is provided by a thermal contact element 32..."). In Laing, thermal contact element 32 defines a boundary wall between the heated object 14 (e.g., processor) and the interior space 36. Laing, FIG. 1 and ¶ [0050].
configured to be placed in thermal contact with a surface of the heat-generating component; and	The Published International Application discloses exactly this limitation. Id. at FIG. 17; Specification, 29:35-39. In Laing, thermal contact element 32 is configured to be placed in contact with the heated object 14. Laing, FIG. 1 and ¶ [0050].
a heat radiator fluidly coupled to the reservoir and configured to dissipate heat from the cooling liquid.	The Published International Application discloses exactly this limitation. Id. at 28:30-40.
2. The cooling system of claim 1, wherein the chassis shields the stator from the cooling liquid in the reservoir.	The Published International Application discloses exactly this limitation. Id. at 28:6-12. Laing states: "Between the rotor 42 and the stator 54 there is a substantially spherical wall 72 …." Laing, ¶ [0068]. The wall 72 shields the stator from the cooling liquid in the interior space 36. FIG. 1.

3. The cooling system of claim 1,	
wherein the heat-exchanging interface includes a first side and a second side opposite the first side, and	The Published International Application discloses exactly this limitation. Id. at 29:38-30:6; FIG. 17 (first side 4A, second side opposite the first side). Laing's thermal contact element 32 has opposed inner side 78 positioned opposite the outer surface (not numbered) adjoining the contact surface 34. Laing, FIG. 1.
wherein the heat-exchanging interface contacts the cooling liquid in the thermal exchange chamber on the first side and	The Published International Application discloses exactly this limitation. Id. at 30:4-6; FIG. 17. Laing's thermal contact element 32 is in contact with the cooling liquid in the chamber adjacent the inner side 78 of the element. Laing, FIG. 1.
the heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component on the second side.	The Published International Application discloses exactly this limitation. Id. at 29:35-39. In Laing, the outer surface (not numbered) of the thermal contact element 32 adjoins the contact surface 34 of the object 14. Laing, FIG. 1
4. The cooling system of claim 3, wherein the first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber.	The Published International Application discloses exactly this limitation. Id. at 29:38-30:6; FIG. 17 (pins 4A). In Laing, the inner side 78 can "have fins in order to increase the surface area" and thereby increase heat transfer from the heat-exchanging interface to the cooling liquid in the chamber between the thermal contact element 32 and the plate 76. Laing, ¶ [0074].
5. The cooling system of claim 4, wherein the features include at least one of pins or fins.	The Published International Application discloses exactly this limitation. Id. at 29:38-30:6; FIG. 17 (pins 4A). In Laing, the inner side 78 can "have fins in order to increase the surface area" and thereby increase heat transfer from the heat-exchanging interface to the cooling liquid in the chamber between the thermal contact element 32 and the

	plate 76. Appendix C, Laing, ¶ [0074].
6. The cooling system of claim 1, wherein a passage of the one or more passages that fluidly couple the pump chamber and the thermal exchange chamber is offset from a center of the impeller.	The Published International Application discloses exactly this limitation. Id. at 29:17-19; FIG. 17. In Laing, the passages 44 are offset from a center of the impeller 46, as are the feed line 20 and the discharge line 26. Laing, FIG. 1.
7. The cooling system of claim 1, wherein the impeller includes a plurality of curved blades.	The Published International Application discloses exactly this limitation. Id. at FIG. 17. Laing discloses curved blades. Appendix C, Laing, FIG. 1. Laing's rotor 42 is curved (e.g., "spherical", see ¶ [0063]; "The rotor 42 forms a single unit with the paddle wheel 46."); ¶ [0027] states "In a variant …, blades are arranged on the rotor, in order in particular to generate additional swirl in the liquid. The blades are disposed in such a way that the spherical geometry is substantially retained."
8. The cooling system of claim 1, wherein the heat-exchanging interface includes one of copper and aluminum.	The Published International Application discloses exactly this limitation. Id. at 29:6-11. Laing states: "In the exemplary embodiment shown in FIG. 1, the thermal contact element 32 is formed as a rigid plate which is made from a material with a good thermal conductivity, such as copper." Laing, ¶ [0081].
9. The cooling system of claim 1, wherein the heat radiator is fluidly coupled to the reservoir using flexible conduits, and the heat radiator is configured to be positioned remote from the reservoir.	The Published International Application discloses exactly this limitation. Id. at pp. 33-39. Laing states: "The discharge line 26 and the feed line 20 are connected to one another outside the housing 18 of the circulation pump 12, in order to form a loop 28 for the liquid. This loop 28 has a cooling section or heating section 30 which is arranged outside the housing 18 ...." Laing, ¶ [0049] and FIG. 2.

10. A cooling system for a computer system, comprising:	The Published International Application discloses exactly such a cooling system. *See*, Appendix J, Published International Application, FIG. 17; Specification, 2:5-6, 7. Laing also discloses exactly the type of cooling system claimed in the '234 Application. Laing's title states it clearly: "Device for the Local Cooling or Heating of an Object." Laing, Title. An example of an object cooled by Laing's device is a processor positioned on a circuit board 16. Laing, ¶ [0044]. Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; or (III) some teaching, suggestion, or motivation to combine. All of these rationale apply here as detailed below. First, combining the '761 Publication's reservoir with Laing's reservoir having a pump chamber and a vertically separated thermal exchange chamber to cool a processor yields predictable results. Second, simply substituting Laing's reservoir for the '761 Publication's reservoir to cool a processor achieves predictable results. Third, Laing suggests providing a reservoir having a pump chamber and a vertically separated thermal exchange chamber to cool a processor.
a centrifugal pump adapted to circulate a cooling liquid, the pump including:	The Published International Application discloses exactly this limitation. Id. at 29:19. Laing: "In the exemplary embodiment shown in FIG. 1, the circulation pump 12 is formed as a centrifugal pump …." Laing, ¶ [0058].
an impeller exposed to the cooling liquid; and	The Published International Application discloses exactly this limitation. Id. at 29:17-28. Laing's "paddle wheel 46" is a form of "impeller." "Then, liquid is guided through the circulation pump 12 via the through-flow space 66, and a swirl is imparted to the liquid which is conducted through by the paddle wheel 46; the pressure required to pump the liquid through the loop 28 is then produced." Laing, ¶ [0064].

a stator isolated from the cooling liquid;	The Published International Application discloses exactly this limitation. Id. at 28:6-21. "Between the rotor 42 and the stator 54 there is a substantially spherical wall 72 …." Laing, ¶ [0068]. The wall 72 isolates the stator 54 from the cooling liquid in the through-flow region 66. Laing, FIG. 1.
a reservoir configured to be thermally coupled to a heat-generating component of the computer system, the reservoir including:	The Published International Application discloses exactly this limitation. Id. at 29:35-39 Laing's housing 18 defines an interior space 36 constituting a chamber for holding excess liquid not capable of being contained in the remaining components. The interior space 36 is configured to be thermally coupled to an object 14, such as a processor mounted to a motherboard 16.
a thermal exchange chamber adapted to be positioned in thermal contact with the heat-generating component;	LAING: A portion of the interior space 36 shown between the thermal contact element 32 and the plate 76 defines a thermal exchanger chamber. Laing, ¶ [0055] (stating "[t]he liquid is also guided past the thermal contact element 32 in order to transfer heat").
a separate pump chamber vertically spaced apart from the thermal exchange chamber and coupled with the thermal exchange chamber through one or more passages configured for fluid communication between the pump chamber and the thermal exchange chamber, and	LAING: Shown in FIG. 1 of Laing, the region between thermal contact element 32 and plate 76 is separate from the volume occupied by the impeller 46 or the impeller 46 and rotor 42. Region shown between thermal contact element 32 and plate 76 is spaced apart from the volume occupied by the impeller 46 or the impeller 46 and rotor 42 in a direction parallel to a rotational axis of Laing's impeller 46. Laing, FIG. 1. The region shown between thermal contact element 32 and plate 76 is coupled with the volume occupied by the impeller 46 or the impeller 46 and rotor 42 by at least the passages 44. Laing, FIG. 1. The region and volume are also coupled with each other through Laing's feed line 20 and Laing's discharge line 26. *See* Appendix C, Laing FIG. 2; ¶ [0049] (stating "The discharge line 26 and the feed line 20 are connected to one another outside the housing 18 of the circulation pump 12, in order to form a loop 28 for the liquid.").
wherein at least one of the one or more passages is offset from a center of the impeller.	In Laing, the passages 44 are offset from a center of the impeller 46. Laing, FIG. 2..

11. The cooling system of claim 10, wherein a top wall of the reservoir physically separates the impeller from the stator.	The Published International Application discloses exactly this limitation. Id. at 28:14-21 Laing's chassis 18 defines an interior space 36 constituting a chamber for holding excess liquid not capable of being contained in the remaining components. "Between the [unitary] rotor 42 [and impeller 46 assembly] and the stator 54 there is a substantially spherical wall 72 …." Laing, ¶ [0068]. The wall 72, a top wall of the interior space 36, physically separates the impeller from the stator. Laing, FIG. 1.
12. The cooling system of claim 10, wherein the thermal exchange chamber includes a heat-exchange interface configured to be placed in thermal contact with the heat-generating component.	The Published International Application discloses that the heat exchanging interface has a plane outer surface (**not shown**) intended for abutting a component such as a CPU. Id. at 29:30-33. LAING Thermal contact element 32 defines a heat-exchanging interface. See Laing, ¶ [0050] (stating "The thermal contact between the fluid and the object 14 is provided by a thermal contact element 32...").
13. The cooling system of claim 10, further including a heat radiator fluidly coupled to the reservoir using flexible conduits, wherein the heat radiator is configured to be positioned remote from the reservoir.	The Published International Application discloses exactly this limitation. Id. at pp. 33-39.
14. The cooling system of claim 10, wherein the fluid passage that is offset from the center of the impeller is positioned tangentially to the circumference of the impeller.	The Published International Application discloses exactly this limitation. Id. at 29:17-19. LAING: Laing's pump is a centrifugal pump. Laing states: "In the exemplary embodiment shown in FIG. 1, the circulation pump 12 is formed as a centrifugal pump …." Appendix C, Laing, ¶ [0058]. Laing also states it is "particularly advantageous if the circulation pump is a centrifugal pump". Id.

	at ¶ [0018]. Laing's passages 44 are positioned tangentially to the circumference of the impeller 46. Id. at FIG. 1.
15. A cooling system for a heat-generating component, comprising:	The Published International Application discloses exactly this type of system. Laing also discloses exactly the type of cooling system claimed in the '234 Application. Laing's title states it clearly: "Device for the Local Cooling or Heating of an Object." Laing, Title. An example of an object cooled by Laing's device is a processor positioned on a circuit board 16. Laing, ¶ [0044]. Under MPEP 2143, various accepted rationale are set forth for making a *prima facie* case of obviousness under *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-1397 (2007). In this instance, several of the rational apply, including but not limited to: (I) combining prior art elements according to known methods to yield predictable results; (II) simple substitution of one known element for another to obtain predictable results; or (III) some teaching, suggestion, or motivation to combine. All of these rationale apply here as detailed below. First, combining the '761 Publication's reservoir with Laing's reservoir having a pump chamber and a vertically separated thermal exchange chamber to cool a processor yields predictable results. Second, simply substituting Laing's reservoir for the '761 Publication's reservoir to cool a processor achieves predictable results. Third, Laing suggests providing a reservoir having a pump chamber and a vertically separated thermal exchange chamber to cool a processor.
a pump adapted to circulate a cooling liquid, the pump including:	The Published International Application discloses exactly this limitation. Id. at 29:19. In Laing, FIG. 1 illustrates a "circulation pump 12, by means of which a fluid, such as water or other liquids, can be guided in a loop (FIG. 2) as a heat transfer medium. The heat transfer medium can be used as a cooling medium." Appendix C, Laing, ¶ [0044].
an impeller exposed to the cooling liquid; and	The Published International Application discloses exactly this limitation. Id. at 29:17-28. In Laing, "[A]n impeller 46 (paddle wheel) … is connected in a rotationally fixed manner to the rotor 42 …." Appendix C, Laing, ¶ [0055]; FIG. 1.

a stator isolated from the cooling liquid;	The Published International Application discloses exactly this limitation. Id. at 28:6-21 Laing states: "Between the rotor 42 and the stator 54 there is a substantially spherical wall 72 …." Laing, ¶ [0068]. The wall 72 isolates the stator 54 from the cooling liquid. Appendix C, Laing, FIG. 1.
a reservoir including an impeller cover, an intermediate member and a heat exchange interface,	The Published International Application discloses exactly this limitation. Id. at FIG. 17. Laing: **"Reservoir."** Laing's housing 18 defines an interior space 36. "An interior space 36 … is formed in the housing 18 of the circulation pump 12. … A swirl chamber 44, in which a swirl is imparted to liquid which has been supplied via the feed line 20, using an impeller 46 (paddle wheel) which is connected in a rotationally fixed manner to the rotor 42, and in which swirling liquid flows, is formed in the interior space 36 of the housing 18. … The liquid is also guided past the thermal contact element 32 in order to transfer heat. … The swirl chamber 44 is formed in the interior space 36 between walls 48 …." Appendix C, Laing, ¶¶ [0052]-[0056]. The interior space 36 constitutes a chamber for holding excess liquid not capable of being contained in the remaining components. "In particular, it is provided that the circulation pump has a housing part which is formed flexibly and/or is movable, and in particular is disposed movably on the housing, in such a manner that it is possible to exert a positive pressure on the system. … By way of example, the housing part may be a flexible plate, a flexible diaphragm or a bellows." Id. at ¶ [0029]; see also, Laing, ¶¶ [0082]-[0086] (describing a flexible thermal contact element 32 to accommodate fluctuations in volumes without requiring a separate expansion vessel). **"Impeller cover."** In Laing, the portion of the interior space 36 occupied by the impeller 36 is defined by at least the housing 18 extending over the impeller (e.g., as an impeller cover). Id. at FIG. 1. Laing's rotor 42 also defines an impeller cover. Id. **"Intermediate member."** A plate 76 is positioned between the impeller 46 and the thermal contact element 32, forming an intermediate member. Id. at FIG. 1. **"Heat exchange interface."** The thermal contact element 32 defines a heat-exchanging interface. See Laing, ¶ [0050] (stating "The thermal contact between the fluid and the object 14 is provided by a thermal contact element

	32...”).
wherein a top wall of the reservoir and the impeller cover define a pump chamber for housing the impeller, and	T Laing’s top wall 72 and the outer wall of the housing 18 overlie the impeller 46 and the rotor, defining a pump chamber for housing the impeller 46. Appendix C, Laing, FIG. 1.
the intermediate member and the heat exchange interface define a thermal exchange chamber, the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together; and	In Laing, the plate 76 (intermediate member) and the thermal contact element 32 define a chamber through which a coolant passes to absorb heat from the thermal contact element 32, forming a thermal exchange chamber. Appendix C, Laing, ¶ [0055] (stating "[t]he liquid is also guided past the thermal contact element 32 in order to transfer heat”); FIG. 1. In Laing, a portion of the interior space 36 shown between the thermal contact element 32 and the plate 76 is below and vertically spaced from the volume occupied by the impeller 46. Appendix C, Laing, FIG. 1; see also, Id. at ¶ [0074] (stating "it is possible for this inner side [of thermal contact element 32] to have fins"). In Laing, the volume occupied by the impeller 46 is fluidly coupled with the portion of the interior space 36 between the thermal contact element 32 and the plate through passages 44, as shown in FIG. 1, as well as through the feed line 20 and discharge line 26, as shown in FIG. 2. Id.
wherein a first side of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and	The Published International Application discloses exactly this limitation. Id. at 30:4-6; FIG. 17. Laing states: “The thermal contact between the fluid and the object 14 is provided by a thermal contact element 32….” Appendix C, Laing, ¶ [0050]. "The liquid is also guided past the thermal contact element 32 in order to transfer heat.” Id. at ¶ [0055].
a second side of the heat-exchanging interface opposite the first side is configured to be placed in thermal contact with a surface of the heat-generating component; and	The Published International Application discloses that the heat exchanging interface has a plane outer surface (**not shown**) intended for abutting a component such as a CPU. Id. at 29:30-33. In Laing, the outer surface (not numbered) of the thermal contact element 32 adjoins the contact surface 34 of the object 14. Appendix C, Laing, FIG. 1

a liquid-to-air heat exchanger fluidly coupled to the reservoir using flexible conduits, the heat exchanger being configured to be positioned remote from the reservoir.	The Published International Application discloses exactly this limitation. Id. at pp. 33-39. Laing states: "This loop 28 has a cooling section or heating section 30 which is arranged outside the housing 18 and along which heated cooling liquid can be cooled, for example by means of air cooling …. The cooling section … 30 for this purpose has a suitable surface area to allow effective cooling ...." Appendix C, Laing, ¶ [0049]; FIG. 2. As shown in FIG. 2, Laing's feed line 20 receives coolant from the liquid-to-air heat exchanger 30 and Laing's discharge line 26 delivers heated coolant to the liquid-to-air heat exchanger 30, fluidly coupling Laing's liquid-to-air heat exchanger 30 and reservoir.
16. The cooling system of claim 15, wherein the impeller cover includes a first opening radially offset from a center of the impeller and	The Published International Application discloses exactly this limitation. Id. at 29:17-19. In Laing, the inflow region 68 is radially offset from a center (e.g., an axis of rotation 40) of the impeller 46. Appendix C, Laing, FIG. 1.
the intermediate member includes a second passage that is aligned with the first opening, the first and the second opening being configured to direct the cooling liquid from the pump chamber into the thermal exchange chamber.	In Laing, the plate 76 defining the intermediate member extends outwardly of the impeller 46, defining a passage radially outward of the impeller between the cover plate 76 and the cross-hatched portion of the rotor 42. The passage also extends radially inward between impeller blades and is aligned with the through-flow region 66. Appendix C, Laing, FIG. 1.
17. The cooling system of claim 15, wherein the first side of the heat-exchanging interface includes at least one of pins or fins.	The Published International Application discloses exactly this limitation. Id. at 29:38-30:6; FIG. 17 (pins 4A). In Laing, the inner side 78 can "have fins in order to increase the surface area" and thereby increase heat transfer from the heat-exchanging interface to the cooling liquid in the chamber between the thermal contact element 32 and the plate 76. Appendix C, Laing, ¶ [0074].

18. The cooling system of claim 15, wherein the top wall of the reservoir extends between the stator and the impeller and shields the stator from the cooling liquid in the reservoir.	The Published International Application discloses exactly this limitation. Id. at 28:14-21; FIG. 17. Laing's wall 72 extends between the stator 54 and the impeller 46, shielding the stator from the cooling liquid. Appendix C, Laing, ¶ [0068]; FIG. 1.

XI. CONCLUSION

For at least the foregoing reasons, each of claims 1-18 should be cancelled. Accordingly, the undersigned respectfully requests on behalf of CoolIT Systems, Inc. that this Request for *Inter Partes* Reexamination be promptly granted.

Respectfully submitted,
GANZ LAW, P.C.

Date: September 15, 2012

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a complete copy of this Request for *Inter partes* Reexamination of U.S. Patent No. 8,245,764 was served on the official correspondence address for the '764 Patent shown in PAIR:

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via first class mail, on September 15, 2012.

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Appendix A to the Request for *Inter Partes* Reexamination of

In re Patent of	:	Andre Sloth Eriksen
U.S. Patent No.	:	8,245,764
Application No.	:	13/269,234
Issue Date	:	August 21, 2012
Filing Date	:	October 7, 2011
Title	:	COOLING SYSTEM FOR A COMPUTER SYSTEM

US008245764B2

(12) **United States Patent**
Eriksen

(10) **Patent No.: US 8,245,764 B2**
(45) **Date of Patent: Aug. 21, 2012**

(54) **COOLING SYSTEM FOR A COMPUTER SYSTEM**

(75) Inventor: **André Sloth Eriksen**, Aalborg C (DK)

(73) Assignee: **Asetek A/S**, Bronderslev (DK)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/269,234**

(22) Filed: **Oct. 7, 2011**

(65) **Prior Publication Data**

US 2012/0061058 A1 Mar. 15, 2012

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(51) **Int. Cl.**
F28F 7/00 (2006.01)
H05K 7/20 (2006.01)

(52) **U.S. Cl.** **165/80.4**; 361/699

(58) **Field of Classification Search** 165/80.2, 165/80.4, 104.21, 104.31, 104.33; 361/699, 361/702, 720; 417/423.1

See application file for complete search history.

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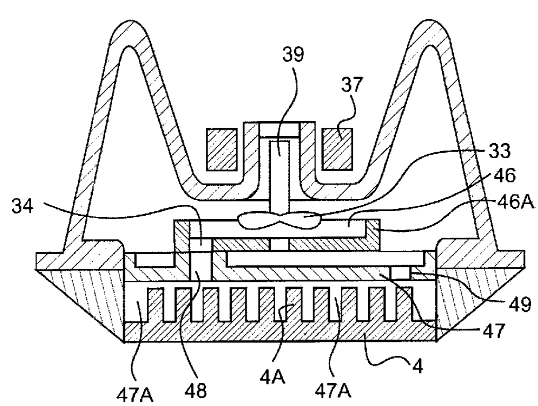
Primary Examiner — Frantz Jules
Assistant Examiner — Emmanuel Duke
(74) *Attorney, Agent, or Firm* — Finnegan, Henderson, Farabow, Garrett & Dunner, LLP

(57) **ABSTRACT**

The invention relates to a cooling system for a computer system, said computer system comprising at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit and comprising a reservoir having an amount of cooling liquid, said cooling liquid intended for accumulating and transferring of thermal energy dissipated from the processing unit to the cooling liquid. The cooling system has a heat exchanging interface for providing thermal contact between the processing unit and the cooling liquid for dissipating heat from the processing unit to the cooling liquid, Different embodiments of the heat exchanging system as well as means for establishing and controlling a flow of cooling liquid and a cooling strategy constitutes the invention of the cooling system.

18 Claims, 12 Drawing Sheets



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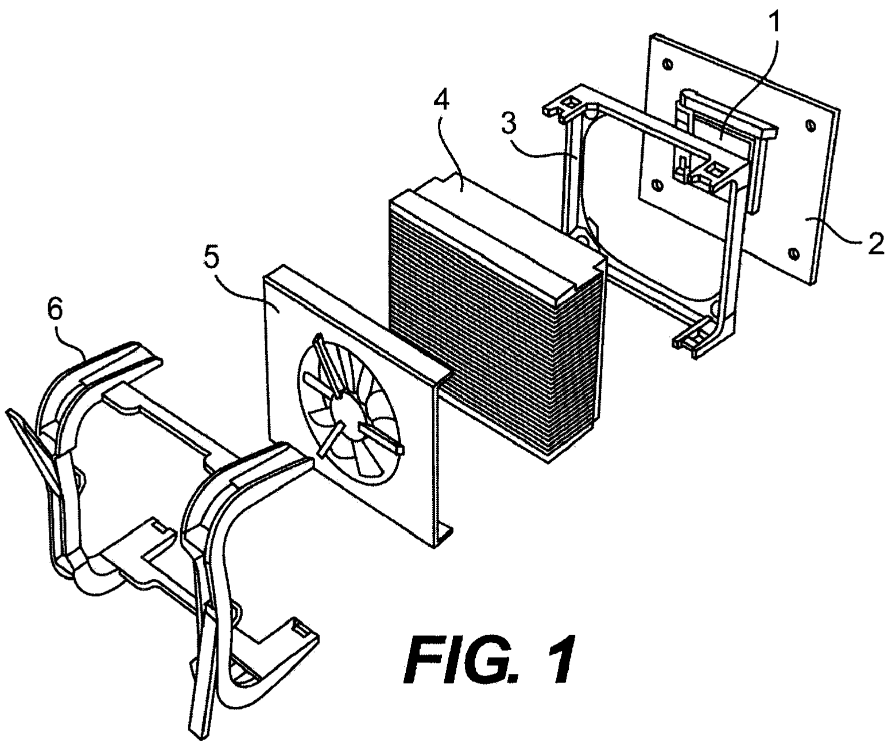


FIG. 1

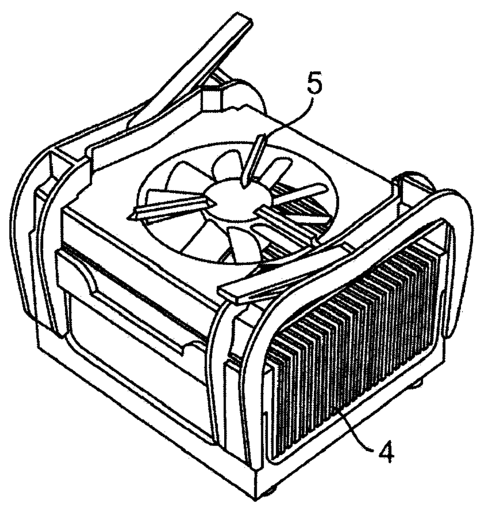


FIG. 2

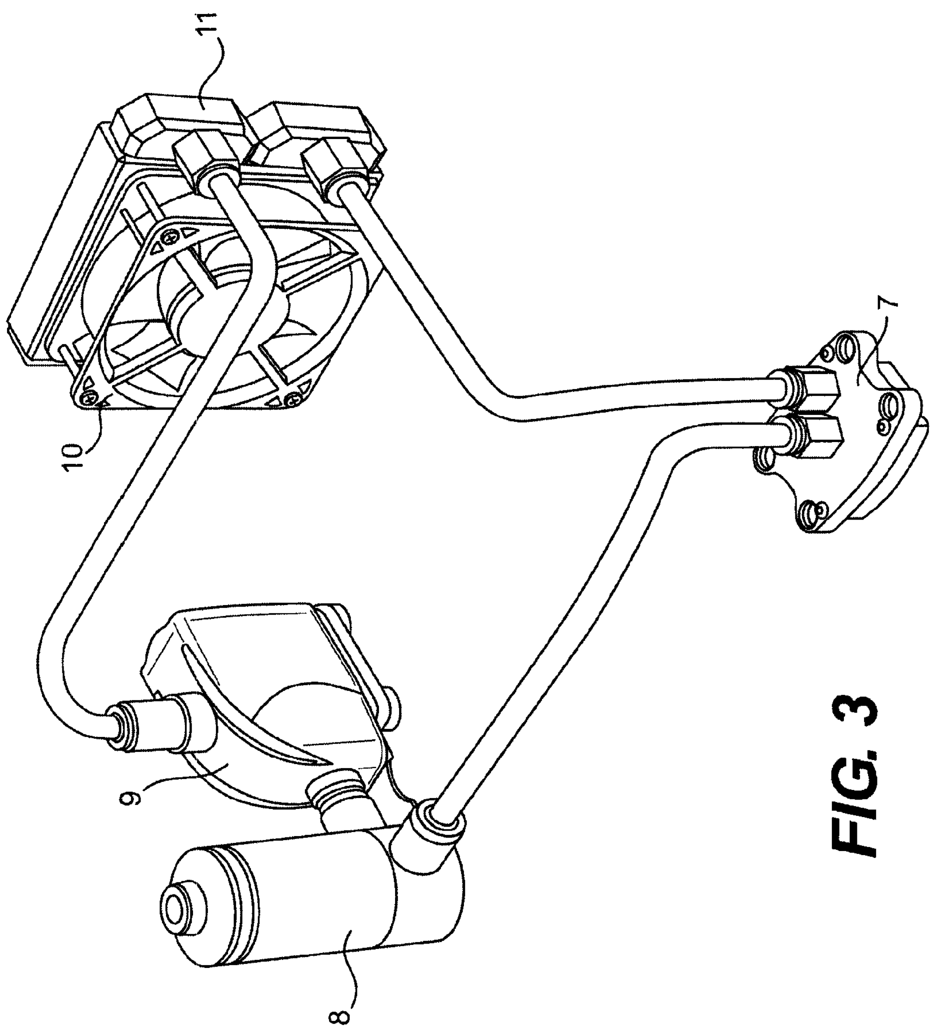


FIG. 3

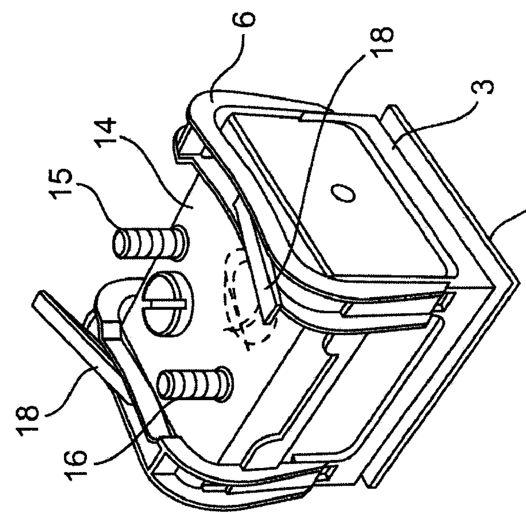


FIG. 5

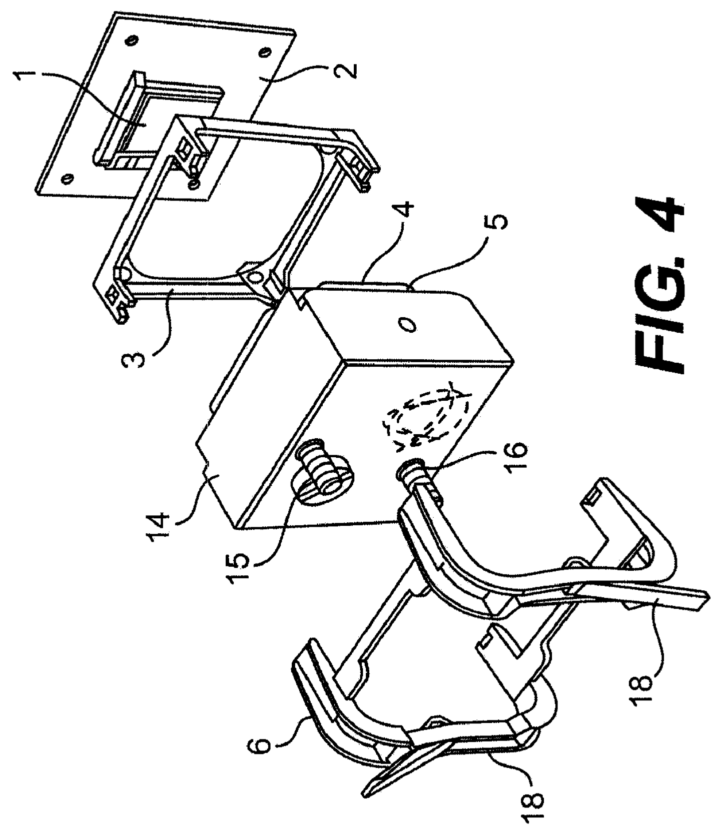


FIG. 4

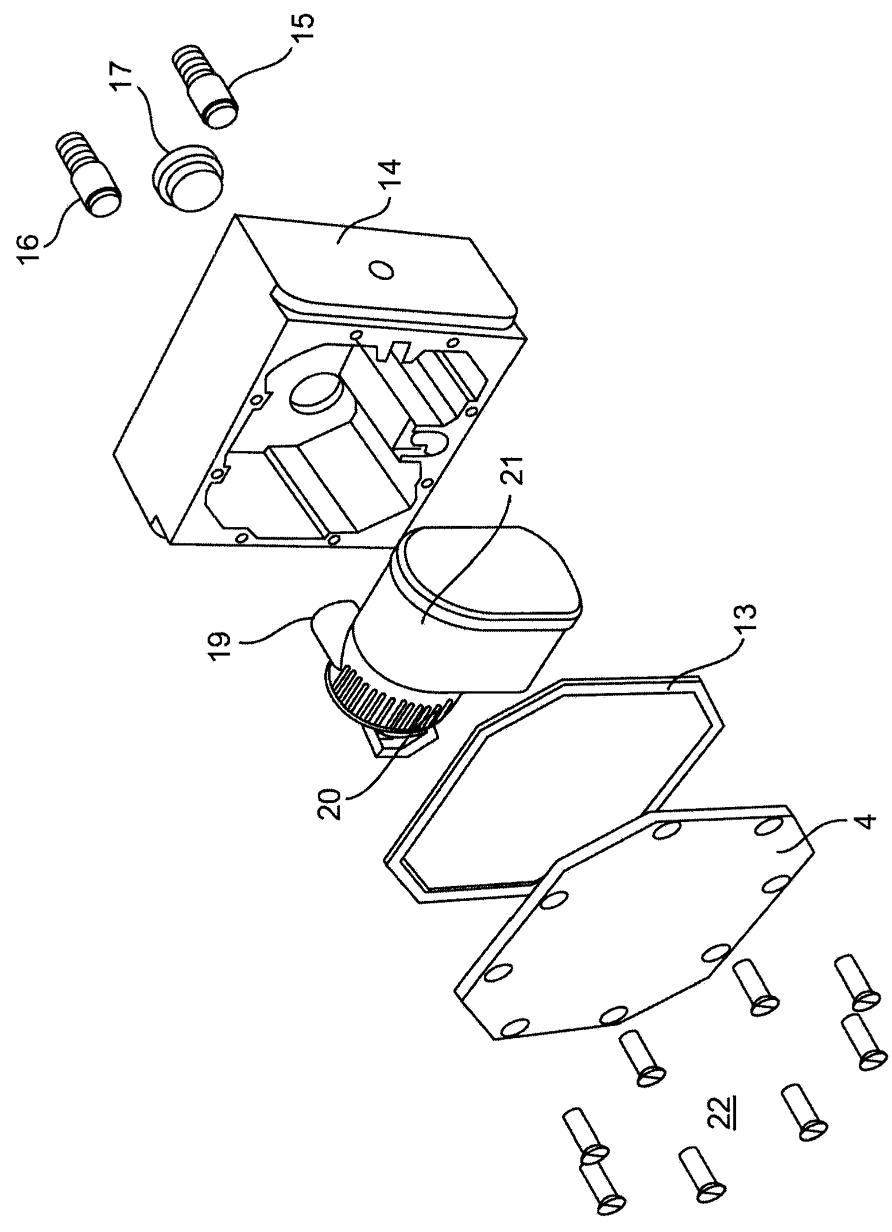


FIG. 6

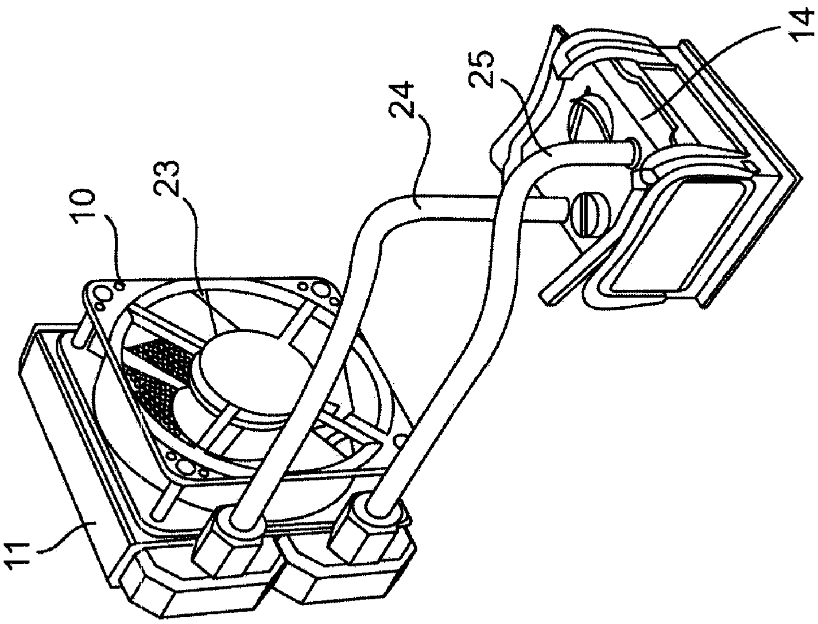


FIG. 7

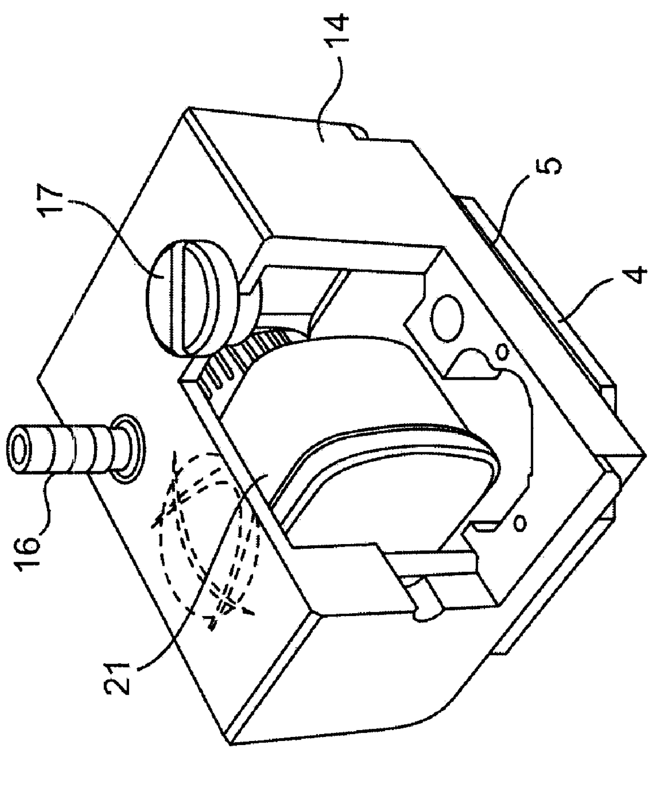


FIG. 8

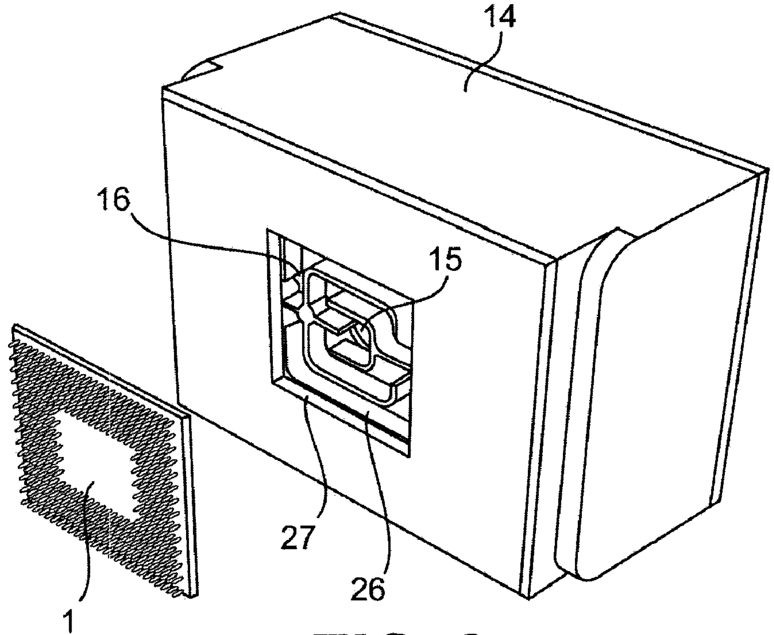


FIG. 9

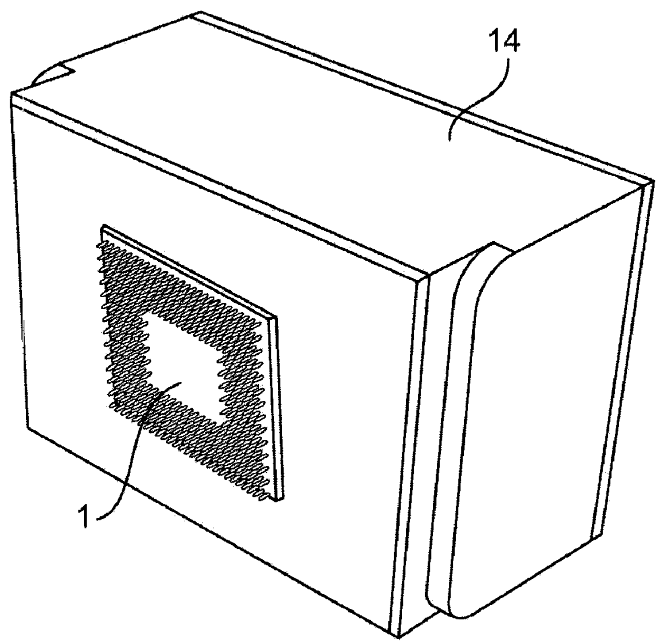


FIG. 10

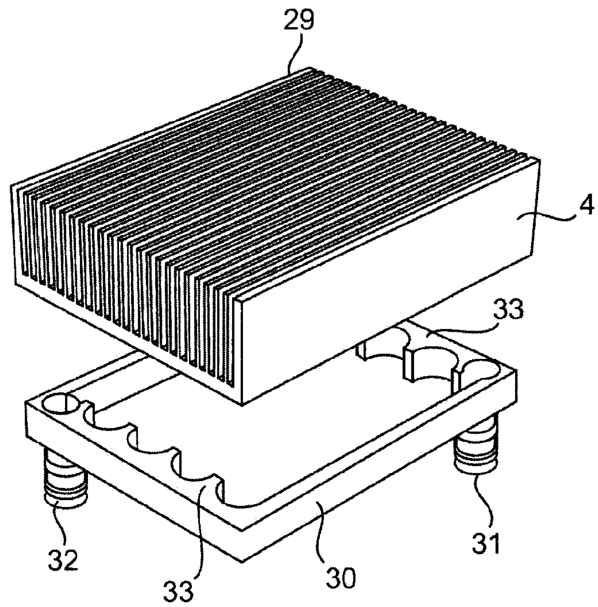


FIG. 11

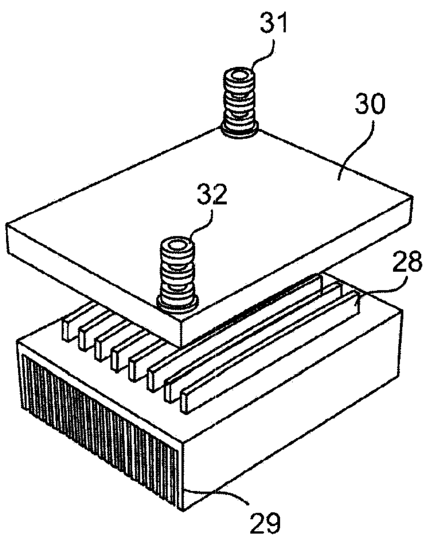


FIG. 12

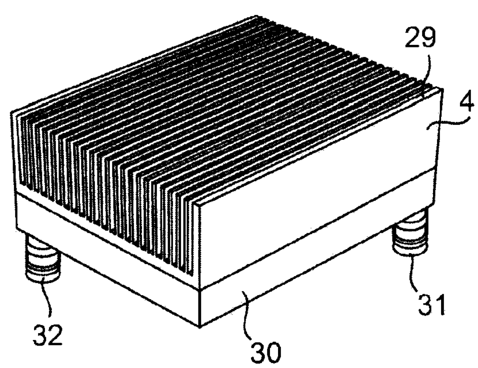


FIG. 13

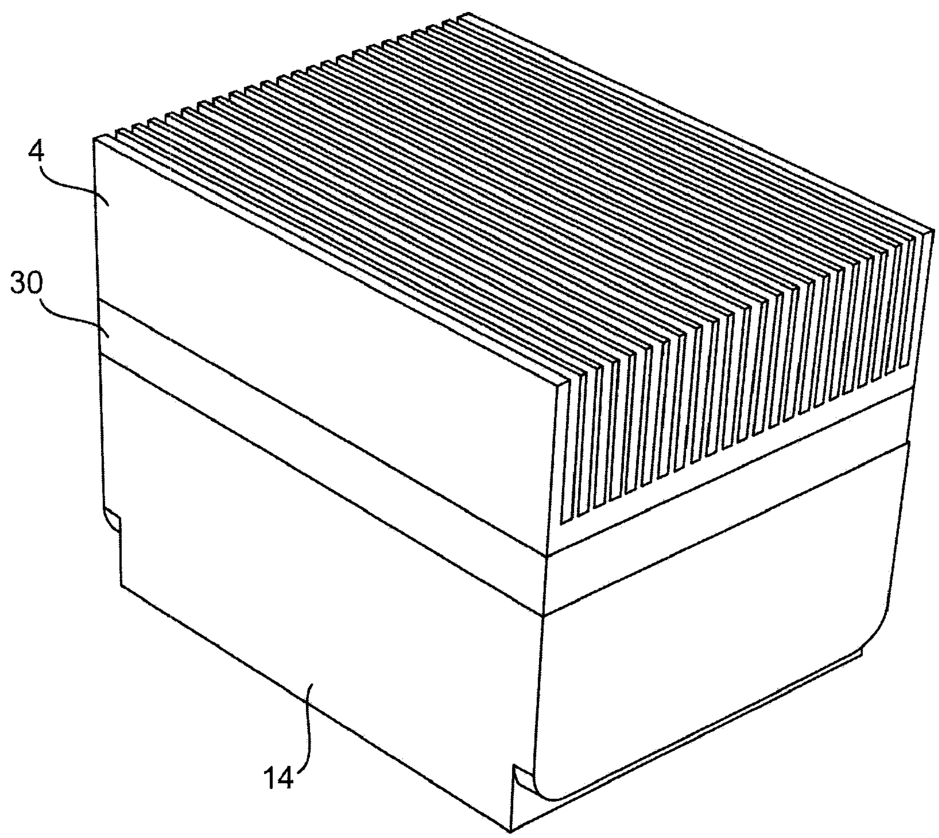


FIG. 14

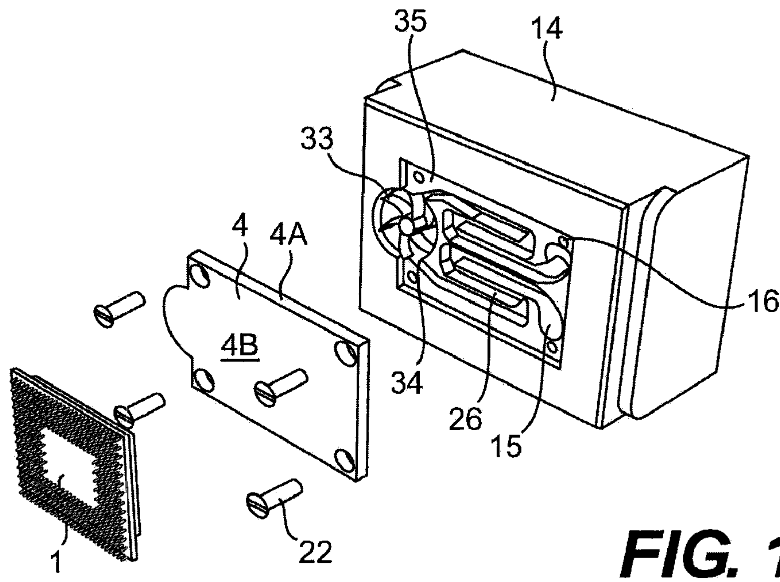


FIG. 15

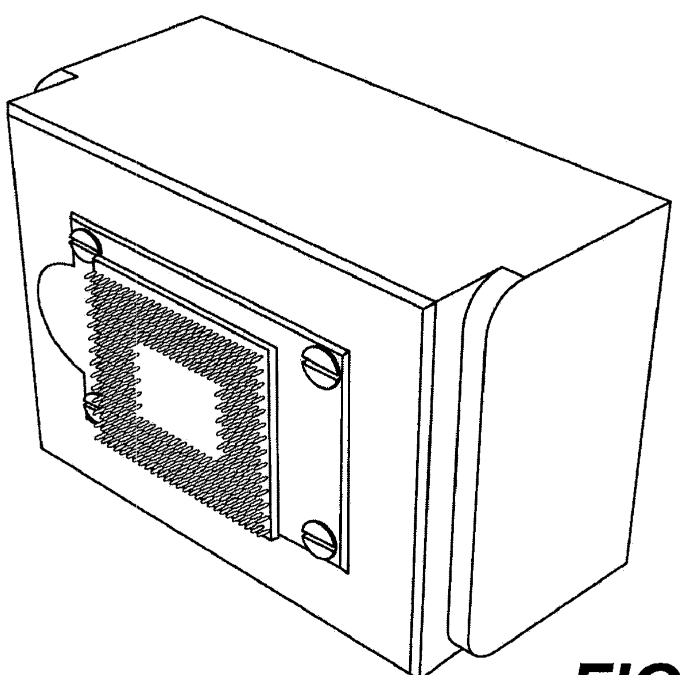
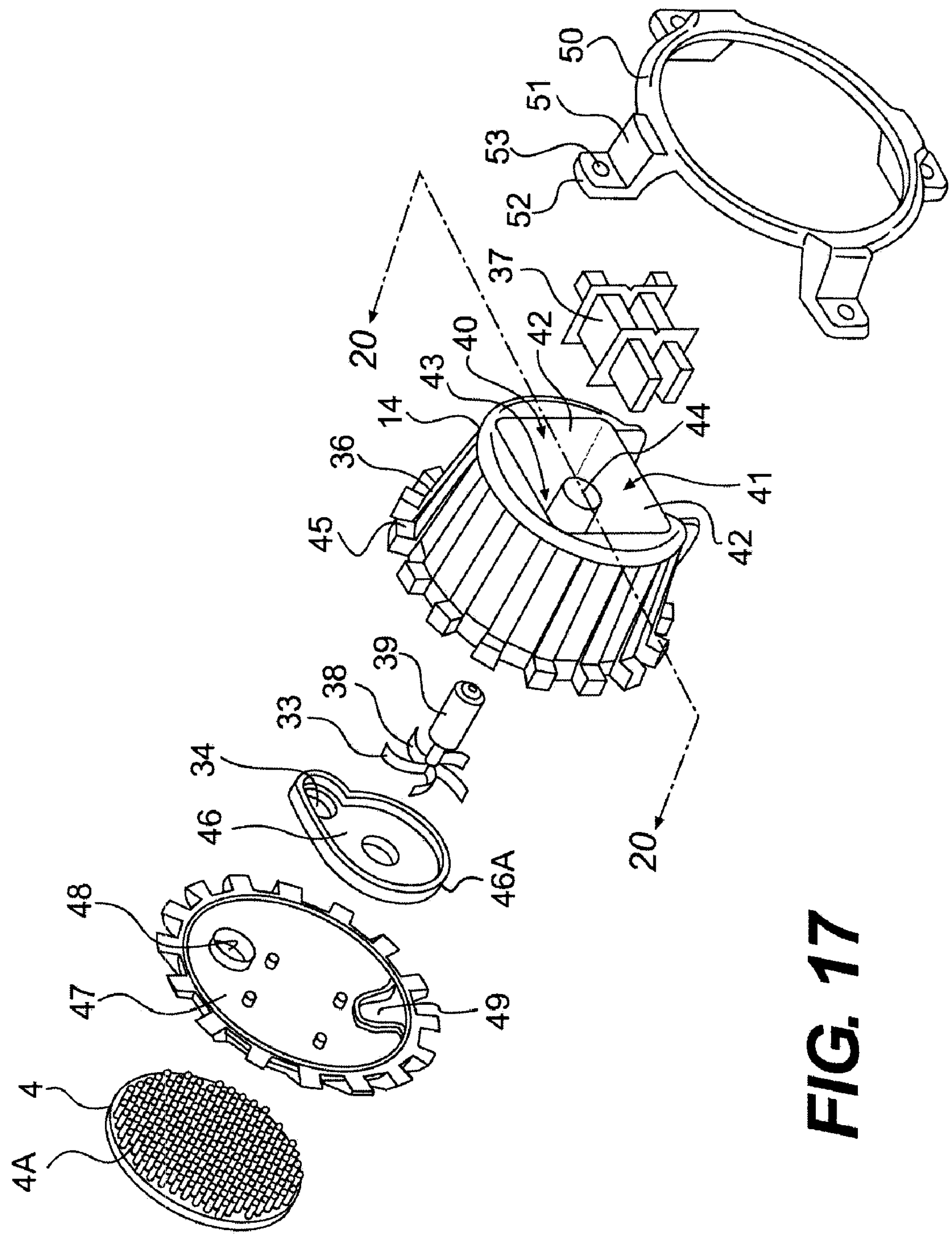


FIG. 16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46A
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4
4A

FIG. 17

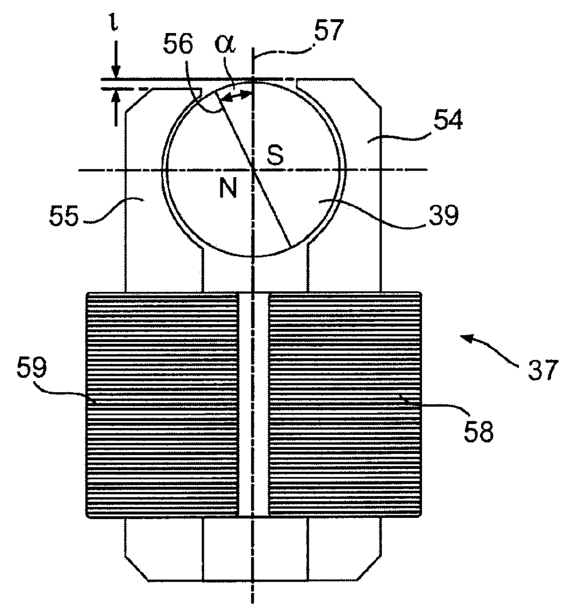

FIG. 18

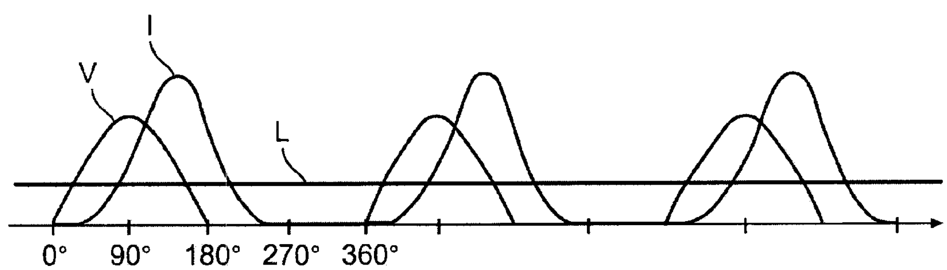

FIG. 19

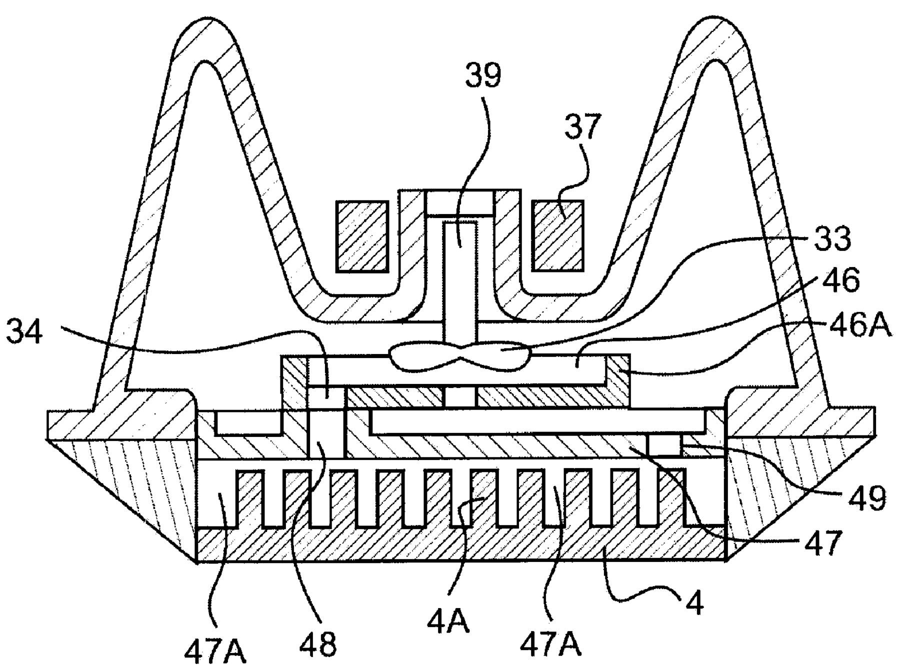

FIG. 20

COOLING SYSTEM FOR A COMPUTER SYSTEM

This application is a continuation of U.S. application Ser. No. 11/919,974, filed Jan. 6, 2009, which is a U.S. National Phase Application of PCT/DK2005/000310, filed May 6, 2005, which is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

The present invention relates to a cooling system for a central processing unit (CPU) or other processing unit of a computer system. More specifically, the invention relates to a liquid-cooling system for a mainstream computer system such as a PC.

During operation of a computer, the heat created inside the CPU or other processing unit must be carried away fast and efficiently, keeping the temperature within the design range specified by the manufacturer. As an example of cooling systems, various CPU cooling methods exist and the most used CPU cooling method to date has been an air-cooling arrangement, wherein a heat sink in thermal contact with the CPU transports the heat away from the CPU and as an option a fan mounted on top of the heat sink functions as an air fan for removing the heat from the heat sink by blowing air through segments of the heat sink. This air-cooling arrangement is sufficient as long as the heat produced by the CPU is kept at today's level, however it becomes less useful in future cooling arrangements when considering the development of CPUs since the speed of a CPU is said to double perhaps every 18 months, thus increasing the heat production accordingly.

Another design used today is a CPU cooling arrangement where cooling liquid is used to cool the CPU by circulating a cooling liquid inside a closed system by means of a pumping unit, and where the closed system also comprises a heat exchanger past which the cooling liquid is circulated.

A liquid-cooling arrangement is more efficient than an air-cooling arrangement and tends to lower the noise level of the cooling arrangement in general. However, the liquid-cooling design consists of many components, which increases the total installation time, thus making it less desirable as a mainstream solution. With a trend of producing smaller and more compact PCs for the end-users, the greater amount of components in a typical liquid-cooling arrangement is also undesirable. Furthermore, the many components having to be coupled together incurs a risk of leakage of cooling liquid from the system.

SUMMARY

It may be one object of the invention to provide a small and compact liquid-cooling solution, which is more efficient than existing air-cooling arrangements and which can be produced at a low cost enabling high production volumes. It may be another object to create a liquid-cooling arrangement, which is easy-to-use and implement, and which requires a low level of maintenance or no maintenance at all. It may be still another object of the present invention to create a liquid-cooling arrangement, which can be used with existing CPU types, and which can be used in existing computer systems.

This object may be obtained by a cooling system for a computer system, said computer system comprising: at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit, a reservoir having an amount of cooling liquid, said cooling liquid intended for accumulating and transferring of thermal energy dissipated from the processing unit to the cooling liquid, a heat exchanging interface for providing thermal contact between the processing unit and the cooling liquid for dissipating heat from the processing unit to the cooling liquid, a pump being provided as part of an integrate element, said integrate element comprising the heat exchanging interface, the reservoir and the pump, said pump intended for pumping the cooling liquid into the reservoir, through the reservoir and from the reservoir to a heat radiating means, said heat radiating means intended for radiating thermal energy from the cooling liquid, dissipated to the cooling liquid, to surroundings of the heat radiating means.

By providing an integrate element, it is possible to limit the number of separate elements of the system. However, there is actually no need for limiting the number of elements, because often there is enough space within a cabinet of a computer system to encompass the different individual elements of the cooling system. Thus, it is surprisingly that, at all, any attempt is conducted of integrating some of the elements.

In possible embodiments according to this aspect of the invention, the entire pump is placed inside the reservoir with at least an inlet or an outlet leading to the liquid in the reservoir. In an alternative embodiment the pump is placed outside the reservoir in the immediate vicinity of the reservoir and wherein at least an inlet or an outlet is leading directly to the liquid in the reservoir. By placing the pump inside the reservoir or in the immediate vicinity outside the reservoir, the integrity of the combined reservoir, heat exchanger and pump is obtained, so that the element is easy to employ in new and existing computer systems, especially mainstream computer systems.

In a preferred embodiment, the pumping member of the pump and a driven part of the motor of the pump, such as a rotor of en electrical motor, is placed inside the reservoir embedded in the cooling liquid, and wherein a stationary part of the motor of the pump, such as a stator of an electrical motor, is placed outside the reservoir. By having the driven part of the motor placed inside the reservoir submerged in the cooling liquid and the stationary part of the motor outside the reservoir, there is no need for encapsulating the stationary part in a liquid-proof insulation. However, problems may occur having then stationary part driving the driven part. However, the present invention provide means for obtaining such action, although not at all evident how to solve this problem.

The object may also be obtained by a cooling system for a computer system, said computer system comprising: at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit, a reservoir having an amount of cooling liquid, said cooling liquid intended for accumulating and transferring of thermal energy dissipated from the processing unit to the cooling liquid, a heat exchanging interface for providing thermal contact between the processing unit and the cooling liquid for dissipating heat from the processing unit to the cooling liquid, a pump intended for pumping the cooling liquid into the reservoir, through the reservoir and from the reservoir to a heat radiating means, said cooling system being intended for thermal contact with the processing unit by means of existing fastening means associated with the processing unit, and said heat radiating means intended for radiating from the cooling liquid thermal energy, dissipated to the cooling liquid, to surroundings of the heat radiating means.

The use of existing fastening means has the advantage that fitting of the cooling system is fast and easy. However, once again there is no problem for the person skilled in the art to adopt specially adapted mounting means for any element of the cooling system, because there are numerous possibilities in existing cabinets of computer systems for mounting any kind of any number of elements, also elements of a cooling system.

In preferred embodiments according to this aspect of the invention, the existing fastening means are means intended for attaching a heat sink to the processing unit, or the existing fastening means are means intended for attaching a cooling fan to the processing unit, or the existing fastening means are means intended for attaching a heat sink together with a cooling fan to the processing unit. Existing fastening means of the kind mentioned is commonly used for air cooling of CPUs of computer systems, however, air cooling arrangements being much less complex than liquid cooling systems. Nevertheless, it has ingeniously been possible to develop a complex and effective liquid cooling system capable of utilizing such existing fastening means for simple and less effective air cooling arrangements.

According to an aspect of the invention, the pump is selected from the following types: Bellows pump, centrifugal pump, diaphragm pump, drum pump, flexible finer pump, flexible impeller pump, gear pump, peristaltic tubing pump, piston pump, processing cavity pump, pressure washer pump, rotary lobe pump, rotary vane pump and electro-kinetic pump. By adopting one or more of the solution of the present invention, a wide variety of pumps may be used without departing from the scope of the invention.

According to another aspect of the invention, driving means for driving the pump is selected among the following driving means: electrically operated rotary motor, piezo-electrically operated motor, permanent magnet operated motor, fluid-operated motor, capacitor-operated motor. As is the case when selecting the pump to pump the liquid, by adopting one or more of the solution of the present invention, a wide variety of pumps may be used without departing from the scope of the invention.

The object may also be obtained by a cooling system for a computer system, said computer system comprising: at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit, a reservoir having an amount of cooling liquid, said cooling liquid intended for accumulating and transferring of thermal energy dissipated from the processing unit to the cooling liquid, a heat exchanging interface for providing thermal contact between the processing unit and the cooling liquid for dissipating heat from the processing unit to the cooling liquid, a pump intended for pumping the cooling liquid into the reservoir, through the reservoir and from the reservoir to a heat radiating means, and said cooling system further comprising a pump wherein the pump is driven by an AC electrical motor by a DC electrical power supply of the computer system, where at least part of the electrical power from said power supply is intended for being converted to AC being supplied to the electrical motor.

It may be advantageous to use an AC motor, such as a 12V AC motor, for driving the pump in order to obtain a stabile unit perhaps having to operate 24 hours a day, 365 days a year. However, the person skilled in the art will find it unnecessary to adopt as example a 12V motor because high voltage such as 220V or 110V is readily accessible as this is the electrical voltage used to power the voltage supply of the computer system itself. Although choosing to use a 12V motor for the pump, it has never been and will never be the choice of the person skilled in the art to use an AC motor. The voltage supplied by the voltage supply of the computer system itself is DC, thus this will be the type of voltage chosen by the skilled person.

In preferred embodiments according to any aspect of the invention, an electrical motor is intended both for driving the pump for pumping the liquid and for driving the a fan for establishing a flow of air in the vicinity of the reservoir, or an electrical motor is intended both for driving the pump for pumping the liquid and for driving the a fan for establishing a flow of air in the vicinity of the heat radiating means, or an electrical motor is intended both for driving the pump for pumping the liquid, and for driving the a fan for establishing a flow of air in the vicinity of the reservoir, and for driving the a fan for establishing a flow of air in the vicinity of the heat radiating means.

By utilizing a single electrical motor for driving more than one element of the cooling system according to any of the aspects of the invention, the lesser complexity and the reliability of the cooling system will be further enhanced.

The heat exchanging interface may be an element being separate from the reservoir, and where the heat exchanging interface is secured to the reservoir in a manner so that the heat exchanging interface constitutes part of the reservoir when being secured to the reservoir. Alternatively, the heat exchanging interface constitutes an integrate surface of the reservoir, and where the heat exchanging surface extends along an area of the surface of the reservoir, said area of surface being intended for facing the processing unit and said area of surface being intended for the close thermal contact with the processing unit. Even alternatively, the heat exchanging interface is constitutes by a free surface of the processing unit, and where the free surface is capable of establishing heat dissipation between the processing unit and the cooling liquid through an aperture provided in the reservoir, and where the aperture extends along an area of the surface of the reservoir, said surface being intended for facing the processing unit.

Possibly, an uneven surface such as pins or fins extending from the copper plate provide a network of channels across the inner surface of the heat exchanging interface. A network of channels ensure the cooling liquid being passed along the inner surface of the interface such as a copper plate in a way that maximizes the retention time of the cooling liquid along the heat exchanging interface and in a way that optimizes the thermal exchange between the heat exchanging interface and the cooling liquid as long as the cooling liquid is in thermal contact with heat exchanging interface.

Possibly, the cooling system may be provided with a heat exchanging interface for providing thermal contact between the processing unit and the cooling liquid for dissipating heat from the processing unit to the cooling liquid, a pumping means being intended for pumping the cooling liquid into the reservoir, through the reservoir and from the reservoir to a heat radiating means, said heat radiating means intended for radiating thermal energy from the cooling liquid, dissipated to the cooling liquid, to surroundings of the heat radiating means, said heat exchanging interface constituting a heat exchanging surface being manufactured from a material suitable for heat conducting, and with a first side of the heat exchanging surface facing the central processing unit being substantially plane and with a second side of the heat exchanging surface facing the cooling liquid being substantially plane and said reservoir being manufactured from plastic, and channels or segments being provided in the reservoir for establishing a certain flow-path for the cooling liquid through the reservoir.

Providing a plane heat exchanging surface, both the first, inner side being in thermal contact with the cooling liquid and the second, outer side being in thermal contact with the heat generating processing unit, results in the costs for manufacturing the heat exchanging surface is reduced to an absolute minimum.

According to the above possible solution, an inlet of the pumping means is positioned in immediate vicinity of the heat exchanging interface for thereby obtaining a turbulence of flow of the cooling liquid in the immediate vicinity of the heat exchanging interface. The turbulence of flow is advantageous for obtaining a heat dissipation. If the heat exchanging interface is plane, the inlet of the pump being positioned as mentioned above, may result in a turbulence of flow occurring along the heat exchanging interface, at least in the vicinity of the inlet of the pump, but possibly also distant form the inlet.

Alternatively, or additionally, an outlet of said pumping means being positioned in immediate vicinity of the heat exchanging interface for thereby obtaining a turbulence of flow of the cooling liquid in the immediate vicinity of the heat exchange interface. The turbulence of flow is advantageous for obtaining a heat dissipation. If the heat exchanging interface is plane, the inlet of the pump being positioned as mentioned above, may result in a turbulence of flow occurring along the heat exchanging interface, at least in the vicinity of the inlet of the pump, but possibly also distant form the inlet.

However, a plane first, inner surface may also result in the cooling liquid passing the heat exchanging surface too fast. This may be remedied by providing grooves along the inner surface, thereby providing a flow path in the heat exchanging surface. This however results in the costs for manufacturing the heat exchanging surface increasing.

The solution to this problem has been dealt with by providing channels or segments in the reservoir housing instead. The reservoir housing may be manufactured by injection molding or by casting, depending on the material which the reservoir housing is made from. Proving channels or segments during molding or casting of the reservoir housing is much more cost-effective than milling grooves along the inner surface of the heat exchanging surface.

Possibly, the cooling system may be provided with at least one liquid reservoir mainly for dissipating or radiating heat, said heat being accumulated and transferred by said cooling liquid, said cooling system being adapted such as to provide transfer of said heat from a heat dissipating surface to a heat radiating surface where said at least one liquid reservoir being provided with one aperture intended for being closed by placing said aperture covering part of, alternatively covering the whole of, the at least one processing unit in such a way that a free surface of the processing unit is in direct heat exchanging contact with an interior of the reservoir, and thus in direct heat exchanging contact with the cooling liquid in the reservoir, through the aperture.

Heat dissipation from the processing unit to the cooling liquid must be very efficient to ensure proper cooling of the processing unit, Especially in the case, where the processing unit is a CPU, the surface for heat dissipation is limited by the surface area of the CPU. This may be remedied by utilizing a heat exchanging surface being made of a material having a high thermal conductivity such as copper or aluminum and ensuring a proper thermal bondage between the heat exchanging interlace and the CPU.

However, in a possible embodiment according to the features in the above paragraph, the heat dissipation takes place directly between the processing unit and the cooling liquid by providing an aperture in the reservoir housing, said aperture being adapted for taking up a free surface of the processing unit. Thereby, the free surface of the processing unit extends into the reservoir or constitutes a part of the boundaries of the reservoir, and the cooling liquid has direct access to the free surface of the processing unit.

A possible heat exchanging interface may be the direct contact between the heat generating unit such as a CPU and the cooling liquid, where at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit comprising at least one liquid reservoir mainly for dissipating or radiating heat, said heat being accumulated and transferred by said cooling liquid, said cooling system being adapted such as to provide transfer of said heat from a heat dissipating interface to a heat radiating surface where said at least one liquid reservoir being provided with one aperture intended for being closed by placing said aperture covering part of, alternatively covering the whole of, the at least one processing unit in such a way that a free surface of the processing unit is in direct heat exchanging contact with an interior of the reservoir, and thus in direct heat exchanging contact with the cooling liquid in the reservoir, through the aperture.

The aperture of the reservoir may be intended for being closed by attaching boundaries of said aperture to a free surface of a the processing unit, said boundaries being liquid-proof when attached to the free surface of the processing unit so that the liquid may flow freely across the free surface without the risk of the liquid dissipating through the boundaries. Alternatively, but posing the same technical effect, the aperture of the reservoir is intended for being closed by attaching boundaries of said aperture along boundaries of a free surface of the processing unit.

If a heat sink is provided as an aid in dissipating heat from the heat generating unit such as a CPU, the aperture of the reservoir may be intended for being closed by attaching boundaries of said aperture to a free surface of a heat sink. Alternatively, the aperture of the reservoir may be intended for being closed by attaching boundaries of said aperture along boundaries of a free surface of a heat sink. Alternatively, possibly, the heat exchanging interface may be provided as a first reservoir intended for being closed by attaching boundaries of an aperture in the first reservoir to, alternatively along, a free surface of a said processing unit, and a second reservoir intended for being closed by attaching boundaries of an aperture in the second reservoir to, alternatively along, a free surface of a to a free surface of a heat sink, and liquid conducting means provided between the first reservoir and the second reservoir.

The first reservoir may be closed by attaching said first reservoir to a heat exchanging surface element being in close thermal contact with the processing unit, said heat exchanging surface intended for dissipating heat from the processing unit to cooling liquid in the first reservoir, and wherein a second reservoir is closed by attaching said second reservoir to a surface of a heat sink, said heat sink intended for radiating heat from cooling liquid in the second reservoir to the exterior surroundings.

Also, the first reservoir and said second reservoir may be provided as a monolithic structure comprising both the first reservoir and the second reservoir and where both a heat dissipation from the processing unit to the cooling liquid in the first reservoir and heat radiation from the cooling liquid in the second reservoir to exterior surrounding is provided by the monolithic structure. The said monolithic structure may preferably be manufactured at least partly from plastic, preferably being manufactured fully in plastic, and said monolithic structure thus being manufactured by injection molding.

Transfer of said cooling liquid from an outlet of the first reservoir to an inlet of the second reservoir, and from an outlet of the second reservoir to an inlet of the first reservoir, and circulating the cooling liquid within said liquid conducting means is provided by a pumping means being intended for pumping the cooling liquid. One of said reservoirs of said monolithic structure may comprise said pumping means.

An inlet and/or an outlet and/or a pumping member of said pumping means, may be provided in the vicinity of said substantially plane side in order to provide a turbulence of flow and hereby improve the exchange of heat between said cooling liquid and substantially plane side, and the inlet of the pumping means may be provided within the first reservoir and the outlet may be provided within the second reservoir.

According to one aspect of the invention, a method is envisaged, said method of cooling a computer system comprising at least one unit such as a central processing unit (CPU) generating thermal energy and said method utilizing a cooling system for cooling the at least one processing unit and, said cooling system comprising a reservoir, at least one heat exchanging interface and a pumping means, said method of cooling comprising the steps of establishing, or defining, or selecting an operative status of the pumping means; controlling the operation of the motor of the pumping means in response to the following parameters; the necessary direction of movement for obtaining a pumping action of a pumping member of the pumping means, the possible direction of movement of a driving part of the motor of the pumping means; and in accordance with the operative status being established, defined or selected, controlling the operation of the computer system in order to achieve the necessary direction of movement of the driving part of the motor for establishing the necessary direction of movement for obtaining he pumping action of the pumping member.

There may be pumping means, where the pumping member is only operable in one direction but where the motor driving the pumping member is operable in two directions. The solution to this problem is to either choose a pumping member operable in both directions or to chose a motor being operable in only one direction. According to the invention, a solution is provided where a one-way directional pumping member may be operated any a two-way directional motor. Despite the contradictory nature of this solution, advantages may however be present.

As example, the method is being applied to a cooling system where the pumping member is a rotary impeller having a one-way direction for obtaining a pumping action, and where the motor of the pumping means is an electrical AC motor having a rotor constituting the driving part of the motor, and where said method comprises the step of establishing, or defining, or selecting a rotary position of the rotor of the electrical AC motor, and applying at least one half-wave of an AC power signal to the stator of the AC motor before applying a full-wave AC power signal.

As an alternative example, the method is being applied to a cooling system where the pumping member is a rotary impeller having a one-way direction for obtaining a pumping action, and where the motor of the pumping means is an electrical AC motor having a rotor constituting the driving part of the motor, and said method comprises the step of establishing, or defining, or selecting a rotary position of the rotor of the electrical AC motor, and applying at least one half-wave of an AC power signal to the stator of the AC motor after having applied the full-wave AC power signal.

In both the above examples, the advantages of the one-way impeller from a traditional DC pump together with the advantages of a motor from a traditional AC pump is obtained in the solution mentioned. The performance of an impeller of a DC pump is much better than the performance of an impeller from an AC pump. The motor from an AC pump is more reliable than a motor from a DC pump. The advantageous obtained is thus of synergetic nature, seeing that different advantages of the impeller of the DC pump and of the motor of the AC pump are different in nature.

According to another aspect of the invention, a method is envisaged, said method of cooling a computer system comprising at least one unit such as a central processing unit (CPU) generating thermal energy and said method utilizing a cooling system for cooling the at least one processing unit and, said cooling system comprising a reservoir, at least one heat exchanging interface, an air blowing fan, a pumping means, said method of cooling comprising the steps of applying one of the following possibilities of how to operate the computer system: establishing, or defining, or selecting an operative status of the computer system; controlling the operation of at least one of the following means of the computer system; the pumping means and the air blowing fan in response to at least one of the following parameters; a surface temperature of the heat generating processing unit, an internal temperature of the heat generating processing unit, or a processing load of the CPU; and in accordance with the operative status being established, defined or selected, controlling the operation of the computer system in order to achieve at least one of the following conditions; a certain cooling performance of the cooling system, a certain electrical consumption of the cooling system, a certain noise level of the cooling system.

Applying the above method ensures an operation of the computer system being in accordance with selected properties during the use of the computer system. For some applications, the cooling performance is vital such as may be the case when working with image files or when downloading large files from a network during which the processing units is highly loaded and thus generating much heat. For other applications, the electrical power consumption is more vital such as may be the case when utilizing domestic computer systems or in large office building in environments where the electrical grid may be weak such as in third countries. In still other applications, the noise generated by the cooling system is to be reduced to a certain level, which may be the case in office buildings with white collar people working alone, or at home, if the domestic computer perhaps is situated in the living room, or at any other location where other exterior considerations have to be dealt with.

According to another aspect of the invention, a method is envisaged, said method being employed with cooling system further comprising a pumping means with an impeller for pumping the cooling liquid through a pumping housing, said pumping means being driven by an AC electrical motor with a stator and a rotor, and said pumping means being provided with a means for sensing a position of the rotor, and wherein the method comprises the following steps: initially establishing a preferred rotational direction of the rotor of the electrical motor; before start of the electrical motor, sensing the angular position of the rotor; during start, applying an electrical AC voltage to the electrical motor and selecting the signal value, positive or negative, of the AC voltage at start of the electrical motor; said selection being made according to the preferred rotational direction; and said application of the AC signal, such as an AC voltage, being performed by the computer system for applying the AC signal, such as an AC voltage, from the electrical power supply of the computer system during conversions of the electrical DC signal, such as a DC voltage, of the power supply to the AC signal, such as an AC voltage, for the electrical motor.

Adopting the above method according to the invention ensures the most efficient circulation of cooling liquid in the cooling system and at the same time ensures the lowest possible energy consumption of the electrical motor driving the impeller. The efficient circulation of the cooling liquid is obtained by means of an impeller being designed for rotation in one rotational direction only, thus optimizing the impeller design with regard to the only one rotational direction as opposed to both rotational directions. The low energy consumption is achieved because of the impeller design being optimized, thus limiting the necessary rotational speed of the impeller for obtaining e certain amount of flow of the cooling liquid through the cooling system. A bonus effect of the lowest possible energy consumption being obtained is the lowest possible noise level of the pump also being obtained. The noise level of the pump is amongst other parameters also dependent on the design and the rotational speed of the impeller. Thus, an optimized impeller design and impeller speed will reduce the noise level to the lowest possible in consideration of ensuring a certain cooling capacity.

BRIEF DESCRIPTION OF THE FIGURES

The invention will hereafter be described with reference to the drawings, where

FIG. **1** shows an embodiment of the prior art. The figure shows the typical components in an air-cooling type CPU cooling arrangement.

FIG. **2** shows an embodiment of the prior art. The figure shows the parts of the typical air-cooling type CPU cooling arrangement of FIG. **1** when assembled.

FIG. **3** shows an embodiment of the prior art. The figure shows the typical components in a liquid-cooling type CPU cooling arrangement.

FIG. **4** is an exploded view of the invention and the surrounding elements.

FIG. **5** shows the parts shown in the previous figure when assembled and attached to the motherboard of a computer system.

FIG. **6** is an exploded view of the reservoir from the previous FIGS. **4** and **5** seen from the opposite site and also showing the pump.

FIG. **7** is a cut-out view into the reservoir housing the pump and an inlet and an outlet extending out of the reservoir.

FIG. **8** is a view of the cooling system showing the reservoir connected to the heat radiator.

FIG. **9-10** are perspective views of a possible embodiment of reservoir housing providing direct contact between a CPU and a cooling liquid in a reservoir.

FIG. **11-13** are perspective views of a possible embodiment of heat sink and a reservoir housing constituting an integrated unit.

FIG. **14** is a perspective view of the embodiment shown in FIG. **9-10** and the embodiment shown in FIG. **11-13** all together constituting an integrated unit.

FIG. **15-16** are perspective view of a possible embodiment of a reservoir and a pump and a heat exchanging surface constituting an integrated unit

FIG. **17** is a perspective view of a preferred embodiment of a reservoir and a pump and a heat exchanging surface constituting an integrated unit,

FIG. **18** is a plane view of a possible, however preferred embodiment of an AC electrical motor for a pumping means of the cooling system according to the invention, and

FIG. **19** is a graph showing a method for starting a rotor of the electrical AC motor, said AC motor driving an impeller selected from a pump driven by a DC motor.

FIG. **20** is a is a simplified schematic showing a cross-sectional view of the reservoir along plane **20**-**20** of FIG. **17**.

DETAILED DESCRIPTION

FIG. **1** is an exploded view of an embodiment of prior art cooling apparatus for a computer system. The figure shows the typical components in an air-cooling type CPU cooling arrangement. The figure shows a prior art heat sink **4** intended for air cooling and provided with segments intersected by interstices, a prior art air fan **5** which is to be mounted on top of the heat sink by use of fastening means **3** and **6**.

The fastening means comprises a frame **3** provided with holes intended for bolts, screws, rivets or other suitable fastening means (not shown) for thereby attaching the frame to a motherboard **2** of a CPU **1** or onto another processing unit of the computer system. The frame **3** is also provided with mortises provided in perpendicular extending studs in each corner of the frame, said mortises intended for taking up tenons of a couple of braces. The braces **6** are intended for enclosing the heat sink **4** and the air fan **5** so that the air fan and the heat sink thereby is secured to the frame. Using proper retention mechanisms, when the frame is attached to the motherboard of the CPU of other processing unit, and when the tenons of the braces are inserted into the mortises of the frame, the air fan and heat exchanger is pressed towards the CPU by using a force perpendicular to the CPU surface, said force being provided by lever arms.

FIG. **2** shows the parts of the typical air-cooling type CPU cooling arrangement of FIG. **1**, when assembled. The parts are attached to each other and will be mounted on top of a CPU on a motherboard (not shown) of a computer system.

FIG. **3** shows another embodiment of a prior art cooling system. The figure shows the typical components in a liquid-cooling type CPU cooling arrangement. The figure shows a prior art heat exchanger **7**, which is in connection with a prior art liquid reservoir **8**, a prior art liquid pump **9** and a heat radiator **11** and an air fan **10** provided together with the heat radiator. The prior art heat exchanger **7**, which can be mounted on a CPU (not shown) is connected to a radiator and reservoir, respectively. The reservoir serves as a storage unit for excess liquid not capable of being contained in the remaining components. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid. The heat radiator **11** serves as a means for removing the heat from the liquid by means of the air fan **10** blowing air through the heat radiator. All the components are in connection with each other via tubes for conducting the liquid serving as the cooling medium.

FIG. **4** is an exploded view of a cooling system according to an embodiment of the invention. Also elements not being part of the cooling system as such are shown. The figure shows a central processing unit CPU **1** mounted on a motherboard of a computer system **2**. The figure also shows a part of the existing fastening means, i.e. amongst others the frame **3** with mortises provided in the perpendicular extending studs in each corner of the frame. The existing fastening means, i.e. the frame **3** and the braces **6**, will during use be attached to the motherboard **2** by means of bolts, screws, rivets or other suitable fastening means extending through the four holes provided in each corner of the frame and extending through corresponding holes in the motherboard of the CPU. The frame **3** will still provide an opening for the CPU to enable the CPU to extend through the frame.

The heat exchanging interface **4** is a separate element and is made of a heat conducting material having a relative high heat thermal conductivity such as copper or aluminum, and which will be in thermal contact with the CPU **1**, when the cooling system is fastened to the motherboard **2** of the CPU. The heat exchanging surface constitutes part of a liquid reservoir housing **14**, thus the heat exchanger **4** constitutes the part of the liquid reservoir housing facing the CPU. The reservoir may as example be made of plastic or of metal. The reservoir or any other parts of the cooling system, which are possibly manufactured from a plastic material may be "metalized" in order to minimize liquid diffusion or evaporation of the liquid. The metal may be provided as a thin layer of metal coating provided on either or on both of the internal side or the external side of the plastic part.

If the reservoir is made of metal or any other material having a relative high heat conductivity compared to as example plastic, the heat exchanging interface as a separate element may be excluded because the reservoir itself may constitute a heat exchanger over an area, wherein the reservoir is in thermal contact with the processing unit. Alternatively to having the heat exchanging interface constitute part of the liquid reservoir housing, the liquid reservoir housing may be tightly attached to the heat exchanging interface by means of screws, glue, soldering, brazing or the like means for securing the heat exchanging interface to the housing and vice versa, perhaps with a sealant **5** provided between the housing and the heat exchanging interface.

Alternatively to providing a heat exchanging interface integrate with the reservoir containing the cooling liquid, it will be possible to exclude the heat exchanger and providing another means for dissipating heat from the processing unit to the cooling liquid in the reservoir, The other means will be a hole provided in the reservoir, said hole intended for being directed towards the processing unit. Boundaries of the hole will be sealed towards boundaries of the processing unit or will be sealed on top of the processing unit for thereby preventing cooling liquid from the reservoir from leaking. The only prerequisite to the sealing is that a liquid-tight connection is provided between boundaries of the hole and the processing unit or surrounding of the processing unit, such as a carrier card of the processing unit.

By excluding the heat exchanger, a more effective heat dissipation will be provided from the processing unit and to the cooling liquid of the reservoir, because the intermediate element of a heat exchanger is eliminated. The only obstacle in this sense is the provision of a sealing being fluid-tight in so that the cooling liquid in the reservoir is prevented from leaking.

The heat exchanging surface **4** is normally a copper plate. When excluding the heat exchanging surface **4**, which may be a possibility not only for the embodiments shown in FIG. **4**, but for all the embodiments of the invention, it may be necessary to provide the CPU with a resistant surface that will prevent evaporation of the cooling liquid and/or any damaging effect that the cooling liquid may pose to the CPU. A resistant surface may be provided the CPU from the CPU producer or it may be applied afterwards. A resistant surface to be applied afterwards may e.g. be a layer, such as an adhesive tape provided on the CPU. The adhesive tape may be made with a thin metal layer e.g. in order to prevent evaporation of the cooling liquid and/or any degeneration of the CPU itself.

Within the liquid reservoir, a liquid pump (not shown) is placed for pumping a cooling liquid from an inlet tube **15** connection being attached to the housing of the reservoir through the reservoir and past the heat exchanger in thermal contact with the CPU to an outlet tube connection **16** also being attached to the reservoir housing. The existing fastening means comprising braces **6** with four tenons and the frame **3** with four corresponding mortises will fasten the reservoir and the heat exchanger to the motherboard of the CPU. When fastening the two parts of the existing fastening means to each other the fastening will by means of the lever arms **18** create a force to assure thermal contact between the CPU **1** mounted on the motherboard and the heat exchanger **4** being provided facing the CPU.

The cooling liquid of the cooling system may be any type of cooling liquid such as water, water with additives such as anti-fungicide, water with additives for improving heat conducting or other special compositions of cooling liquids such as electrically non-conductive liquids or liquids with lubricant additives or anti-corrosive additives.

FIG. **5** shows the parts shown in FIG. **4** when assembled and attached to the motherboard of a CPU of a computer system **2**. The heat exchanger and the CPU is in close thermal contact with each other. The heat exchanger and the remainder of the reservoir housing **14** is fastened to the motherboard **2** by means of the existing fastening means being secured to the motherboard of the CPU and by means of the force established by the lever arms **18** of the existing fastening means. The tube inlet connection **15** and the tube outlet connection **16** are situated so as to enable connection of tubes to the connections.

FIG. **6** is an exploded view of the reservoir shown in previous FIG. **4** and FIG. **5** and seen from the opposite site and also showing the pump **21** being situated inside the reservoir. Eight screws **22** are provided for attaching the heat exchanging surface **4** to the remainder of the reservoir. The heat exchanging surface is preferably made from a copper plate having a plane outer surface as shown in the figure, said outer surface being intended for abutting the free surface of the heat generating component such as the CPU (see FIG. **4**). However, also the inner surface (not shown, see FIG. **7**) facing the reservoir is plane. Accordingly, the copper plate need no machining other than the shaping of the outer boundaries into the octagonal shape used in the embodiment shown and drilling of holes for insertion of the bolts. No milling of the inner and/or the outer surface need be provided.

A sealant in form of a gasket **13** is used for the connection between the reservoir housing **14** and the heat exchanging surface forming a liquid tight connection. The pump is intended for being placed within the reservoir. The pump has a pump inlet **20** through which the cooling liquid flows from the reservoir and into the pump, and the pump has a pump outlet **19** through which the cooling liquid is pumped from the pump and to the outlet connection. The figure also shows a lid **17** for the reservoir. The non-smooth inner walls of the reservoir and the fact that the pump is situated inside the reservoir will provide a swirling of the cooling liquid inside the reservoir.

However, apart from the non-smooth walls of the reservoir and the pump being situated inside the reservoir, the reservoir may be provided with channels or segments for establishing a certain flow-path for the cooling liquid through the reservoir (see FIG. **9**-**10** and FIG. **15**). Channel or segments are especially needed when the inner surface of the heat exchanging surface is plane and/or when the inner walls of the reservoir are smooth and/or if the pump is not situated inside the reservoir. In either of the circumstances mentioned, the flow of the cooling liquid inside the reservoir may result in the cooling liquid passing the reservoir too quickly and not being resident in the reservoir for a sufficient amount of time to take up a sufficient amount of heat from the heat exchanging surface. By providing channels or segments inside the reservoir, a flow will be provided forcing the cooling liquid to pass the heat exchanging surface, and the amount of time increased of the cooling liquid being resident inside the reservoir, thus enhancing heat dissipation. If channels or segments are to be provided inside the reservoir, the shape and of the channels and segments may be decisive of whether the reservoir is to be made of plastic, perhaps by injection molding, or is to be made of metal such as aluminum, perhaps by die casting.

The cooling liquid enters the reservoir through the tube inlet connection **15** and enters the pump inlet **20**, and is pumped out of the pump outlet **19** connected to the outlet connection **16**. The connection between the reservoir and the inlet tube connection and the outlet tube connection, respectively, are made liquid tight. The pump may not only be a self-contained pumping device, but may be made integrated into the reservoir, thus making the reservoir and a pumping device one single integrated component. This single integrated element of the reservoir and the pumping device may also be integrated, thus making the reservoir, the pumping device and the heat exchanging surface one single integrated unit. This may as example be possible if the reservoir is made of a metal such as aluminum. Thus, the choice of material provides the possibility of constituting both the reservoir and a heat exchanging surface having a relatively high heat conductivity, and possibly also renders the possibility of providing bearings and the like constructional elements for a motor and a pumping wheel being part of the pumping device.

In an alternative embodiment, the pump is placed in immediate vicinity of the reservoir, however outside the reservoir. By placing the pump outside, but in immediate vicinity of the reservoir, still an integrate element may be obtained. The pump or the inlet or the outlet is preferably positioned so as to obtain a turbulence of flow in the immediate vicinity of the heat exchanging interface, thereby promoting increased heat dissipation between the heat exchanging interface end the cooling liquid. even in the alternative, a pumping member such as an impeller (see FIG. **15-16**) may be provided in the immediate vicinity of the heat exchanging surface. The pumping member itself normally introduces a turbulence of flow, and thereby the increased heat dissipation is promoted irrespective of the position of the pump itself, or the position of the inlet or of the outlet to the reservoir or to the pump.

The pump may be driven by an AC or a DC electrical motor. When driven by an AC electrical motor, although being technically and electrically unnecessary in a computer system, this may be accomplished by converting part of the DC electrical power of the power supply of the computer system to AC electrical power for the pump. The pump may be driven by an electrical motor at any voltage common in public electrical networks such as 110V or 220V. However, in the embodiment shown, the pump is driven by a 12V AC electrical motor.

Control of the pump in case the pump is driven by an AC electrical motor, preferably takes place by means of the operative system or an alike means of the computer system itself, and where the computer system comprises means for measuring the CPU load and/or the CPU temperature. Using the measurement performed by the operative system or alike system of the computer system eliminates the need for special means for operating the pump. Communication between the operative system or alike system and a processor for operating the pump may take place along already established communication links in the computer system such as a USB-link. Thereby, a real-time communication between the cooling system and the operative system is provided without any special means for establishing the communication.

In the case of the motor driving the pump is an AC electrical motor, the above method of controlling the pump may be combined with a method, where said pumping means is provided with a means for sensing a position of the rotor of the electrical motor, and wherein the following steps are employed: Initially establishing a preferred rotational direction of the rotor of the electrical motor, before start of the electrical motor, sensing the angular position of the rotor, during start, applying an electrical AC voltage to the electrical motor and selecting the signal value, positive or negative, of the AC voltage at start of the electrical motor, said selection being made according to the preferred rotational direction, and said application of the AC voltage being performed by the computer system for applying the AC voltage from the electrical power supply of the computer system during conversion of the electrical DC voltage of the power supply to AC voltage for the electrical motor. By the operative system of the computer system itself generating the AC voltage for the electrical motor, the rotational direction of the pump is exclusively selected by the computer system, non-depending on the applied voltage of the public grid powering the computer system.

Further control strategies utilizing the operative system or alike system of the computer system may involve balancing the rotational speed of the pump as a function of the cooling capacity needed. If a lower cooling capacity is needed, the rotational speed of the pump, may be limited, thereby limiting the noise generating by the motor driving the pump.

In the case an air fan is provided in combination with a heat sink as shown in FIG. **1**, of the air fan is provided in combination with the heat radiator, the operative system or alike system of the computer system may be designed for regulating the rotational speed of the pump, and thus of the motor driving the pump, and the rotational speed of the air fan, and thus the motor driving the air fan. The regulation will take into account the cooling capacity needed, but the regulation will at the same time take into account which of the two cooling means, i.e. the pump and the air fan, is generating the most noise. Thus, it the air fan generally is generating more noise than the pump, then the regulation will reduce the rotational speed of the air fan before reducing the rotational speed of the pump, whenever a lower cooling capacity is needed. Thereby, the noise level of the entire cooling system is lowered as much as possible. If the opposite is the case, i.e. the pump generally generating more noise than the air fan, then the rotational speed of the pump will be reduced before reducing the rotational speed of the air fan.

Even further control strategies involve controlling the cooling capacity in dependence on the type of computer processing taking place. Some kind of computer processing, such as word-processing, applies a smaller load on the processing units such as the CPU than other kinds of computer processing, such as image processing. Therefore, the kind of processing taking place on the computer system may be used as an indicator of the cooling capacity. It may even be possible as part of the operative system or similar system to establish certain cooling scenarios, depending on the kind of processing intended by the user. If the user selects as example word-processing, a certain cooling strategy is applied based on a limited need for cooling. If the user selects as example image-processing, a certain cooling strategy is applied based on an increased need for cooling. Two or more different cooling scenarios may be established depending on the capacity and the control possibilities and capabilities of the cooling system and depending on the intended use of the computer system, either as selected by a user during use of the computer system or as selected when choosing hardware during build-up of the computer system, i.e. before actual use of the computer system.

The pump is not being restricted to a mechanical device, but can be in any form capable of pumping the cooling liquid through the system. However, the pump is preferably one of the following types of mechanical pumps: Bellows pump, centrifugal pump, diaphragm pump, drum pump, flexible liner pump, flexible impeller pump, gear pump, peristaltic tubing pump, piston pump, processing cavity pump, pressure washer pump, rotary lobe pump, rotary vane pump and electro-kinetic pump. Similarly, the motor driving the pumping member need not be electrical but may also be a piezo-electrically operated motor, a permanent magnet operated motor, a fluid-operated motor or a capacitor-operated motor. The choice of pump and the choice of motor driving the pump id dependent on many different parameters, and it is up to the person skilled in the art to choose the type of pump and the type of motor depending on the specific application. As example, some pumps and some motors are better suited for small computer systems such as lab-tops, some pumps and some motors are better suited for establishing high flow of the cooling liquid and thus a high cooling effect, and even some pumps and motors are better suited for ensuring a low-noise operation of the cooling system.

FIG. **7** is a cut-out view into the reservoir, when the reservoir and the heat exchanging surface **4** is assembled and the pump **21** is situated inside the reservoir. The reservoir is provided with the tube inlet connection (not seen from the figure) through which the cooling liquid enters the reservoir. Subsequently, the cooling liquid flows through the reservoir passing the heat exchanging surface and enters the inlet of the pump. After having been passed through the pump, the cooling liquid is passed out of the outlet of the pump and further out through the tube outlet connection **16**. The figure also shows a lid **17** for the reservoir. The flow of the cooling liquid inside the reservoir and trough the pump may be further optimized in order to use as little energy as possible for pumping the cooling liquid, but still having a sufficient amount of heat from the heat exchanging surface being dissipated in the cooling liquid. This further optimization can be established by changing the length and shape of the tube connection inlet within the reservoir, and/or by changing the position of the pump inlet, and/or for instance by having the pumping device placed in the vicinity and in immediate thermal contact with the heat exchanging surface and/or by providing channels or segments inside the reservoir.

In this case, an increased turbulence created by the pumping device is used to improve the exchange of heat between the heat exchanging surface and the cooling liquid. Another or an additional way of improving the heat exchange is to force the cooling liquid to pass through specially adapted channels or segments being provided inside the reservoir or by making the surface of the heat exchanging surface plate inside the reservoir uneven or by adopting a certain shape of a heat sink with segments. In the figure shown, the inner surface of the heat exchanging surface facing the reservoir is plane.

FIG. **8** is a perspective view of the cooling system showing the reservoir housing **14** with the heat exchanging surface (not shown) and the pump (not shown) inside the reservoir. The tube inlet connection and the tube outlet connection are connected to a heat radiator by means of connecting tubes **24** and **25** through which the cooling liquid flows into and out of the reservoir and the heat radiator, respectively. Within the heat radiator **11**, the cooling liquid passes a number of channels for radiating the heat, which has been dissipated into the cooling liquid inside the reservoir, and to the surroundings of the heat exchanger. The air fan **10** blows air past the channels of the heat radiator in order to cool the radiator and thereby cooling the cooling liquid flowing inside the channels through the heat radiator and back into the reservoir.

According to the invention, the heat radiator **11** may be provided alternatively. The alternative heat radiator is constituted by a heat sink, such as a standard heat sink made of extruded aluminum with fins on a first side and a substantially plane second side. An air-fan may be provided in connection with the fins along the first side. Along the second side of the heat sink a reservoir is provided with at least one aperture intended for being closed by placing said aperture covering part of, alternatively covering the whole of, the substantial plane side of the heat sink. When closing the reservoir in such a way a surface of the heat sink is in direct heat exchanging contact with an interior of the reservoir, and thus in direct heat exchanging contact with the cooling liquid in the reservoir, through the at least one aperture. This alternative way of providing the heat radiator may be used in the embodiment shown in FIG. **8** or may be used as a heat radiator for another use and/or for another embodiment of the invention.

A pumping means for pumping the cooling liquid trough the reservoir may or may not be provided inside the reservoir at the heat sink. The reservoir may be provided with channels or segments for establishing a certain flow-path for the cooling liquid through the reservoir. Channels or segments are especially needed when the inner surface of the heat exchanging surface is plane and/or when the inner walls of the reservoir are smooth and/or if the pump is not situated inside the reservoir. In either of the circumstances mentioned, the flow of the cooling liquid inside the reservoir may result in the cooling liquid passing the reservoir too quickly and not being resident in the reservoir for a sufficient amount of time to take up a sufficient amount of heat from the heat exchanging surface. If channels or segments in the reservoir are to be provided inside the reservoir, the shape and of the channels and segments may be decisive of whether the reservoir is to be made of plastic, perhaps by injection molding, or is to be made of metal such as aluminum, perhaps by die casting.

By means of the alternative heat radiator, the heat radiator **11** is not provided as is shown in the figure with the rather expensive structure of channels leading the cooling liquid along ribs connecting the channels for improved surface of the structure. Instead, the heat radiator is provided as described as a unit constituted by a heat sink with or without a fan and a reservoir, and thereby providing a simpler and thereby cheaper heat radiator than the heat radiator **11** shown in the figure.

The alternative heat radiator provided as an unit constituted by a heat sink and a reservoir, may be used solely, with or without a pump inside the reservoir and with or without the segments or channels, for being placed in direct or indirect thermal contact with a heat generating processing unit such as CPU or with the heat exchanging surface, respectively. These embodiments of the invention may e.g. be used for a reservoir, where the cooling liquid along a first side within the reservoir is in direct heat exchanging contact with the heat generating processing unit such as a CPU and the cooling liquid along a second side within the reservoir is in direct heat exchanging contact with a heat sink. Such a reservoir may be formed such as to provide a larger area of heat exchanging surface towards the heat generating processing unit such as a CPU than the area of the heat exchanging surface facing the heat sink. This may e.g. have the purpose of enlarging the area of the heat exchanging surface so as to achieve an improved heat dissipation form e.g. the CPU to the heat sink than that of a conventional heat sink without a reservoir attached. Conventional heat sinks normally only exchanges heat with the CPU through the area as given by the area of the top side of the CPU. A system comprising a liquid reservoir and a heat sink with a fan provided has been found to be a simple, cost optimized system with an improved heat dissipation than that of a standard heat sink with a fan, but without the reservoir. In another embodiment of the invention, which may be derived from FIG. **8**, the air fan and the heat radiator is placed directly in alignment of the reservoir. Thereby, the reservoir housing **14**, the air fan **10** and the radiator **11** constitute an integrate unit. Such an embodiment may provide the possibility of omitting the connection tubes, and passing the cooling liquid directly from the heat radiator to the reservoir via an inlet connection of the reservoir, and directly from the reservoir to the heat radiator via an outlet connection of the reservoir. Such an embodiment may even render the possibility of both the pumping device of the liquid pump inside the reservoir and the electrical motor for the propeller of the air fan **23** of the heat radiator **11** being driven by the same electrical motor, thus making this electrical motor the only motor of the cooling system.

When placing the heat radiator on top of the air fan now placed directly in alignment with the reservoir and connecting the heat radiator directly to the inlet connection and outlet connection of the reservoir, a need for tubes will not be present. However, if the heat radiator and the reservoir is not in direct alignment with each other, but tubes may still be needed, but rather than tubes, pipes made of metal such as copper or aluminum may be employed, such pipes being impervious to any possible evaporation of cooling liquid. Also, the connections between such pipes and the heat radiator and the reservoir, respectively, may be soldered so that even the connections are made impervious to evaporation of cooling liquid.

In the derived embodiment just described, an integrated unit of the reservoir, the heat exchanging surface and the pumping device will be given a structure establishing improved heat radiating characteristics because the flow of air of the air fan may also be directed along outer surfaces of the reservoir. If the reservoir is made of a metal, the metal will be cooled by the air passing the reservoir after having passed or before passing the heat radiator. If the reservoir is made of metal, and if the reservoir is provided with segments on the outside surface of the reservoir, such cooling of the reservoir by the air will be further improved. Thereby, the integrated unit just described will be applied improved heat radiating characteristics, the heat radiation function normally carried out by the heat radiator thus being supplemented by one or more of the further elements of the cooling system, i.e. the reservoir, the heat exchanging surface, the liquid pump and the air fan.

FIG. **9-10** show an embodiment of a reservoir housing **14**, where channels **25** are provided inside the reservoir for establishing a forced flow of the cooling liquid inside the reservoir. The channels **25** in the reservoir housing **14** lead from an inlet **15** to an outlet **16** like a maze between the inlet and the outlet. The reservoir housing **14** is provided with an aperture **27** having outer dimensions corresponding to the dimensions of a free surface of the processing unit **1** to be cooled. In the embodiment shown, the processing unit to be cooled is a CPU **1**.

When channels **26** are provided inside the reservoir, the shape of the channels may be decisive of whether the reservoir is to be made of plastic, perhaps manufactured by injection molding, or is to be made of metal such as aluminum, perhaps manufactured by extrusion or by die casting.

The reservoir housing **14** or any other parts of the cooling system, which are possibly manufactured from a plastic material may be "metalized" in order to minimize liquid diffusion or evaporation of the liquid. The metal may be provided as a thin layer of metal coating provided on either or on both of the internal side or the external side of the plastic part.

The CPU **1** is intended for being positioned in the aperture **27**, as shown in FIG. **10**, so that outer boundaries of the CPU are engaging boundaries of the aperture. Possibly, a sealant (not shown) may be provided along the boundaries of the CPU and the aperture for ensuring a fluid tight engagement between the boundaries of the CPU and the boundaries of the aperture. When the CPU **1** is positioned in the aperture **27**, the free surface (not shown) of the CPU is facing the reservoir, i.e. the part of the reservoir having the channels provided. Thus, when positioned in the aperture **27** (see FIG. **10**), the free surface of the CPU **1** is having direct contact with cooling liquid flowing through the channels **26** in the reservoir.

When cooling liquid is forced from the inlet **15** along the channels **26** to the outlet **16**, the whole of the free surface of the CPU **1** will be passed over by the cooling liquid, thus ensuring a proper and maximized cooling of the CPU. The configuration of the channels may be designed and selected according to any one or more provisions, i.e. high heat dissipation, certain flow characteristics, ease of manufacturing etc. Accordingly, the channels may have another design depending on any desire or requirement and depending on the type of CPU and the size and shape of the free surface of the CPU. Also. other processing units than a CPU may exhibit different needs for heat dissipation, and may exhibit other sizes and shapes of the free surface, leading to a need for other configurations of the channels. If the processing unit is very elongate, such as a row of microprocessors, one or a plurality of parallel channels may be provided, perhaps just having a common inlet and a common outlet.

FIG. **11-13** show an embodiment of a heat sink **4**, where segments **28** are provided at a first side **4**A of the heat sink, and fins **29** for dissipating heat to the surroundings are provided at the other, second side **4**B of the heat sink. An intermediate reservoir housing **30** is provided having a recessed reservoir at the one side facing the first side **4**A of the heat sink. The recessed reservoir **30** has an inlet **31** and an outlet **32** at the other side opposite the side facing the heat sink **4**.

When segments **28** are provided on the first side **4**A of the heat sink, the shape of the segments may be decisive of whether the reservoir, which is made from metal such as aluminum or copper, is to be made by extrusion or is to be made by other manufacturing processes such as die casting. Especially when the segments **28** are linear and are parallel with the fins **29**, as shown in the embodiment, extrusion is a possible and cost-effective means of manufacturing the heat sink **4**.

The intermediate reservoir **30** or any other parts of the cooling system, which are possibly manufactured from a plastic material may be "metalized" in order to minimize liquid diffusion or evaporation of the liquid. The metal may be provided as a thin layer of metal coating provided on either or on both of the internal side or the external side of the plastic part.

The recessed reservoir is provided with a kind of serration **33** along opposite sides of the reservoir, and the inlet **31** and the outlet **32**, respectively, are provided at opposite corners of the intermediate reservoir **30**. The segments **28** provided at the first side **4**A of the heat sink, i.e. the side facing the intermediate reservoir **30**, are placed so that when the heat sink is assembled with the intermediate reservoir housing (see FIG. **13**) the segments **29** run from one serrated side of the reservoir to the other serrated side of the reservoir.

When cooling liquid is forced from the inlet **31** through the reservoir, along channels (not shown) formed by the segments **29** of the heat sink **4** and to the outlet **32**, the whole of the first side **4**A of the heat sink will be passed over by the cooling liquid, thus ensuring a proper and maximized heat dissipation between the cooling liquid and the heat sink. The configuration of the segments on the first side **4**A of the heat sink and the configuration of the serrated sides of the intermediate reservoir housing may be designed and selected according to any provisions. Accordingly, the segments may have another design, perhaps being wave-shaped or also a serrated shape, depending on any desired flow characteristics of the cooling liquid and depending on the type of heat sink and the size and shape of the reservoir.

Also other types of heat sinks, perhaps circular shaped heat sinks may exhibit different needs for heat dissipation, may exhibit other sizes and shapes of the free surface, leading to a need for other configurations of the segments and the intermediate reservoir. If the heat sink and the reservoir are circular or oval, a spiral-shaped segmentation or radially extending segments may be provided, perhaps having the inlet or the outlet in the centre of the reservoir. If an impeller of the pump is provided, as shown in FIG. **15-16**, the impeller of the pump may be positioned in the centre of a spiral-shaped segmentation or in the centre of radially extending segments.

FIG. **14** shows the reservoir housing **14** shown in FIG. **9-10** and the heat sink **4** and the intermediate reservoir **30** shown in FIG. **11-13** being assembled for thereby constituting an integrated monolithic unit. It is not absolutely necessary to assemble the reservoir housing **14** of FIG. **9-10** and the heat sink **4** and the intermediate reservoir **30** of FIG. **11-13** in order to obtain a properly functioning cooling system. The inlet **15** and the outlet **16** of the reservoir housing **14** of FIG. **9-10** may be connected to the outlet **32** and the inlet **31**, respectively, of the intermediate reservoir of FIG. **11-13** by means of tubes or pipes.

The reservoir housing **14** of FIG. **9-10** and the heat sink **4** and the intermediate reservoir **30** of FIG. **11-13** may then be positioned in the computer system at different locations. However, by assembling the reservoir housing **14** of FIG. **9-10** and the heat sink **4** and the intermediate reservoir **30** of FIG. **11-13** a very compact monolithic unit is obtained, also obviating the need for tubes or pipes. Tubes or pipes may involve an increased risk of leakage of cooling liquid or may require soldering or other special working in order to eliminate the risk of leakage of cooling liquid. By eliminating the need for tubes or pipes, any leakage and any additional working is obviated when assembling the cooling system.

FIG. **15-16** show a possible embodiment of a reservoir according to the invention. The reservoir is basically similar to the reservoir shown in FIG. **9-10**. However, an impeller **33** of the pump of the cooling system is provided in direct communication with the channels **26**. Also, in the embodiment shown, a heat exchanging interface **4** such as a surface made from a copper plate, alternatively a plate of another material having a high thermal conductivity, is placed between the channels **26** inside the reservoir and the CPU **1** as the processing unit.

The heat exchanging surface **4** is preferably made from a copper plate having a plane outer surface as shown in the figure, said outer surface being intended for abutting the free surface of the heat generating component such as the CPU **1** (see FIG. **4**). However, also the inner surface (not shown, see FIG. **7**) facing the reservoir is plane. Accordingly, the copper plate need no machining other than the shaping of the outer boundaries into the specially adapted shape used in the embodiment shown and drilling of holes for insertion of the bolts. No milling of the inner and/or the outer surface need be provided.

The provision of the heat exchanging surface **4** need not be a preferred embodiment, seeing that the solution incorporating the aperture (see FIG. **9-10**) result in a direct heat exchange between the free surface of the CPU or other processing unit and the cooling liquid flowing along the channels in the reservoir. However, the heat exchanging surface enables usage of the cooling system independently on the type and size of the free surface of CPU or other processing unit. Also, the heat exchanging surface enables replacement, repair or other intervention of the cooling system without the risk of cooling liquid entering the computer system as such and possibly without the need for draining the cooling system fully or partly of cooling liquid.

In the embodiment shown, the heat exchanging surface **4** is secured to the reservoir by means of bolts **22**. Other convenient fastening means may be used. The heat exchanging surface **4** and thus the reservoir housing **14** may be fastened to the CPU **1** or other processing unit by any suitable means such as soldering, brazing or by means of thermal paste combined with glue. Alternatively, special means (not shown) may be provided for ensuring a thermal contact between the free surface of the CPU or other processing unit and the heat exchanging surface. One such means may be the fastening means shown in FIG. **4** and FIG. **5** or similar fastening means already provided as part of the computer system.

When channels **26** are provided inside the reservoir housing **14**, the shape of the channels may be decisive of whether the reservoir is to be made of plastic, perhaps by injection molding, or is to be made of metal such as aluminum, perhaps by die casting.

The reservoir housing **14** or any other parts of the cooling system, which are possibly manufactured from a plastic material may be "metalized" in order to minimize liquid diffusion or evaporation of the liquid. The metal may be provided as a thin layer of metal coating provided on either or on both of the internal side or the external side of the plastic part.

The impeller **33** (see FIG. **14**) of the pump is positioned in a separate recess of the channels **26**, said separate recess having a size corresponding to the diameter of the impeller of the pump. The recess is provided with an inlet **34** and an outlet **35** being positioned opposite an inlet **31** and an outlet **32** of cooling liquid to and from, respectively, the channels **26**. The impeller **33** of the pump has a shape and a design intended only for one way rotation, in the embodiment shown a clockwise rotation only. Thereby, the efficiency of the impeller of the pump is highly increased compared to impellers capable of and intended for both clock-wise and counter clock-wise rotation.

The increased efficiency of the impeller design results in the electric motor (not shown) driving the impeller of the pump possibly being smaller than otherwise needed for establishing a proper and sufficient flow of cooling liquid through the channels. in a preferred embodiment, the electric motor is an AC motor, preferably a 12V AC motor, although the impeller is intended for a DC motor. The contradictory use of an AC motor driving a DC impeller leads to the possibility of an even smaller motor needed for establishing the proper and sufficient flow of cooling liquid through the channels.

The impeller may be driven by an electrical motor at any voltage common in public electrical networks such as 110V or 220V. The power supply of the computer system converts the high voltage AC power to low voltage DC power. Thus, the impeller of the pump may be driven by an AC or a DC electrical motor. As mentioned, preferably the impeller of the pump is driven by an AC electrical motor. Although being technically unnecessary to use an AC electrical motor and being electrically disadvantageous to use an AC electrical motor in a computer system supplying DC electrical power, this may be accomplished by converting part of the DC electrical power of the power supply of the computer system to AC electrical power for the AC motor of the pump. However, in the embodiment shown, the impeller of the pump is driven by a 12V electrical motor.

FIG. **17** shows a preferred possible embodiment of a reservoir according to the invention. The reservoir housing **14**, as shown in FIGS. **17** and **20**, is in the form of a double-sided chassis configured to mount an electrical motor. The reservoir housing **14** has basically the same features as the reservoir housing shown in FIG. **15-16**. In the embodiment shown, the reservoir substantially has a conical, circular configuration and is provided with stiffening ribs **36** extending axially along the exterior of the reservoir housing **14**.

Other shapes such as cylindrical, circular, or conical rectangular or cylindrical, rectangular or even oval or triangular shapes may be adopted, when designing and possibly injection molding or casting the reservoir. The dimension of the embodiment shown is approximately 55 mm in diameter and also 55 mm in axial extension.

The reservoir housing **14** has a recess **40** in the centre on the upper side_of the reservoir. The recess **40** is intended for accommodating a stator **37** of an electrical motor driving an impeller **33** of the pump, said impeller being attached to a shaft **38** of a rotor **39** of the electrical motor. The recess **40** has an orifice **41**, four sidewalls **42**, a bottom **43** and a circular jacket **44** extending from the bottom **43** of the recess **40** and outwards towards the orifice **41** of the recess **40**. The interior (see FIG. **20**) of the jacket **44** is intended for encompassing the rotor **39** of the pump. As shown in FIG. **20**, the impeller **33** is housed in a recess on the underside of the reservoir housing **14**, the recess being an extension of the interior of the jacket **44**.

Thereby, a liquid-proof division is made between the rotor **39** of the motor, said rotor **39** being placed inside the interior of the jacket **44** and being submerged in the cooling liquid, and the stator **37** of the pump, said stator **37** being positioned in the recess **40** and surrounding the exterior of the jacket **44**. Accordingly, the stator **37** need not be sealed against the cooling liquid, because the recess **40** together with the jacket **44** ensures the stator staying dry from the cooling liquid, but the stator **37** still being capable of driving the rotor **39**, when being supplied with electrical power from a power supply (not shown) of the computer system.

Along an outer circumferential extension, the reservoir housing **14** is provided with protrusions **45** extending outwardly from the circumferential extension. The protrusions are intended for cooperating with a clip (see description below) for fastening the reservoir housing **14** to the CPU or other processing unit of the computer system. The protrusions **45** are shown as a plurality of singular protrusions. Alternatively, the protrusions may be only one continuous protrusion extending outwardly and around the circumferential extension.

The reservoir housing **14** may also be provided with an inlet (not shown) and an outlet (not shown) for the cooling liquid. The inlet and the outlet are provided along a surface of the reservoir facing downward and inwards when seen in the perspective view of the drawing. The inlet and the outlet lead to a radiator (not shown) intended for cooling the cooling liquid after having been heated by the processing unit via a heat exchanging surface (see description below).

The radiator may be placed nearby or distant from the reservoir housing **14**, depending on the set-up of the computer system. In one possible embodiment, the radiator is placed in the immediate vicinity of the reservoir, thereby possible excluding any tubing extending between the radiator and the inlet and the outlet, respectively. Such embodiment provides a very compact configuration of the entire cooling system, namely a monolithic configuration where all elements needed for the cooling system are incorporated in one unit.

In an alternative embodiment, the reservoir housing **14** itself also constitutes the radiator of the cooling system. In such embodiment, an inlet and an outlet are not needed. If the reservoir is made of a metal such as copper or aluminum or other material having a high thermal conductance, the cooling liquid, after having been heated by the processing unit via a heat exchanging surface **8** see description below) may radiate the heat via the exterior surface of the reservoir housing **14** itself. In such embodiment, the ribs **36** along the exterior surface of the reservoir housing **14** may also, or may instead, function as cooling fins. In such embodiment, the fins will have a smaller dimension than the transverse dimension of the ribs **14** shown in FIG. **17**, and the number of fins will be greater than the number of fins shown in FIG. **17**.

An impeller **33** of the pump of the cooling system is provided in direct communication with a pump chamber **46** formed by impeller cover **46**A having an outlet **34** provided tangentially to the circumference of the impeller **33**. Thus, the pump functions as a centrifugal pump. The inlet of the pump chamber **46** is the entire opening into the cavity that the pump chamber configures, said cavity being in direct communication with the interior of the reservoir housing **14** as such. An intermediate member **47** is provided between the pump chamber **46** together with the interior of the reservoir and a heat exchanging interface **4**. The intermediate member **47** is provided with a first passage **48** for leading cooling liquid from the pump chamber **46** to a thermal exchange chamber **47**A provided at the opposite of the intermediate member **47**. The intermediate member **47** is provided also with a second passage **49** for leading cooling liquid from the thermal exchange chamber **47**A provided at the opposite of the intermediate member **47** to the interior of the reservoir housing **14**. Thus, the area enclosed between the underside of the reservoir housing **14** and the heat exchange surface **4** constitutes an enclosed space for circulating the cooling liquid therethrough. The enclosed spaced is divided into two separate chambers by the impeller cover **46**A and the intermediate member **47**, as shown in FIG. **20**. The impeller cover **46**A interfaces with the recess on the underside of the reservoir **14** to define the pump chamber **46** which houses the impeller **33**, while the intermediate member **47** and the heat exchange surface **4** together define the thermal exchange chamber **47**A.

In the embodiment shown, a heat exchanging interface **4** such as a surface made from a copper plate, alternatively a plate of another material having a high thermal conductivity, is placed in thermal communication with the thermal exchange chamber (not shown) at the opposite side of the intermediate member **47**.

The heat exchanging interface **4** is preferably made from a copper plate having a plane outer surface (not shown) at the opposite side as the side shown in the figure, said outer surface being intended for abutting the free surface of the heat generating component such as the CPU (see FIG. **4**). The inner surface facing the thermal exchange chamber (not shown) at the opposite side of the intermediate member **47** is provided with pins **4**A extending from the base of the copper plate and into the thermal exchange chamber (not shown) at the opposite side of intermediate member **47**. The pins **4**A constitutes an uneven surface and may either be provided during casting of the copper plate or may be provided by means of milling or other machining process of a copper plate. The pins provide a network of channels across the inner surface of the heat exchanging interface, along which network the cooling liquid is intended to flow.

Alternatively, also the inner surface of the copper plate facing the reservoir is plane. In this alternative embodiment, the copper plate need no machining other than the shaping of the outer boundaries into the specially adapted shape used in the embodiment shown. No milling or other machining process of the inner and/or the outer surface need be provided, when both the outer surface and the inner surface is plane.

The provision of the heat exchanging interface **4** need not be a preferred embodiment, seeing that the solution incorporating the aperture (see FIG. **9-10**) result in a direct heat exchange between the free surface of the CPU or other processing unit and the cooling liquid flowing along the channels in the reservoir. However, the heat exchanging interface enables usage of the cooling system independently on the type and size of the free surface of CPU or other processing unit. Also, the heat exchanging interface enables replacement, repair or other intervention of the cooling system without the risk of cooling liquid entering the computer system as such and possibly without the need for draining the cooling system fully or partly of cooling liquid.

In the embodiment shown, the heat exchanging interface **4** is secured to the intermediate member **47** by means of gluing or other means ensuring a proper and liquid-tight fastening of the heat exchanging interface with the intermediate member. Any other suitable and convenient means (not shown) for securing the heat exchanging interface to the intermediate member may be envisaged.

The heat exchanging interface and thus the reservoir is fastened to the top of the CPU by means of a clip **50**. The clip **50** has a circular configuration and has four legs **51** extending axially from the circular configuration. The four legs **51** are provided with footing **52** and the footings **52** are provided with holes **53**. The clip **50** is intended for being displaced around the exterior of the reservoir housing **14** and further axially to the protrusions **45** of the reservoir housing **14**.

The clip **50**, after having been placed around the reservoir housing **14**, is fastened to the motherboard of the computer system by means of bolts (not shown) or the like fastening means extending through the holes **53** in the footings **52** and further though corresponding holes in the motherboard. The corresponding holes in the motherboard are preferably holes already available in the motherboard in the vicinity of the CPU and the socket of the CPU, respectively. Accordingly, the legs **51** and the footings **52** of the clip **50** are specially designed in accordance with the already provided holes in the motherboard.

Alternatively, the heat exchanging interface **4** and thus the reservoir housing **14** may be fastened to the CPU or other processing unit by any other suitable means such as soldering, brazing or by means of thermal paste combined with glue. Alternatively, special means (not shown) may be provided for ensuring a thermal contact between the free surface of the CPU or other processing unit and the heat exchanging interface. One such means may be the fastening means shown in FIG. **4** and FIG. **5** or similar fastening means already provided as part of the computer system.

When stiffening and/or cooling fins **36** are provided at the exterior of the reservoir housing **14**, the shape of and the number of fins may be decisive of whether the reservoir is to be made of plastic, perhaps by injection molding, or is to be made of metal such as aluminum, perhaps by die casting. Also, the purpose of the fins i.e. just for stiffening the reservoir, or also or instead for cooling purposes, may be decisive of whether the reservoir is to be made of plastic, perhaps by injection molding, or is to be made of metal such as aluminum, perhaps by die casting.

The reservoir housing **14** or any other parts of the cooling system, which are possibly manufactured from a plastic material may be "metalized" in order to minimize liquid diffusion or evaporation of the liquid. The metal may be provided as a thin layer of metal coating provided on either or on both of the internal side or the external side of the plastic part.

The impeller **33** of the pump has a shape and a design intended only for one way rotation, in the embodiment shown a clock-wise rotation only. Thereby, the efficiency of the impeller of the pump is highly increased compared to impellers capable of and intended for both clock-wise and counter clock-wise rotation.

The increased efficiency of the impeller design results in the electric motor (not shown) driving the impeller of the pump possibly being smaller than otherwise needed for establishing a proper and sufficient flow of cooling liquid through the channels. In a preferred embodiment, the electric motor is an AC motor, preferably a 12V AC motor, although the impeller is intended for a DC motor. The contradictory use of an AC motor driving a DC impeller leads to the possibility of an even smaller motor needed for establishing the proper and sufficient flow of cooling liquid through the channels.

The impeller may be driven by an electrical motor at any voltage common in public electrical networks such as 110V AC power or 220V AC power. The power supply of the computer system converts the high voltage AC power to low voltage DC power. Thus, the impeller of the pump may be driven by either an AC or a DC electrical motor. As mentioned, preferably the impeller of the pump is driven by an AC electrical motor. Although being technically unnecessary to use an AC electrical motor and being electrically disadvantageous to use an AC electrical motor in a computer system supplying DC electrical power, this may be nevertheless be accomplished by converting part of the DC electrical power of the power supply of the computer system to AC electrical power for the AC motor of the pump.

In every aspect of the invention, where an AC motor is used for driving an impeller from a DC motor, although this way of configuring a pump is contradictory, the following preferred mode of operation is established for alleviating the disadvantages:

In order to be able to control direction of rotation of the impeller attached to the rotor and to optimize the conditions of maximum average torque value during starting, i.e. from zero speed up to the synchronous speed, an electronic control circuit is used. The electronic control circuit comprises a processing unit, which drives a static power switch, constituted for example by a triac arranged in series between the alternating-voltage power, which is obtained from the DC power supply of the computer system, and the AC motor. The same series network also includes a detector for the current I which flows through the triac and then through the AC motor. The output of the current detector is an input signal for the electronic processing unit.

The electronic control circuit may also comprise a number or sensors suitable for detecting the position and polarity of the permanent magnets comprised in the rotor of the AC motor, both when the rotor is moving and when it is in particular operating conditions, or when it is motionless or stalled at zero speed. The number of position sensors may be

Hall sensors, encoders or optical or electromechanical sensors capable of establishing and/or measuring the position of the rotor. The output signal from the number of position sensors is an input signal for the electronic processing unit.

Alternatively, the output signal from the position sensor may be phase shifted by means of an electronic phase shifting circuit before the output signal is sent to the input of the electronic processing unit.

A third signal may be input to the processing unit, said third signal enabling the processing unit to detect the polarity of the AC voltage applied to the AC motor. However, the third signal is not compulsory.

The signals input to the electronic processing unit are converted into digital form and after being processed by the processing unit, an output signal is provided by the processing unit. The output signal is used for closing or opening the static switch constituted by a triac arranged in series with the AC motor.

In the electronic processing unit, the current signal provided by the current sensor enters a zero-crossing detector which provides in output a logical “1” signal indicating that said current approaches zero with a positive or negative deviation from the zero value of said current. This deviation depends on the type of motor used and on its application, as well as on the type of static power switch being used. The signal arriving from the position sensor enters a phase-shift and processing circuit the output whereof is 1 or 0 according to the position and polarity of the rotor.

In the electronic processing unit, the phase shifted position signal as well as the signal processed from the AC voltage, enter an electronic logic XOR gate which outputs a “1” signal if the digital value of the AC voltage is equal to “0” and the digital value of the phase shifted position signal is equal to “1” or the digital value of the AC voltage is equal to “1” and the digital value of the phase shifted position signal is equal to “0”.

The output of the zero-crossing detector and the output of the XOR gate, thus in digital form, enter an electronic logic AND gate which provides in output the control signal for closing or opening the static power switch.

The AND gate with two inputs and the signal processing system allow determining two conditions: 1) the AC voltage signal is positive, the current is proximate to zero, and the rotor rotation angle is between 0 degrees and 180 degrees; 2) the AC voltage signal is negative, the current is proximate to zero, and the rotor rotation angle is between 180 degrees and 360 degrees. These two conditions provide the same rotation direction of the rotor of the AC motor.

FIG. **18** shows an embodiment of an AC motor in which one stator pole **54** is longer than the other stator pole **55** by an amount indicated by 1. With this configuration the permanent-magnet rotor **39** with an ideal line **56** separating the north N and the south S of the rotor, is positioned so that the ideal line **56** do not coincide with the median axis **57** of the stator **37**, but so that the ideal line **56** is tilted by a certain angle .alpha. in respect to the median **57** of the stator **37**.

Two energizing windings **58**, **59** are provided on the two poles **54**,**55** of the stator **37**, respectively, and the energizing windings are connected in series and are powered, through terminals (not shown), by an AC power source. With this configuration of the AC motor, the motor is able to start more easily in an intended rotational direction of the rotor.

In a preferred embodiment of the invention, the control electronics supplies the AC motor with only a half-wave voltage signal during start up, thereby providing torque pulses to the rotor. Since only a half-wave voltage signal is supplied to the motor, the torque pulses are always unidirectional and will therefore force the rotor to start rotating in a required direction. The required direction of rotation is determined by the design of the impeller attached to the rotor and by polarity of the half-wave voltage signal.

After some amount of time, in which a number of half-wave voltage signals has been supplied to the motor, the rotor will stop rotating at a certain position e.g. as shown in the figure. Thus, the rotor is brought into a determined steady state position that is independent of its start position. Subsequent to this process, the AC motor is supplied with a full-wave voltage signal that will accelerate the rotor until the motor enters synchronous operation, that is, when the rotor rotates with the same cyclic frequency as the frequency of the AC voltage source.

The initial polarity of the AC voltage signal is determinative for the resulting direction of rotation of the rotor, thus if the initial voltage is positive with an increasing amplitude, the rotor will start rotating in one direction, whereas if the voltage is negative with a decreasing amplitude, the rotor will start rotating in an opposite direction.

The number of half-waves required for bringing the rotor into a determined steady state position, where the rotor stops rotating, depends on the characteristics of the motor such as moment of inertia and the external load applied to the rotor. Thus, the number of half-waves required is based on empirical analysis of a particular motor in particular load conditions.

The half-wave voltage signal and the corresponding half-wave current signal supplied to the motor will have an appearance as shown in FIG. **19**.

In an alternative embodiment the control electrics used to drive the AC motor shown if FIG. **18** is configured so that that the control electronics dictates the AC motor to stop at a predetermined position by supplying the motor with a number of half-wave voltage signals subsequent to the synchronous operation in which the motor was supplied with a full-wave voltage signal. Thus, at the time the motor needs to be started again, the rotor is already in a position so that only the polarity of the full-wave AC voltage signal supplied to the motor must be chosen so that the resulting direction of rotation of the rotor is in conformity with the terminal position of the rotor at the last operation.

According to this method, the initial step of bringing the rotor into a determined steady state position by supplying the motor with a number of half-wave voltage signals is not required. Even in the alternative, it will be possible to both terminate the full-wave power supply with a number of half-wave voltage signals as well as commencing the full-wave power supply by initially supplying the motor with a number of half-wave signals. However, this is more cumbersome, but nevertheless more safe.

FIG. **19** shows a voltage signal V and a current signal I applied to the AC motor as well as the position signal of the rotor. Initially the rotor stands still, which is represented by the straight line L. The electronic control circuit controls the static power switch so that the voltage signal V and the current signal I are present as half-waves. Thus, the rotor receives torque pulses due to the current-voltage combination; these pulses are always one-way directional and tend to start the rotor moving in the required direction. Subsequent to the start-up phase, the rotor enters into its synchronous operation.

Thus, an AC signal is generated, preferably a 12 VAC signal, possibly by means of digital electric pulses from the 12 V DC power supply of the computer’s power supply. Based on a possible sensor output relating to the impeller position, a decision is made of how to initiate the AC power signal, i.e. with a negative or positive half-wave, and by doing making sure the impeller starts in the same rotational direction each time and thus the performance benefits of the AC pump is similar to those of a DC pump.

Alternatively, the magnetic field sensor is omitted, and instead of reading the impeller position, the impeller is forced to be in the same position every time the impeller starts. To be sure the impeller is in a defined position before start, a signal is supplied to the stator of the AC motor for a defined period of time. The signal is supplied perhaps three times in a row according to the curvature of the electrical power source. The pulses must be within the same half-wave part of a signal period. The frequency of the pulsed signal is arbitrary, but may be 50/60 Hz, although, despite the fact that under normal circumstances an AC pump being driven by the AC signal from the power outlet of the public electrical power network and transformed from 230/115 V to 12V would not function, as there is no chance of changing the sine signal from the public network.

By this way the impeller will be forced to the right polarity before start, and the pump will start turning the impeller in a defined way of rotation when the power signal full-wave is supplied. The full-wave power signal, which is supplied, must start in the opposite signal half-wave amplitude than that of the initial half-wave pulses, that was supplied before start of the full-wave power signal.

The invention has been described with reference to specific embodiments and with reference to specific utilization, it is to be noted that the different embodiments of the invention may be manufactured, marketed, sold and used separately or jointly in any combination of the plurality of embodiments. In the above detailed description of the invention, the description of one embodiment, perhaps with reference to one or more figures, may be incorporated into the description of another embodiment, perhaps with reference to another or more other figures, and vice versa. Accordingly, any separate embodiment described in the text and/or in the drawings, or any combination of two or more embodiments is envisaged by the present application.

What is claimed is:

1. A cooling system for a heat-generating component, comprising:
- a double-sided chassis adapted to mount a pump configured to circulate a cooling liquid, the pump comprising a stator and an impeller, the impeller being positioned on the underside of the chassis and the stator being positioned on the upper side of the chassis and isolated from the cooling liquid;
- a reservoir adapted to pass the cooling liquid therethrough, the reservoir including:
  - a pump chamber including the impeller and formed below the chassis, the pump chamber being defined by at least an impeller cover having one or more passages for the cooling liquid to pass through;
  - a thermal exchange chamber formed below the pump chamber and vertically spaced apart from the pump chamber, the pump chamber and the thermal exchange chamber being separate chambers that are fluidly coupled together by the one or more passages; and
  - a heat-exchanging interface, the heat-exchanging interface forming a boundary wall of the thermal exchange chamber, and configured to be placed in thermal contact with a surface of the heat-generating component; and
- a heat radiator fluidly coupled to the reservoir and configured to dissipate heat from the cooling liquid.

2. The cooling system of claim **1**, wherein the chassis shields the stator from the cooling liquid in the reservoir.

3. The cooling system of claim **1**, wherein the heat-exchanging interface includes a first side and a second side opposite the first side, and wherein the heat-exchanging interface contacts the cooling liquid in the thermal exchange chamber on the first side and the heat-exchanging interface is configured to be in thermal contact with the surface of the heat-generating component on the second side.

4. The cooling system of claim **3**, wherein the first side of the heat-exchanging interface includes features that are adapted to increase heat transfer from the heat-exchanging interface to the cooling liquid in the thermal exchange chamber.

5. The cooling system of claim **4**, wherein the features include at least one of pins or fins.

6. The cooling system of claim **1**, wherein a passage of the one or more passages that fluidly couple the pump chamber and the thermal exchange chamber is offset from a center of the impeller.

7. The cooling system of claim **1**, wherein the impeller includes a plurality of curved blades.

8. The cooling system of claim **1**, wherein the heat-exchanging interface includes one of copper and aluminum.

9. The cooling system of claim **1**, wherein the heat radiator is fluidly coupled to the reservoir using flexible conduits, and the heat radiator is configured to be positioned remote from the reservoir.

10. A cooling system for a computer system, comprising:
- a centrifugal pump adapted to circulate a cooling liquid, the pump including:
  - an impeller exposed to the cooling liquid; and
  - a stator isolated from the cooling liquid;
- a reservoir configured to be thermally coupled to a heat-generating component of the computer system, the reservoir including:
  - a thermal exchange chamber adapted to be positioned in thermal contact with the heat-generating component;
  - a separate pump chamber vertically spaced part from the thermal exchange chamber and coupled with the thermal exchange chamber through one or more passages configured for fluid communication between the pump chamber and the thermal exchange chamber, and wherein at least one of the one or more passages is offset from a center of the impeller.

11. The cooling system of claim **10**, wherein a top wall of the reservoir physically separates the impeller from the stator.

12. The cooling system of claim **10**, wherein the thermal exchange chamber includes a heat-exchange interface configured to be placed in thermal contact with the heat-generating component.

13. The cooling system of claim **10**, further including a heat radiator fluidly coupled to the reservoir using flexible conduits, wherein the heat radiator is configured to be positioned remote from the reservoir.

14. The cooling system of claim **10**, wherein the fluid passage that is offset from the center of the impeller is positioned tangentially to the circumference of the impeller.

15. A cooling system for a heat-generating component, comprising:
- a pump adapted to circulate a cooling liquid, the pump including:
  - an impeller exposed to the cooling liquid; and
  - a stator isolated from the cooling liquid;
- a reservoir including an impeller cover, an intermediate member and a heat exchange interface, wherein a top wall of the reservoir and the impeller cover define a pump chamber for housing the impeller, and the intermediate member and the heat exchange interface define

a thermal exchange chamber, the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together; and

wherein a first side of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and a second side of the heat-exchanging interface opposite the first side is configured to be placed in thermal contact with a surface of the heat-generating component; and

a liquid-to-air heat exchanger fluidly coupled to the reservoir using flexible conduits, the heat exchanger being configured to be positioned remote from the reservoir.

16. The cooling system of claim **15**, wherein the impeller cover includes a first opening radially offset from a center of the impeller and the intermediate member includes a second passage that is aligned with the first opening, the first and the second opening being configured to direct the cooling liquid from the pump chamber into the thermal exchange chamber.

17. The cooling system of claim **15**, wherein the first side of the heat-exchanging interface includes at least one of pins or fins.

18. The cooling system of claim **15**, wherein the top wall of the reservoir extends between the stator and the impeller and shields the stator from the cooling liquid in the reservoir.

* * * * *

Appendix B to the Request for *Inter Partes* Reexamination of

In re Patent of	:	Andre Sloth Eriksen
U.S. Patent No.	:	8,245,764
Application No.	:	13/269,234
Issue Date	:	August 21, 2012
Filing Date	:	October 7, 2011
Title	:	COOLING SYSTEM FOR A COMPUTER SYSTEM

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	Not yet assigned
	Filing Date	2012-09-15
	First Named Inventor	Eriksen
	Art Unit	Not yet assigned
	Examiner Name	Not yet assigned
	Attorney Docket Number	COOL-1.012

U.S.PATENTS						
Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6529376	B2	2003-03-04	Hamman	
	2	5731954		1998-03-24	Cheon	
	3	7325591	B2	2008-02-05	Duan	
	4	7544049	B2	2009-06-09	Koga	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	Not yet assigned
	Filing Date	2012-09-15
	First Named Inventor	Eriksen
	Art Unit	Not yet assigned
	Examiner Name	Not yet assigned
	Attorney Docket Number	COOL-1.012

	1	2006119761	WO	A1	2006-11-16	Asetek A/S		☐

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

Appendix J to the Request for *Inter Partes* Reexamination of

In re Patent of	:	Andre Sloth Eriksen
U.S. Patent No.	:	8,245,764
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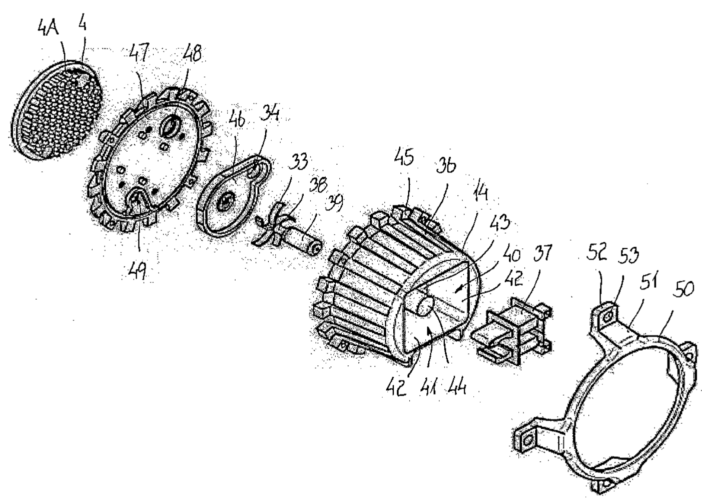

(57) **Abstract:** The invention relates to a cooling system for a compute system, said computer system comprising at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit and comprising a reservoir having an amount of cooling liquid, said cooling liquid intended for accumulating and transferring of thermal energy dissipated from the processing unit to the cooling liquid. The cooling system has a heat exchanging interface for providing thermal contact between he processing unit and the cooling liquid for dissipating heat from the processing unit to the cooling liquid, Different embodiments of the heat exchanging system as well as means for establishing and controlling a flow of cooling liquid and a cooling strategy constitutes the invention of the cooling system.

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COOLING SYSTEM FOR A COMPUTER SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates to a cooling system for a central processing unit (CPU) or other processing unit of a computer system. More specifically, the invention relates to a liquid-cooling system for a mainstream computer system such as a PC.

During operation of a computer, the heat created inside the CPU or other processing unit must be carried away fast and efficiently, keeping the temperature within the design range specified by the manufacturer. As an example of cooling systems, various CPU cooling methods exist and the most used CPU cooling method to date has been an air-cooling arrangement, wherein a heat sink in thermal contact with the CPU transports the heat away from the CPU and as an option a fan mounted on top of the heat sink functions as an air fan for removing the heat from the heat sink by blowing air through segments of the heat sink. This air-cooling arrangement is sufficient as long as the heat produced by the CPU is kept at today's level, however it becomes less useful in future cooling arrangements when considering the development of CPUs since the speed of a CPU is said to double perhaps every 18 months, thus increasing the heat production accordingly.

Another design used today is a CPU cooling arrangement where cooling liquid is used to cool the CPU by circulating a cooling liquid inside a closed system by means of a pumping unit, and where the closed system also comprises a heat exchanger past which the cooling liquid is circulated.

A liquid-cooling arrangement is more efficient than an air-cooling arrangement and tends to lower the noise level of the cooling arrangement in general. However, the liquid-cooling design consists of many components, which increases the total installation time, thus making it less desirable as a mainstream solution. With a trend of producing smaller and more compact PCs for the end-users, the greater amount of components in a typical liquid-cooling arrangement is also undesirable. Furthermore, the many components having to be coupled together incurs a risk of leakage of cooling liquid from the system.

SUMMARY OF INVENTION

It may be one object of the invention to provide a small and compact liquid-cooling solution, which is more efficient than existing air-cooling arrangements and which can be produced at a low cost enabling high production volumes. It may be another object to create a liquid-cooling arrangement, which is easy-to-use and implement, and which

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requires a low level of maintenance or no maintenance at all. It may be still another object of the present invention to create a liquid-cooling arrangement, which can be used with existing CPU types, and which can be used in existing computer systems.

This object may be obtained by a cooling system for a computer system, said computer system comprising:
- at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit,
- a reservoir having an amount of cooling liquid, said cooling liquid intended for accumulating and transferring of thermal energy dissipated from the processing unit to the cooling liquid,
- a heat exchanging interface for providing thermal contact between the processing unit and the cooling liquid for dissipating heat from the processing unit to the cooling liquid,
- a pump being provided as part of an integrate element, said integrate element comprising the heat exchanging interface, the reservoir and the pump,
- said pump intended for pumping the cooling liquid into the reservoir, through the reservoir and from the reservoir to a heat radiating means,
- said heat radiating means intended for radiating thermal energy from the cooling liquid, dissipated to the cooling liquid, to surroundings of the heat radiating means.

By providing an integrate element, it is possible to limit the number of separate elements of the system. However, there is actually no need for limiting the number of elements, because often there is enough space within a cabinet of a computer system to encompass the different individual elements of the cooling system. Thus, it is surprisingly that, at all, any attempt is conducted of integrating some of the elements.

In possible embodiments according to this aspect of the invention, the entire pump is placed inside the reservoir with at least an inlet or an outlet leading to the liquid in the reservoir. In an alternative embodiment the pump is placed outside the reservoir in the immediate vicinity of the reservoir and wherein at least an inlet or an outlet is leading directly to the liquid in the reservoir. By placing the pump inside the reservoir or in the immediate vicinity outside the reservoir, the integrity of the combined reservoir, heat exchanger and pump is obtained, so that the element is easy to employ in new and existing computer systems, especially mainstream computer systems.

In a preferred embodiment, the pumping member of the pump and a driven part of the motor of the pump, such as a rotor of en electrical motor, is placed inside the reservoir embedded in the cooling liquid, and wherein a stationary part of the motor of the pump, such as a stator of an electrical motor, is placed outside the reservoir. By having the driven part of the motor placed inside the reservoir submerged in the cooling liquid and the stationary part of the motor outside the reservoir, there is no need for encapsulating the stationary part in a liquid-proof insulation. However, problems may occur having then stationary part driving the driven part. However, the present invention provide means for obtaining such action, although not at all evident how to solve this problem.

The object may also be obtained by a cooling system for a computer system, said computer system comprising:
- at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit,
- a reservoir having an amount of cooling liquid, said cooling liquid intended for accumulating and transferring of thermal energy dissipated from the processing unit to the cooling liquid,
- a heat exchanging interface for providing thermal contact between the processing unit and the cooling liquid for dissipating heat from the processing unit to the cooling liquid,
- a pump intended for pumping the cooling liquid into the reservoir, through the reservoir and from the reservoir to a heat radiating means,
- said cooling system being intended for thermal contact with the processing unit by means of existing fastening means associated with the processing unit, and
- said heat radiating means intended for radiating from the cooling liquid thermal energy, dissipated to the cooling liquid, to surroundings of the heat radiating means.

The use of existing fastening means has the advantage that fitting of the cooling system is fast and easy. However, once again there is no problem for the person skilled in the art to adopt specially adapted mounting means for any element of the cooling system, because there are numerous possibilities in existing cabinets of computer systems for mounting any kind of any number of elements, also elements of a cooling system.

In preferred embodiments according to this aspect of the invention, the existing fastening means are means intended for attaching a heat sink to the processing unit, or the existing fastening means are means intended for attaching a cooling fan to the processing unit, or the existing fastening means are means intended for attaching a heat sink together with a cooling fan to the processing unit. Existing fastening means of the kind mentioned is commonly used for air cooling of CPUs of computer systems, however, air cooling arrangements being much less complex than liquid cooling systems. Nevertheless, it has ingeniously been possible to develop a complex and effective liquid cooling system capable of utilising such existing fastening means for simple and less effective air cooling arrangements.

According to an aspect of the invention, the pump is selected from the following types: Bellows pump, centrifugal pump, diaphragm pump, drum pump, flexible liner pump, flexible impeller pump, gear pump, peristaltic tubing pump, piston pump, processing cavity pump, pressure washer pump, rotary lobe pump, rotary vane pump and electro-kinetic pump. By adopting one or more of the solution of the present invention, a wide variety of pumps may be used without departing from the scope of the invention.

According to another aspect of the invention, driving means for driving the pump is selected among the following driving means: electrically operated rotary motor, piezo-electrically operated motor, permanent magnet operated motor, fluid-operated motor, capacitor-operated motor. As is the case when selecting the pump to pump the liquid, by adopting one or more of the solution of the present invention, a wide variety of pumps may be used without departing from the scope of the invention.

The object may also be obtained by a cooling system for a computer system, said computer system comprising:
- at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit,
- a reservoir having an amount of cooling liquid, said cooling liquid intended for accumulating and transferring of thermal energy dissipated from the processing unit to the cooling liquid,
- a heat exchanging interface for providing thermal contact between the processing unit and the cooling liquid for dissipating heat from the processing unit to the cooling liquid,
- a pump intended for pumping the cooling liquid into the reservoir, through the reservoir and from the reservoir to a heat radiating means, and
- said cooling system further comprising a pump wherein the pump is driven by an AC electrical motor by a DC electrical power supply of the computer system,
- where at least part of the electrical power from said power supply is intended for being converted to AC being supplied to the electrical motor.

It may be advantageous to use an AC motor, such as a 12V AC motor, for driving the pump in order to obtain a stabile unit perhaps having to operate 24 hours a day, 365 days a year. However, the person skilled in the art will find it unnecessary to adopt as example a 12V motor because high voltage such as 220V or 110V is readily accessible as this is the electrical voltage used to power the voltage supply of the computer system itself. Although choosing to use a 12V motor for the pump, it has never been and will never be the choice of the person skilled in the art to use an AC motor. The voltage supplied by the voltage supply of the computer system itself is DC, thus this will be the type of voltage chosen by the skilled person.

In preferred embodiments according to any aspect of the invention, an electrical motor is intended both for driving the pump for pumping the liquid and for driving the a fan for establishing a flow of air in the vicinity of the reservoir, or an electrical motor is intended both for driving the pump for pumping the liquid and for driving the a fan for establishing a flow of air in the vicinity of the heat radiating means, or an electrical motor is intended both for driving the pump for pumping the liquid, and for driving the a fan for establishing a flow of air in the vicinity of the reservoir, and for driving the a fan for establishing a flow of air in the vicinity of the heat radiating means.

By utilising a single electrical motor for driving more than one element of the cooling system according to any of the aspects of the invention, the lesser complexity and the reliability of the cooling system will be further enhanced.

The heat exchanging interface may be an element being separate from the reservoir, and where the heat exchanging interface is secured to the reservoir in a manner so that the heat exchanging interface constitutes part of the reservoir when being secured to the reservoir. Alternatively, the heat exchanging interface constitutes an integrate surface of the reservoir, and where the heat exchanging surface extends along an area of the surface of the reservoir, said area of surface being intended for facing the processing unit and said area of surface being intended for the close thermal contact with the processing unit. Even alternatively, the heat exchanging interface is constitutes by a free surface of the processing unit, and where the free surface is capable of establishing heat dissipation between the processing unit and the cooling liquid through an aperture provided in the reservoir, and where the aperture extends along an area of the surface of the reservoir, said surface being intended for facing the processing unit.

Possibly, an uneven surface such as pins or fins extending from the copper plate provide a network of channels across the inner surface of the heat exchanging interface. A network of channels ensure the cooling liquid being passed along the inner surface of the interface such as a copper plate in a way that maximises the retention time of the cooling liquid along the heat exchanging interface and in a way that optimises the thermal exchange between the heat exchanging interface and the cooling liquid as long as the cooling liquid is in thermal contact with heat exchanging interface.

Possibly, the cooling system may be provided with a heat exchanging interface for providing thermal contact between the processing unit and the cooling liquid for dissipating heat from the processing unit to the cooling liquid,

- a pumping means being intended for pumping the cooling liquid into the reservoir, through the reservoir and from the reservoir to a heat radiating means,
- said heat radiating means intended for radiating thermal energy from the cooling liquid, dissipated to the cooling liquid, to surroundings of the heat radiating means,
- said heat exchanging interface constituting a heat exchanging surface being manufactured from a material suitable for heat conducting, and
- with a first side of the heat exchanging surface facing the central processing unit being substantially plane and
- with a second side of the heat exchanging surface facing the cooling liquid being substantially plane and
- said reservoir being manufactured from plastic, and channels or segments being provided in the reservoir for establishing a certain flow-path for the cooling liquid through the reservoir.

Providing a plane heat exchanging surface, both the first, inner side being in thermal contact with the cooling liquid and the second, outer side being in thermal contact with the heat generating processing unit, results in the costs for manufacturing the heat exchanging surface is reduced to an absolute minimum.

According to the above possible solution, an inlet of the pumping means is positioned in immediate vicinity of the heat exchanging interface for thereby obtaining a turbulence of flow of the cooling liquid in the immediate vicinity of the heat exchanging interface. The turbulence of flow is advantageous for obtaining a heat dissipation. If the heat exchanging interface is plane, the inlet of the pump being positioned as mentioned above, may result in a turbulence of flow occurring along the heat exchanging interface, at least in the vicinity of the inlet of the pump, but possibly also distant form the inlet.

Alternatively, or additionally, an outlet of said pumping means being positioned in immediate vicinity of the heat exchanging interface for thereby obtaining a turbulence of flow of the cooling liquid in the immediate vicinity of the heat exchange interface. The turbulence of flow is advantageous for obtaining a heat dissipation. If the heat exchanging interface is plane, the inlet of the pump being positioned as mentioned above, may result in a turbulence of flow occurring along the heat exchanging interface, at least in the vicinity of the inlet of the pump, but possibly also distant form the inlet.

However, a plane first, inner surface may also result in the cooling liquid passing the heat exchanging surface too fast. This may be remedied by providing grooves along the inner surface, thereby providing a flow path in the heat exchanging surface. This however results in the costs for manufacturing the heat exchanging surface increasing.

The solution to this problem has been dealt with by providing channels or segments in the reservoir housing in stead. The reservoir housing may be manufactured by injection moulding or by casting, depending on the material which the reservoir housing is made from. Proving channels or segments during moulding or casting of the reservoir housing is much more cost-effective than milling grooves along the inner surface of the heat exchanging surface.

Possibly, the cooling system may be provided with at least one liquid reservoir mainly for dissipating or radiating heat, said heat being accumulated and transferred by said cooling liquid,
- said cooling system being adapted such as to provide transfer of said heat from a heat dissipating surface to a heat radiating surface where
- said at least one liquid reservoir being provided with one aperture intended for being closed by placing said aperture covering part of, alternatively covering the whole of, the at least one processing unit in such a way that a free surface of the processing unit is in direct heat exchanging contact with an interior of the reservoir, and thus in direct heat exchanging contact with the cooling liquid in the reservoir, through the aperture.

Heat dissipation from the processing unit to the cooling liquid must be very efficient to ensure proper cooling of the processing unit, Especially in the case, where the processing unit is a CPU, the surface for heat dissipation is limited by the surface area of the CPU. This may be remedied by utilising a heat exchanging surface being made of a material having a high thermal conductivity such as copper or aluminium and ensuring a proper thermal bondage between the heat exchanging interface and the CPU.

However, in a possible embodiment according to the features in the above paragraph, the heat dissipation takes place directly between the processing unit and the cooling liquid by providing an aperture in the reservoir housing, said aperture being adapted for taking up a free surface of the processing unit. Thereby, the free surface of the processing unit extends into the reservoir or constitutes a part of the boundaries of the reservoir, and the cooling liquid has direct access to the free surface of the processing unit.

A possible heat exchanging interface may be the direct contact between the heat generating unit such as a CPU and the cooling liquid, where
- at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit comprising
- at least one liquid reservoir mainly for dissipating or radiating heat, said heat being accumulated and transferred by said cooling liquid,

- said cooling system being adapted such as to provide transfer of said heat from a heat dissipating interface to a heat radiating surface where
- said at least one liquid reservoir being provided with one aperture intended for being closed by placing said aperture covering part of, alternatively covering the whole of, the at least one processing unit in such a way that a free surface of the processing unit is in direct heat exchanging contact with an interior of the reservoir, and thus in direct heat exchanging contact with the cooling liquid in the reservoir, through the aperture.

The aperture of the reservoir may be intended for being closed by attaching boundaries of said aperture to a free surface of a the processing unit, said boundaries being liquid-proof when attached to the free surface of the processing unit so that the liquid may flow freely across the free surface without the risk of the liquid dissipating through the boundaries. Alternatively, but posing the same technical effect, the aperture of the reservoir is intended for being closed by attaching boundaries of said aperture along boundaries of a free surface of the processing unit.

If a heat sink is provided as an aid in dissipating heat from the heat generating unit such as a CPU, the aperture of the reservoir may be intended for being closed by attaching boundaries of said aperture to a free surface of a heat sink. Alternatively, the aperture of the reservoir may be intended for being closed by attaching boundaries of said aperture along boundaries of a free surface of a heat sink. Alternatively,

Possibly, the heat exchanging interface may be provided as
- a first reservoir intended for being closed by attaching boundaries of an aperture in the first reservoir to, alternatively along, a free surface of a said processing unit, and
- a second reservoir intended for being closed by attaching boundaries of an aperture in the second reservoir to, alternatively along, a free surface of a to a free surface of a heat sink, and
- liquid conducting means provided between the first reservoir and the second reservoir.

The first reservoir may be closed by attaching said first reservoir to a heat exchanging surface element being in close thermal contact with the processing unit, said heat exchanging surface intended for dissipating heat from the processing unit to cooling liquid in the first reservoir, and wherein a second reservoir is closed by attaching said second reservoir to a surface of a heat sink, said heat sink intended for radiating heat from cooling liquid in the second reservoir to the exterior surroundings.

Also, the first reservoir and said second reservoir may be provided as a monolithic structure comprising both the first reservoir and the second reservoir and where both a heat dissipation from the processing unit to the cooling liquid in the first reservoir and heat radiation from the cooling liquid in the second reservoir to exterior surrounding is provided by the monolithic structure. The said monolithic structure may preferably be manufactured at least partly from plastic, preferably being manufactured fully in plastic, and said monolithic structure thus being manufactured by injection moulding.

Transfer of said cooling liquid from an outlet of the first reservoir to an inlet of the second reservoir, and from an outlet of the second reservoir to an inlet of the first reservoir, and circulating the cooling liquid within said liquid conducting means is provided by a pumping means being intended for pumping the cooling liquid.

One of said reservoirs of said monolithic structure may comprise said pumping means.

An inlet and/or an outlet and/or a pumping member of said pumping means, may be provided in the vicinity of said substantially plane side in order to provide a turbulence of flow and hereby improve the exchange of heat between said cooling liquid and substantially plane side, and the inlet of the pumping means may be provided within the first reservoir and the outlet may be provided within the second reservoir.

According to one aspect of the invention, a method is envisaged, said method of cooling a computer system comprising at least one unit such as a central processing unit (CPU) generating thermal energy and said method utilising a cooling system for cooling the at least one processing unit and, said cooling system comprising a reservoir, at least one heat exchanging interface and a pumping means, said method of cooling comprising the steps of

- establishing, or defining, or selecting an operative status of the pumping means
- controlling the operation of the motor of the pumping means in response to the following parameters; the necessary direction of movement for obtaining a pumping action of a pumping member of the pumping means, the possible direction of movement of a driving part of the motor of the pumping means, and
- in accordance with the operative status being established, defined or selected, controlling the operation of the computer system in order to achieve the necessary direction of movement of the driving part of the motor for establishing the necessary direction of movement for obtaining he pumping action of the pumping member.

There may be pumping means, where the pumping member is only operationable in one direction but where the motor driving the pumping member is operationable in two directions. The solution to this problem is to either choose a pumping member operationale in both directions or to chose a motor being operationable in only one direction. According to the invention, a solution is provided where a one-way directional pumping member may be operated ny a two-way directional motor. Despite the contradictory nature of this solution, advantages may however be present.

As example, the method is being applied to a cooling system where the pumping member is a rotary impeller having a one-way direction for obtaining a pumping action, and where the motor of the pumping means is an electrical AC motor having a rotor constituting the driving part of the motor, and where said method comprises the step of establishing, or defining, or selecting a rotary position of the rotor of the electrical AC motor, and applying at least one half-wave of an AC power signal to the stator of the AC motor before applying a full-wave AC power signal.

As an alternative example, the method is being applied to a cooling system where the pumping member is a rotary impeller having a one-way direction for obtaining a pumping action, and where the motor of the pumping means is an electrical AC motor having a rotor constituting the driving part of the motor, and said method comprises the step of establishing, or defining, or selecting a rotary position of the rotor of the electrical AC motor, and applying at least one half-wave of an AC power signal to the stator of the AC motor after having applied the full-wave AC power signal.

In both the above examples, the advantages of the one-way impeller from a traditional DC pump together with the advantages of a motor from a traditional AC pump is obtained in the solution mentioned. The performance of an impeller of a DC pump is much better than the performance of an impeller from an AC pump. The motor from an AC pump is more reliable than a motor from a DC pump. The advantageous obtained is thus of synergetic nature, seeing that different advantages of the impeller of the DC pump and of the motor of the AC pump are different in nature.

According to another aspect of the invention, a method is envisaged, said method of cooling a computer system comprising at least one unit such as a central processing unit (CPU) generating thermal energy and said method utilising a cooling system for cooling the at least one processing unit and, said cooling system comprising a reservoir, at least one heat exchanging interface, an air blowing fan, a pumping means, said method of cooling comprising the steps of
- applying one of the following possibilities of how to operate the computer system: establishing, or defining, or selecting an operative status of the computer system
- controlling the operation of at least one of the following means of the computer system; the pumping means and the air blowing fan in response to at least one of the following

parameters; a surface temperature of the heat generating processing unit, an internal temperature of the heat generating processing unit, or a processing load of the CPU and
- in accordance with the operative status being established, defined or selected, controlling the operation of the computer system in order to achieve at least one of the following conditions; a certain cooling performance of the cooling system, a certain electrical consumption of the cooling system, a certain noise level of the cooling system.

Applying the above method ensures an operation of the computer system being in accordance with selected properties during the use of the computer system. For some applications, the cooling performance is vital such as may be the case when working with image files or when downloading large files from a network during which the processing units is highly loaded and thus generating much heat. For other applications, the electrical power consumption is more vital such as may be the case when utilising domestic computer systems or in large office building in environments where the electrical grid may be weak such as in third countries. In still other applications, the noise generated by the cooling system is to be reduced to a certain level, which may be the case in office buildings with white collar people working alone, or at home, if the domestic computer perhaps is situated in the living room, or at any other location where other exterior considerations have to be dealt with.

According to another aspect of the invention, a method is envisaged, said method being employed with cooling system further comprising a pumping means with an impeller for pumping the cooling liquid through a pumping housing, said pumping means being driven by an AC electrical motor with a stator and a rotor, and said pumping means being provided with a means for sensing a position of the rotor, and wherein the method comprises the following steps:
- initially establishing a preferred rotational direction of the rotor of the electrical motor
- before start of the electrical motor, sensing the angular position of the rotor
- during start, applying an electrical AC voltage to the electrical motor and selecting the signal value, positive or negative, of the AC voltage at start of the electrical motor
- said selection being made according to the preferred rotational direction, and
- said application of the AC signal, such as an AC voltage, being performed by the computer system for applying the AC signal, such as an AC voltage, from the electrical power supply of the computer system during conversions of the electrical DC signal, such as a DC voltage, of the power supply to the AC signal, such as an AC voltage, for the electrical motor.

Adopting the above method according to the invention ensures the most efficient circulation of cooling liquid in the cooling system and at the same time ensures the lowest possible energy consumption of the electrical motor driving the impeller. The efficient circulation of the cooling liquid is obtained by means of an impeller being designed for rotation in one rotational direction only, thus optimising the impeller design with regard to the only one rotational direction as opposed to both rotational directions. The low energy consumption is achieved because of the impeller design being optimised, thus limiting the necessary rotational speed of the impeller for obtaining e certain amount of flow of the cooling liquid through the cooling system. A bonus effect of the lowest possible energy consumption being obtained is the lowest possible noise level of the pump also being obtained. The noise level of the pump is amongst other parameters also dependent on the design and the rotational speed of the impeller. Thus, an optimised impeller design and impeller speed will reduce the noise level to the lowest possible in consideration of ensuring a certain cooling capacity.

BRIEF DESCRIPTION OF THE FIGURES

The invention will hereafter be described with reference to the drawings, where

Fig. 1 shows an embodiment of the prior art. The figure shows the typical components in an air-cooling type CPU cooling arrangement.
Fig. 2 shows an embodiment of the prior art. The figure shows the parts of the typical air-cooling type CPU cooling arrangement of figure 1 when assembled.
Fig. 3 shows an embodiment of the prior art. The figure shows the typical components in a liquid-cooling type CPU cooling arrangement.
Fig. 4 is an exploded view of the invention and the surrounding elements.
Fig. 5 shows the parts shown in the previous figure when assembled and attached to the motherboard of a computer system.
Fig. 6 is an exploded view of the reservoir from the previous figures 4 and 5 seen from the opposite site and also showing the pump.
Fig. 7 is a cut-out view into the reservoir housing the pump and an inlet and an outlet extending out of the reservoir.
Fig. 8 is a view of the cooling system showing the reservoir connected to the heat radiator.
Fig. 9-10 are perspective views of a possible embodiment of reservoir housing providing direct contact between a CPU and a cooling liquid in a reservoir.
Fig. 11-13 are perspective views of a possible embodiment of heat sink and a reservoir housing constituting an integrated unit.
Fig. 14 is a perspective view of the embodiment shown in fig. 9-10 and the embodiment shown in fig. 11-13 all together constituting an integrated unit.
Fig. 15-16 are perspective view of a possible embodiment of a reservoir and a pump and a heat exchanging surface constituting an integrated unit

Fig. 17 is a perspective view of a preferred embodiment of a reservoir and a pump and a heat exchanging surface constituting an integrated unit,

Fig. 18 is a plane view of a possible, however preferred embodiment of an AC electrical motor for a pumping means of the coolling system according to the invention, and

Fig. 19 is a graph showing a method for starting a rotor of the electrical AC motor, said AC motor driving an impeller selected from a pump driven by a DC motor.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 is an exploded view of an embodiment of prior art cooling apparatus for a computer system. The figure shows the typical components in an air-cooling type CPU cooling arrangement. The figure shows a prior art heat sink 4 intended for air cooling and provided with segments intersected by interstices, a prior art air fan 5 which is to be mounted on top of the heat sink by use of fastening means 3 and 6.

The fastening means comprises a frame 3 provided with holes intended for bolts, screws, rivets or other suitable fastening means (not shown) for thereby attaching the frame to a motherboard 2 of a CPU 1 or onto another processing unit of the computer system. The frame 3 is also provided with mortises provided in perpendicular extending studs in each corner of the frame, said mortises intended for taking up tenons of a couple of braces. The braces 6 are intended for enclosing the heat sink 4 and the air fan 5 so that the air fan and the heat sink thereby is secured to the frame. Using proper retention mechanisms, when the frame is attached to the motherboard of the CPU of other processing unit, and when the tenons of the braces are inserted into the mortises of the frame, the air fan and heat exchanger is pressed towards the CPU by using a force perpendicular to the CPU surface, said force being provided by lever arms.

Fig. 2 shows the parts of the typical air-cooling type CPU cooling arrangement of figure 1, when assembled. The parts are attached to each other and will be mounted on top of a CPU on a motherboard (not shown) of a computer system.

Fig. 3 shows another embodiment of a prior art cooling system. The figure shows the typical components in a liquid-cooling type CPU cooling arrangement. The figure shows a prior art heat exchanger 7, which is in connection with a prior art liquid reservoir 8, a prior art liquid pump 9 and a heat radiator 11 and an air fan 10 provided together with the heat radiator. The prior art heat exchanger 7, which can be mounted on a CPU (not shown) is connected to a radiator and reservoir, respectively. The reservoir serves as a storage unit for excess liquid not capable of being contained in the remaining components. The reservoir is also intended as a means for venting the system of any air entrapped in the system and as a means for filling the system with liquid. The heat radiator 11 serves as a means for removing the heat from the liquid by means of the air fan 10 blowing air through the heat radiator. All the components are in connection with each other via tubes for conducting the liquid serving as the cooling medium.

Fig. 4 is an exploded view of a cooling system according to an embodiment of the invention. Also elements not being part of the cooling system as such are shown. The figure shows a central processing unit CPU 1 mounted on a motherboard of a computer system 2. The figure also shows a part of the existing fastening means, i.e. amongst others the frame 3 with mortises provided in the perpendicular extending studs in each corner of the frame. The existing fastening means, i.e. the frame 3 and the braces 6, will during use be attached to the motherboard 2 by means of bolts, screws, rivets or other suitable fastening means extending through the four holes provided in each corner of the frame and extending through corresponding holes in the motherboard of the CPU. The frame 3 will still provide an opening for the CPU to enable the CPU to extend through the frame.

The heat exchanging interface 4 is a separate element and is made of a heat conducting material having a relative high heat thermal conductivity such as copper or aluminium, and which will be in thermal contact with the CPU 1, when the cooling system is fastened to the motherboard 2 of the CPU. The heat exchanging surface constitutes part of a liquid reservoir housing 14, thus the heat exchanger 4 constitutes the part of the liquid reservoir housing facing the CPU. The reservoir may as example be made of plastic or of metal. The reservoir or any other parts of the cooling system, which are possibly manufactured from a plastic material may be "metallised" in order to minimise liquid diffusion or evaporation of the liquid. The metal may be provided as a thin layer of metal coating provided on either or on both of the internal side or the external side of the plastic part.

If the reservoir is made of metal or any other material having a relative high heat conductivity compared to as example plastic, the heat exchanging interface as a separate element may be excluded because the reservoir itself may constitute a heat exchanger over an area, wherein the reservoir is in thermal contact with the processing unit. Alternatively to having the heat exchanging interface constitute part of the liquid reservoir housing, the liquid reservoir housing may be tightly attached to the heat exchanging interface by means of screws, glue, soldering, brazing or the like means for securing the heat exchanging interface to the housing and vice versa, perhaps with a sealant 5 provided between the housing and the heat exchanging interface.

Alternatively to providing a heat exchanging interface integrate with the reservoir containing the cooling liquid, it will be possible to exclude the heat exchanger and providing another means for dissipating heat from the processing unit to the cooling liquid in the reservoir, The other means will be a hole provided in the reservoir, said hole intended for being directed towards the processing unit. Boundaries of the hole will be sealed towards boundaries of the processing unit or will be sealed on top of the processing unit for thereby preventing cooling liquid from the reservoir from leaking. The only prerequisite to the sealing is that a liquid-tight connection is provided between boundaries of the hole and the processing unit or surrounding of the processing unit, such as a carrier card of the processing unit.

By excluding the heat exchanger, a more effective heat dissipation will be provided from the processing unit and to the cooling liquid of the reservoir, because the intermediate element of a heat exchanger is eliminated. The only obstacle in this sense is the provision of a sealing being fluid-tight in so that the cooling liquid in the reservoir is prevented from leaking.

The heat exchanging surface 4 is normally a copper plate. When excluding the heat exchanging surface 4, which may be a possibility not only for the embodiments shown in fig. 4, but for all the embodiments of the invention, it may be necessary to provide the CPU with a resistant surface that will prevent evaporation of the cooling liquid and/or any damaging effect that the cooling liquid may pose to the CPU. A resistant surface may be provided the CPU from the CPU producer or it may be applied afterwards. A resistant surface to be applied afterwards may e.g. be a layer, such as an adhesive tape provided on the CPU. The adhesive tape may be made with a thin metal layer e.g. in order to prevent evaporation of the cooling liquid and/or any degeneration of the CPU itself.

Within the liquid reservoir, a liquid pump (not shown) is placed for pumping a cooling liquid from an inlet tube 15 connection being attached to the housing of the reservoir through the reservoir and past the heat exchanger in thermal contact with the CPU to an outlet tube connection 16 also being attached to the reservoir housing. The existing fastening means comprising braces 6 with four tenons and the frame 3 with four corresponding mortises will fasten the reservoir and the heat exchanger to the motherboard of the CPU. When fastening the two parts of the existing fastening means to each other the fastening will by means of the lever arms 18 create a force to assure thermal contact between the CPU 1 mounted on the motherboard and the heat exchanger 4 being provided facing the CPU.

The cooling liquid of the cooling system may be any type of cooling liquid such as water, water with additives such as anti-fungicide, water with additives for improving heat conducting or other special compositions of cooling liquids such as electrically non-conductive liquids or liquids with lubricant additives or anti-corrosive additives.

Fig. 5 shows the parts shown in fig. 4 when assembled and attached to the motherboard of a CPU of a computer system 2. The heat exchanger and the CPU is in close thermal contact with each other. The heat exchanger and the remainder of the reservoir 14 is fastened to the motherboard 2 by means of the existing fastening means being secured to the motherboard of the CPU and by means of the force established by the lever arms 18 of the existing fastening means. The tube inlet connection 15 and the tube outlet connection 16 are situated so as to enable connection of tubes to the connections.

Fig. 6 is an exploded view of the reservoir shown in previous fig. 4 and fig. 5 and seen from the opposite site and also showing the pump 21 being situated inside the reservoir. Eight screws 22 are provided for attaching the heat exchanging surface 4 to the remainder of the reservoir. The heat exchanging surface is preferably made from a copper plate having a plane outer surface as shown in the figure, said outer surface being intended for abutting the free surface of the heat generating component such as the CPU (see fig. 4). However, also the inner surface (not shown, see fig. 7) facing the reservoir is plane. Accordingly, the copper plate need no machining other than the shaping of the outer boundaries into the octagonal shape used in the embodiment shown and drilling of holes for insertion of the bolts. No milling of the inner and/or the outer surface need be provided.

A sealant in form of a gasket 13 is used for the connection between the reservoir 14 and the heat exchanging surface forming a liquid tight connection. The pump is intended for being placed within the reservoir. The pump has a pump inlet 20 through which the cooling liquid flows from the reservoir and into the pump, and the pump has a pump outlet 19 through which the cooling liquid is pumped from the pump and to the outlet connection. The figure also shows a lid 17 for the reservoir. The non-smooth inner walls of the reservoir and the fact that the pump is situated inside the reservoir will provide a swirling of the cooling liquid inside the reservoir.

However, apart from the non-smooth walls of the reservoir and the pump being situated inside the reservoir, the reservoir may be provided with channels or segments for establishing a certain flow-path for the cooling liquid through the reservoir (see fig 9-10 and fig 15). Channel or segments are especially needed when the inner surface of the heat exchanging surface is plane and/or when the inner walls of the reservoir are smooth and/or if the pump is not situated inside the reservoir. In either of the circumstances mentioned, the flow of the cooling liquid inside the reservoir may result in the cooling liquid passing the reservoir too quickly and not being resident in the reservoir for a sufficient amount of time to take up a sufficient amount of heat from the heat exchanging surface. By providing channels or segments inside the reservoir, a flow will be provided forcing the cooling liquid to pass the heat exchanging surface , and the amount of time increased of the cooling liquid being resident inside the reservoir, thus enhancing heat dissipation. If channels or segments are to be provided inside the reservoir, the shape and of the channels and segments may be decisive of whether the reservoir is to be made of plastic, perhaps by injection moulding, or is to be made of metal such as aluminium, perhaps by die casting.

The cooling liquid enters the reservoir through the tube inlet connection 15 and enters the pump inlet 20, and is pumped out of the pump outlet 19 connected to the outlet connection 16. The connection between the reservoir and the inlet tube connection and the outlet tube connection, respectively, are made liquid tight. The pump may not only be a self-contained pumping device, but may be made integrated into the reservoir, thus making the reservoir and a pumping device one single integrated component. This single integrated element of the reservoir and the pumping device may also be integrated, thus making the reservoir, the pumping device and the heat exchanging surface one single integrated unit. This may as example be possible if the reservoir is made of a metal such as aluminium. Thus, the choice of material provides the possibility of constituting both the reservoir and a heat exchanging surface having a relatively high heat conductivity, and possibly also renders the possibility of providing bearings and the like constructional elements for a motor and a pumping wheel being part of the pumping device.

In an alternative embodiment, the pump is placed in immediate vicinity of the reservoir, however outside the reservoir. By placing the pump outside, but in immediate vicinity of the reservoir, still an integrate element may be obtained, The pump or the inlet or the outlet is preferably positioned so as to obtain a turbulence of flow in the immediate vicinity of the heat exchanging interface, thereby promoting increased heat dissipation between the heat exchanging interface end the cooling liquid. even in the alternative, a pumping member such as an impeller (see fig. 15-16) may be provided in the immediate vicinity of the heat exchanging surface. The pumping member itself normally introduces a turbulence of flow, and thereby the increased heat dissipation is promoted irrespective of the position of the pump itself, or the position of the inlet or of the outlet to the reservoir or to the pump.

The pump may be driven by an AC or a DC electrical motor. When driven by an AC electrical motor, although being technically and electrically unnecessary in a computer system, this may be accomplished by converting part of the DC electrical power of the power supply of the computer system to AC electrical power for the pump. The pump may be driven by an electrical motor at any voltage common in public electrical networks such as 110V or 220V. However, in the embodiment shown, the pump is driven by a 12V AC electrical motor.

Control of the pump in case the pump is driven by an AC electrical motor, preferably takes place by means of the operative system or an alike means of the computer system itself, and where the computer system comprises means for measuring the CPU load and/or the CPU temperature. Using the measurement performed by the operative system or alike system of the computer system eliminates the need for special means for operating the pump. Communication between the operative system or alike system and a processor for operating the pump may take place along already established communication links in the computer system such as a USB-link. Thereby, a real-time communication between the cooling system and the operative system is provided without any special means for establishing the communication.

In the case of the motor driving the pump is an AC electrical motor, the above method of controlling the pump may be combined with a method, where said pumping means is provided with a means for sensing a position of the rotor of the electrical motor, and wherein the following steps are employed: Initially establishing a preferred rotational direction of the rotor of the electrical motor, before start of the electrical motor, sensing the angular position of the rotor, during start, applying an electrical AC voltage to the electrical motor and selecting the signal value, positive or negative, of the AC voltage at start of the electrical motor, said selection being made according to the preferred rotational direction, and said application of the AC voltage being performed by the computer system for applying the AC voltage from the electrical power supply of the computer system during conversion of the electrical DC voltage of the power supply to AC voltage for the electrical motor. By the operative system of the computer system itself generating the AC voltage for the electrical motor, the rotational direction of the pump is exclusively selected by the computer system, non-depending on the applied voltage of the public grid powering the computer system.

Further control strategies utilising the operative system or alike system of the computer system may involve balancing the rotational speed of the pump as a function of the cooling capacity needed. If a lower cooling capacity is needed, the rotational speed of the pump, may be limited, thereby limiting the noise generating by the motor driving the pump.

In the case an air fan is provided in combination with a heat sink as shown in fig. 1, of the air fan is provided in combination with the heat radiator, the operative system or alike system of the computer system may be designed for regulating the rotational speed of the pump, and thus of the motor driving the pump, and the rotational speed of the air fan, and thus the motor driving the air fan. The regulation will take into account the cooling capacity needed, but the regulation will at the same time take into account which of the two cooling means, i.e. the pump and the air fan, is generating the most noise. Thus, it the air fan generally is generating more noise than the pump, then the regulation will reduce the rotational speed of the air fan before reducing the rotational speed of the pump, whenever a lower cooling capacity is needed. Thereby, the noise level of the entire cooling system is lowered as much as possible. If the opposite is the case, i.e. the pump generally generating more noise than the air fan, then the rotational speed of the pump will be reduced before reducing the rotational speed of the air fan.

Even further control strategies involve controlling the cooling capacity in dependence on the type of computer processing taking place. Some kind of computer processing, such as word-processing, applies a smaller load on the processing units such as the CPU than other kinds of computer processing, such as image processing. Therefore, the kind of processing taking place on the computer system may be used as an indicator of the cooling capacity. It may even be possible as part of the operative system or similar system to establish certain cooling scenarios, depending on the kind of processing intended by the user. If the user selects as example word-processing, a certain cooling strategy is applied based on a limited need for cooling. If the user selects as example image-processing, a certain cooling strategy is applied based on an increased need for cooling. Two or more different cooling scenarios may be established depending on the capacity and the control possibilities and capabilities of the cooling system and depending on the intended use of the computer system, either as selected by a user during use of the computer system or as selected when choosing hardware during build-up of the computer system, i.e. before actual use of the computer system.

The pump is not being restricted to a mechanical device, but can be in any form capable of pumping the cooling liquid through the system. However, the pump is preferably one of the following types of mechanical pumps: Bellows pump, centrifugal pump, diaphragm pump, drum pump, flexible liner pump, flexible impeller pump, gear pump, peristaltic tubing pump, piston pump, processing cavity pump, pressure washer pump, rotary lobe pump, rotary vane pump and electro-kinetic pump. Similarly, the motor driving the pumping member need not be electrical but may also be a piezo-electrically operated motor, a permanent magnet operated motor, a fluid-operated motor or a capacitor-operated motor. The choice of pump and the choice of motor driving the pump id dependent on many different parameters, and it is up to the person skilled in the art to choose the type of pump and the type of motor depending on the specific application. As example, some pumps and some motors are better suited for small computer systems such as lab-tops, some pumps and some motors are better suited for establishing i high flow of the cooling liquid and thus a high cooling effect, and even some pumps and motors are better suited for ensuring a low-noise operation of the cooling system.

Fig. 7 is a cut-out view into the reservoir, when the reservoir and the heat exchanging surface 4 is assembled and the pump 21 is situated inside the reservoir. The reservoir is provided with the tube inlet connection (not seen from the figure) through which the cooling liquid enters the reservoir. Subsequently, the cooling liquid flows through the reservoir passing the heat exchanging surface and enters the inlet of the pump. After having been passed through the pump, the cooling liquid is passed out of the outlet of the pump and further out through the tube outlet connection 16. The figure also shows a lid 17 for the reservoir. The flow of the cooling liquid inside the reservoir and trough the pump may be further optimised in order to use as little energy as possible for pumping the cooling liquid, but still having a sufficient amount of heat from the heat exchanging surface being dissipated in the cooling liquid. This further optimisation can be established by changing the length and shape of the tube connection inlet within the reservoir, and/or by changing the position of the pump inlet, and/or for instance by having the pumping device placed in the vicinity and in immediate thermal contact with the heat exchanging surface and/or by providing channels or segments inside the reservoir.

In this case, an increased turbulence created by the pumping device is used to improve the exchange of heat between the heat exchanging surface and the cooling liquid. Another or an additional way of improving the heat exchange is to force the cooling liquid to pass through specially adapted channels or segments being provided inside the reservoir or by making the surface of the heat exchanging surface plate inside the reservoir uneven or by adopting a certain shape of a heat sink with segments. In the figure shown, the inner surface of the heat exchanging surface facing the reservoir is plane.

Fig. 8 is a perspective view of the cooling system showing the reservoir 14 with the heat exchanging surface (not shown) and the pump (not shown) inside the reservoir. The tube inlet connection and the tube outlet connection are connected to a heat radiator by means of connecting tubes 24 and 25 through which the cooling liquid flows into and out of the reservoir and the heat radiator, respectively. Within the heat radiator 11, the cooling liquid passes a number of channels for radiating the heat, which has been dissipated into the cooling liquid inside the reservoir, and to the surroundings of the heat exchanger. The air fan 10 blows air past the channels of the heat radiator in order to cool the radiator and thereby cooling the cooling liquid flowing inside the channels through the heat radiator and back into the reservoir.

According to the invention, the heat radiator 11 may be provided alternatively. The alternative heat radiator is constituted by a heat sink, such as a standard heat sink made of extruded aluminium with fins on a first side and a substantially plane second side. An air-fan may be provided in connection with the fins along the first side. Along the second side of the heat sink a reservoir is provided with at least one aperture intended for being closed by placing said aperture covering part of, alternatively covering the whole of, the substantial plane side of the heat sink. When closing the reservoir in such a way a surface of the heat sink is in direct heat exchanging contact with an interior of the reservoir, and thus in direct heat exchanging contact with the cooling liquid in the reservoir, through the at least one aperture. This alternative way of providing the heat radiator may be used in the embodiment shown in fig. 8 or may be used as a heat radiator for another use and/or for another embodiment of the invention.

A pumping means for pumping the cooling liquid trough the reservoir may or may not be provided inside the reservoir at the heat sink. The reservoir may be provided with channels or segments for establishing a certain flow-path for the cooling liquid through the reservoir. Channels or segments are especially needed when the inner surface of the heat exchanging surface is plane and/or when the inner walls of the reservoir are smooth and/or if the pump is not situated inside the reservoir. In either of the circumstances mentioned, the flow of the cooling liquid inside the reservoir may result in the cooling liquid passing the reservoir too quickly and not being resident in the reservoir for a sufficient amount of time to take up a sufficient amount of heat from the heat exchanging surface. If channels or segments in the reservoir are to be provided inside the reservoir, the shape and of the channels and segments may be decisive of whether the reservoir is to be made of plastic, perhaps by injection moulding, or is to be made of metal such as aluminium, perhaps by die casting.

By means of the alternative heat radiator, the heat radiator 11 is not provided as is shown in the figure with the rather expensive structure of channels leading the cooling liquid along ribs connecting the channels for improved surface of the structure. Instead, the heat radiator is provided as described as a unit constituted by a heat sink with or without a fan and a reservoir, and thereby providing a simpler and thereby cheaper heat radiator than the heat radiator 11 shown in the figure.

The alternative heat radiator provided as an unit constituted by a heat sink and a reservoir, may be used solely, with or without a pump inside the reservoir and with or without the segments or channels, for being placed in direct or indirect thermal contact with a heat generating processing unit such as CPU or with the heat exchanging surface, respectively. These embodiments of the invention may e.g. be used for a reservoir, where the cooling liquid along a first side within the reservoir is in direct heat exchanging contact with the heat generating processing unit such as a CPU and the cooling liquid along a second side within the reservoir is in direct heat exchanging contact with a heat sink. Such a reservoir may be formed such as to provide a larger area of heat exchanging surface towards the heat generating processing unit such as a CPU than the area of the heat exchanging surface facing the heat sink. This may e.g. have the purpose of enlarging the area of the heat exchanging surface so as to achieve an improved heat dissipation form e.g. the CPU to the heat sink than that of a conventional heat sink without a reservoir attached. Conventional heat sinks normally only exchanges heat with the CPU through the area as given by the area of the top side of the CPU. A system comprising a liquid reservoir and a heat sink with a fan provided has been found to be a simple, cost optimised system with an improved heat dissipation than that of a standard heat sink with a fan, but without the reservoir. In another embodiment of the invention, which may be derived from fig. 8, the air fan and the heat radiator is placed directly in alignment of the reservoir. Thereby, the reservoir 14, the air fan 10 and the radiator 11 constitute an integrate unit. Such an embodiment may provide the possibility of omitting the connection tubes, and passing the cooling liquid directly from the heat radiator to the reservoir via an inlet connection of the reservoir, and directly from the reservoir to the heat radiator via an outlet connection of the reservoir. Such an embodiment may even render the possibility of both the pumping device of the liquid pump inside the reservoir and the electrical motor for the propeller of the air fan 23 of the heat radiator 11 being driven by the same electrical motor, thus making this electrical motor the only motor of the cooling system.

When placing the heat radiator on top of the air fan now placed directly in alignment with the reservoir and connecting the heat radiator directly to the inlet connection and outlet connection of the reservoir, a need for tubes will not be present. However, if the heat radiator and the reservoir is not in direct alignment with each other, but tubes may still be needed, but rather than tubes, pipes made of metal such as copper or aluminium may be employed, such pipes being impervious to any possible evaporation of cooling liquid. Also, the connections between such pipes and the heat radiator and the reservoir, respectively, may be soldered so that even the connections are made impervious to evaporation of cooling liquid.

In the derived embodiment just described, an integrated unit of the reservoir, the heat exchanging surface and the pumping device will be given a structure establishing improved heat radiating characteristics because the flow of air of the air fan may also be directed along outer surfaces of the reservoir. If the reservoir is made of a metal, the metal will be cooled by the air passing the reservoir after having passed or before passing the heat radiator. If the reservoir is made of metal, and if the reservoir is provided with segments on the outside surface of the reservoir, such cooling of the reservoir by the air will be further improved. Thereby, the integrated unit just described will be applied improved heat radiating characteristics, the heat radiation function normally carried out by the heat radiator thus being supplemented by one or more of the further elements of the cooling system, i.e. the reservoir, the heat exchanging surface, the liquid pump and the air fan.

Fig. 9-10 show an embodiment of a reservoir housing 14, where channels 25 are provided inside the reservoir for establishing a forced flow of the cooling liquid inside the reservoir. The channels 25 in the reservoir 14 lead from an inlet 15 to an outlet 16 like a maze between the inlet and the outlet. The reservoir 14 is provided with an aperture 27 having outer dimensions corresponding to the dimensions of a free surface of the processing unit 1 to be cooled. In the embodiment shown, the processing unit to be cooled is a CPU 1.

When channels 26 are provided inside the reservoir, the shape of the channels may be decisive of whether the reservoir is to be made of plastic, perhaps manufactured by injection moulding, or is to be made of metal such as aluminium, perhaps manufactured by extrusion or by die casting.

The reservoir 14 or any other parts of the cooling system, which are possibly manufactured from a plastic material may be "metallised" in order to minimise liquid diffusion or evaporation of the liquid. The metal may be provided as a thin layer of metal coating provided on either or on both of the internal side or the external side of the plastic part.

The CPU 1 is intended for being positioned in the aperture 27, as shown in fig. 10, so that outer boundaries of the CPU are engaging boundaries of the aperture. Possibly, a sealant (not shown) may be provided along the boundaries of the CPU and the aperture for ensuring a fluid tight engagement between the boundaries of the CPU and the boundaries of the aperture. When the CPU 1 is positioned in the aperture 27, the free surface (not shown) of the CPU is facing the reservoir, i.e. the part of the reservoir having the channels provided. Thus, when positioned in the aperture 27 (see fig. 10), the free surface of the CPU 1 is having direct contact with cooling liquid flowing through the channels 26 in the reservoir.

When cooling liquid is forced from the inlet 15 along the channels 26 to the outlet 16, the whole of the free surface of the CPU 1 will be passed over by the cooling liquid, thus ensuring a proper and maximised cooling of the CPU. The configuration of the channels may be designed and selected according to any one or more provisions, i.e. high heat dissipation, certain flow characteristics, ease of manufacturing etc. Accordingly, the channels may have another design depending on any desire or requirement and depending on the type of CPU and the size and shape of the free surface of the CPU. Also. other processing units than a CPU may exhibit different needs for heat dissipation, and may exhibit other sizes and shapes of the free surface, leading to a need for other configurations of the channels. If the processing unit is very elongate, such as a row of microprocessors, one or a plurality of parallel channels may be provided, perhaps just having a common inlet and a common outlet.

Fig. 11-13 show an embodiment of a heat sink 4, where segments 28 are provided at a first side 4A of the heat sink, and fins 29 for dissipating heat to the surroundings are provided at the other, second side 4B of the heat sink. An intermediate reservoir housing 30 is provided having a recessed reservoir at the one side facing the first side 4A of the heat sink. The recessed reservoir 30 has an inlet 31 and an outlet 32 at the other side opposite the side facing the heat sink 4.

When segments 28 are provided on the first side 4A of the heat sink, the shape of the segments may be decisive of whether the reservoir, which is made from metal such as aluminium or copper, is to be made by extrusion or is to be made by other manufacturing processes such as die casting. Especially when the segments 28 are linear and are parallel with the fins 29, as shown in the embodiment, extrusion is a possible and cost-effective means of manufacturing the heat sink 4.

The intermediate reservoir 30 or any other parts of the cooling system, which are possibly manufactured from a plastic material may be "metallised" in order to minimise liquid diffusion or evaporation of the liquid. The metal may be provided as a thin layer of metal coating provided on either or on both of the internal side or the external side of the plastic part.

The recessed reservoir is provided with a kind of serration 33 along opposite sides of the reservoir, and the inlet 31 and the outlet 32, respectively, are provided at opposite corners of the intermediate reservoir 30. The segments 28 provided at the first side 4A of the heat sink, i.e. the side facing the intermediate reservoir 30, are placed so that when the heat sink is assembled with the intermediate reservoir housing (see fig 13) the segments 29 run from one serrated side of the reservoir to the other serrated side of the reservoir.

When cooling liquid is forced from the inlet 31 through the reservoir, along channels (not shown) formed by the segments 29 of the heat sink 4 and to the outlet 32, the whole of the first side 4A of the heat sink will be passed over by the cooling liquid, thus ensuring a proper and maximised heat dissipation between the cooling liquid and the heat sink. The configuration of the segments on the first side 4A of the heat sink and the configuration of the serrated sides of the intermediate reservoir housing may be designed and selected according to any provisions. Accordingly, the segments may have another design, perhaps being wave-shaped or also a serrated shape, depending on any desired flow characteristics of the cooling liquid and depending on the type of heat sink and the size and shape of the reservoir.

Also other types of heat sinks, perhaps circular shaped heat sinks may exhibit different needs for heat dissipation, may exhibit other sizes and shapes of the free surface, leading to a need for other configurations of the segments and the intermediate reservoir. If the heat sink and the reservoir are circular or oval, a spiral-shaped segmentation or radially extending segments may be provided, perhaps having the inlet or the outlet in the centre of the reservoir. If an impeller of the pump is provided, as shown in fig. 15-16, the impeller of the pump may be positioned in the centre of a spiral-shaped segmentation or in the centre of radially extending segments.

Fig. 14 shows the reservoir 14 shown in fig. 9-10 and the heat sink 4 and the intermediate reservoir 30 shown in fig. 11-13 being assembled for thereby constituting an integrated monolithic unit. It is not absolutely necessary to assemble the reservoir 14 of fig. 9-10 and the heat sink 4 and the intermediate reservoir 30 of fig. 11-13 in order to obtain a properly functioning cooling system. The inlet 15 and the outlet 16 of the reservoir 14 of fig. 9-10 may be connected to the outlet 32 and the inlet 31, respectively, of the intermediate reservoir of fig. 11-13 by means of tubes or pipes.

The reservoir 14 of fig. 9-10 and the heat sink 4 and the intermediate reservoir 30 of fig. 11-13 may then be positioned in the computer system at different locations. However, by assembling the reservoir 14 of fig- 9-10 and the heat sink 4 and the intermediate reservoir 30 of fig. 11-13 a very compact monolithic unit is obtained, also obviating the need for tubes or pipes. Tubes or pipes may involve an increased risk of leakage of cooling liquid or may require soldering or other special working in order to eliminate the risk of leakage of cooling liquid. By eliminating the need for tubes or pipes, any leakage and any additional working is obviated when assembling the cooling system.

Fig. 15-16 show a possible embodiment of a reservoir according to the invention. The reservoir is basically similar to the reservoir shown in fig. 9-10. However, an impeller 33 of the pump of the cooling system is provided in direct communication with the channels 26. Also, in the embodiment shown, a heat exchanging interface 4 such as a surface made from a copper plate, alternatively a plate of another material having a high thermal conductivity, is placed between the channels 26 inside the reservoir and the CPU 1 as the processing unit.

The heat exchanging surface 4 is preferably made from a copper plate having a plane outer surface as shown in the figure, said outer surface being intended for abutting the free surface of the heat generating component such as the CPU 1 (see fig. 4). However, also the inner surface (not shown, see fig. 7) facing the reservoir is plane. Accordingly, the copper plate need no machining other than the shaping of the outer boundaries into the specially adapted shape used in the embodiment shown and drilling of holes for insertion of the bolts. No milling of the inner and/or the outer surface need be provided.

The provision of the heat exchanging surface 4 need not be a preferred embodiment, seeing that the solution incorporating the aperture (see fig. 9-10) result in a direct heat exchange between the free surface of the CPU or other processing unit and the cooling liquid flowing along the channels in the reservoir. However, the heat exchanging surface enables usage of the cooling system independently on the type and size of the free surface of CPU or other processing unit. Also, the heat exchanging surface enables replacement, repair or other intervention of the cooling system without the risk of cooling liquid entering the computer system as such and possibly without the need for draining the cooling system fully or partly of cooling liquid.

In the embodiment shown, the heat exchanging surface 4 is secured to the reservoir by means of bolts 22. Other convenient fastening means may be used. The heat exchanging surface 4 and thus the reservoir 14 may be fastened to the CPU 1 or other processing unit by any suitable means such as soldering, brazing or by means of thermal paste combined with glue. Alternatively, special means (not shown) may be provided for ensuring a thermal contact between the free surface of the CPU or other processing unit and the heat exchanging surface. One such means may be the fastening means shown in fig. 4 and fig. 5 or similar fastening means already provided as part of the computer system.

When channels 26 are provided inside the reservoir 14, the shape of the channels may be decisive of whether the reservoir is to be made of plastic, perhaps by injection moulding, or is to be made of metal such as aluminium, perhaps by die casting.

The reservoir 14 or any other parts of the cooling system, which are possibly manufactured from a plastic material may be "metallised" in order to minimise liquid diffusion or evaporation of the liquid. The metal may be provided as a thin layer of metal coating provided on either or on both of the internal side or the external side of the plastic part.

The impeller 33 (see fig. 14) of the pump is positioned in a separate recess of the channels 26, said separate recess having a size corresponding to the diameter of the impeller of the pump. The recess is provided with an inlet 34 and an outlet 35 being positioned opposite an inlet 31 and an outlet 32 of cooling liquid to and from, respectively, the channels 26. The impeller 33 of the pump has a shape and a design intended only for one way rotation, in the embodiment shown a clock-wise rotation only. Thereby, the efficiency of the impeller of the pump is highly increased compared to impellers capable of and intended for both clock-wise and counter clock-wise rotation.

The increased efficiency of the impeller design results in the electric motor (not shown) driving the impeller of the pump possibly being smaller than otherwise needed for establishing a proper and sufficient flow of cooling liquid through the channels. In a preferred embodiment, the electric motor is an AC motor, preferably a 12V AC motor, although the impeller is intended for a DC motor. The contradictory use of an AC motor driving a DC impeller leads to the possibility of an even smaller motor needed for establishing the proper and sufficient flow of cooling liquid through the channels.

The impeller may be driven by an electrical motor at any voltage common in public electrical networks such as 110V or 220V. The power supply of the computer system converts the high voltage AC power to low voltage DC power. Thus, the impeller of the pump may be driven by an AC or a DC electrical motor. As mentioned, preferably the impeller of the pump is driven by an AC electrical motor. Although being technically unnecessary to use an AC electrical motor and being electrically disadvantageous to use an AC electrical motor in a computer systemsupplying DC electrical power, this may be accomplished by converting part of the DC electrical power of the power supply of the computer system to AC electrical power for the AC motor of the pump. However, in the embodiment shown, the impeller of the pump is driven by a 12V electrical motor.

Fig. 17 shows a preferred possible embodiment of a reservoir according to the invention. The reservoir 14 has basically the same features as the reservoir shown in fig. 15-16. In the embodiment shown, the reservoir substantially has a conical, circular configuration and is provided with stiffening ribs 36 extending axially along the exterior of the reservoir 14.

Other shapes such as cylindrical, circular, or conical rectangular or cylindrical, rectangular or even oval or triangular shapes may be adopted, when designing and possibly injection moulding or casting the reservoir. The dimension of the embodiment shown is approximately 55 mm in diameter and also 55 mm in axial extension.

The reservoir 14 has a recess 40 in the centre of the reservoir. The recess 37 is intended for accommodating a stator 37 of an electrical motor driving an impeller 33 of the pump, said impeller being attached to a shaft 38 of a rotor 39 of the electrical motor. The recess 40 has an orifice 41, four sidewalls 42, a bottom 43 and a circular jacket 44 extending from the bottom 43 of the recess 40 and outwards towards the orifice 41 of the recess 40. The interior (not shown) of the jacket 44 is intended for encompassing the rotor 39 of the pump.

Thereby, a liquid-proof division is made between the rotor 39 of the motor, said rotor 39 being placed inside the interior of the jacket 44 and being submerged in the cooling liquid, and the stator 37 of the pump, said stator 37 being positioned in the recess 40 and surrounding the exterior of the jacket 44. Accordingly, the stator 37 need not be sealed against the cooling liquid, because the recess 40 together with the jacket 44 ensures the stator staying dry from the cooling liquid, but the stator 37 still being capable of driving the rotor 39, when being supplied with electrical power from a power supply (not shown) of the computer system.

Along an outer circumferential extension, the reservoir 14 is provided with protrusions 45 extending outwardly from the circumferential extension. The protrusions are intended for cooperating with a clip (see description below) for fastening the reservoir 14 to the CPU or other processing unit of the computer system. The protrusions 45 are shown as a plurality of singular protrusions. Alternatively, the protrusions may be only one continuous protrusion extending outwardly and around the circumferential extension.

The reservoir 14 may also be provided with an inlet (not shown) and an outlet (not shown) for the cooling liquid. The inlet and the outlet are provided along a surface of the reservoir facing downward and inwards when seen in the perspective view of the drawing. The inlet and the outlet lead to a radiator (not shown) intended for cooling the cooling liquid after having been heated by the processing unit via a heat exchanging surface (see description below).

The radiator may be placed nearby or distant from the reservoir 14, depending on the set-up of the computer system. In one possible embodiment, the radiator is placed in the immediate vicinity of the reservoir, thereby possible excluding any tubing extending between the radiator and the inlet and the outlet, respectively. Such embodiment provides a very compact configuration of the entire cooling system, namely a monolithic configuration where all elements needed for the cooling system are incorporated in one unit.

In an alternative embodiment, the reservoir 14 itself also constitutes the radiator of the cooling system. In such embodiment, an inlet and an outlet are not needed. If the reservoir is made of a metal such as copper or aluminium or other material having a high thermal conductance, the cooling liquid, after having been heated by the processing unit via a heat exchanging surface 8see description below) may radiate the heat via the exterior surface of the reservoir 14 itself. In such embodiment, the ribs 36 along the exterior surface of the reservoir 14 may also, or may in stead, function as cooling fins. In such embodiment, the fins will have a smaller dimension than the transverse dimension of the ribs 14 shown in figure 17, and the number of fins will be greater than the number of fins shown in figure 17.

An impeller 33 of the pump of the cooling system is provided in direct communication with a pump chamber 46 having an outlet 34 provided tangentially to the circumference of the impeller 33. Thus, the pump functions as a centrifugal pump. The inlet if the pump chamber 46 is the entire opening into the cavity that the pump chamber configures, said cavity being in direct communication with the interior of the reservoir 14 as such. An intermediate member 47 is provided between the pump chamber 46 together with the interior of the reservoir and a heat exchanging interface 4. The intermediate member 47 is provided with a first passage 48 for leading cooling liquid from the pump chamber 46 to a thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47. The intermediate member 47 is provided also with a second passage 49 for leading cooling liquid from the thermal exchange chamber (not shown) provided at the opposite of the intermediate member 47 to the interior of the reservoir 14.

In the embodiment shown, a heat exchanging interface 4 such as a surface made from a copper plate, alternatively a plate of another material having a high thermal conductivity, is placed in thermal communication with the thermal exchange chamber (not shown) at the opposite side of the intermediate member 47.

The heat exchanging interface 4 is preferably made from a copper plate having a plane outer surface (not shown) at the opposite side as the side shown in the figure, said outer surface being intended for abutting the free surface of the heat generating component such as the CPU (see fig. 4). The inner surface facing the thermal exchange chamber (not shown) at the opposite side of the intermediate member 47 is provided with pins 4A extending from the base of the copper plate and into the thermal exchange chamber (not shown) at the opposite side of intermediate member 47. The pins 4A constitutes an uneven surface and may either be provided during casting of the copper plate or may be provided by means of milling or other machining process of a copper plate. The pins provide a network of channels across the inner surface of the heat exchanging interface, along which network the cooling liquid is intended to flow.

Alternatively, also the inner surface of the copper plate facing the reservoir is plane. In this alternative embodiment, the copper plate need no machining other than the shaping of the outer boundaries into the specially adapted shape used in the embodiment shown. No milling or other machining process of the inner and/or the outer surface need be provided, when both the outer surface and the inner surface is plane.

The provision of the heat exchanging interface 4 need not be a preferred embodiment, seeing that the solution incorporating the aperture (see figure 9-10) result in a direct heat exchange between the free surface of the CPU or other processing unit and the cooling liquid flowing along the channels in the reservoir. However, the heat exchanging interface enables usage of the cooling system independently on the type and size of the free surface of CPU or other processing unit. Also, the heat exchanging interface enables replacement, repair or other intervention of the cooling system without the risk of cooling liquid entering the computer system as such and possibly without the need for draining the cooling system fully or partly of cooling liquid.

In the embodiment shown, the heat exchanging interface 4 is secured to the intermediate member 47 by means of gluing or other means ensuring a proper and liquid-tight fastening of the heat exchanging interface with the intermediate member. Any other suitable and convenient means (not shown) for securing the heat exchanging interface to the intermediate member may be envisaged.

The heat exchanging interface and thus the reservoir is fastened to the top of the CPU by means of a clip 50. The clip 50 has a circular configuration and has four legs 51 extending axially from the circular configuration. The four legs 51 are provided with footing 52 and the footings 52 are provided with holes 53. The clip 50 is intended for being displaced around the exterior of the reservoir 14 and further axially to the protrusions 45 of the reservoir 14.

The clip 50, after having been placed around the reservoir 14, is fastened to the motherboard of the computer system by means of bolts (not shown) or the like fastening means extending through the holes 53 in the footings 52 and further though corresponding holes in the motherboard. The corresponding holes in the motherboard are preferably holes already available in the motherboard in the vicinity of the CPU and the socket of the CPU, respectively. Accordingly, the legs 51 and the footings 52 of the clip 50 are specially designed in accordance with the already provided holes in the motherboard.

Alternatively, the heat exchanging interface 4 and thus the reservoir 14 may be fastened to the CPU or other processing unit by any other suitable means such as soldering, brazing or by means of thermal paste combined with glue. Alternatively, special means (not shown) may be provided for ensuring a thermal contact between the free surface of the CPU or other processing unit and the heat exchanging interface. One such means may be the fastening means shown in fig. 4 and fig. 5 or similar fastening means already provided as part of the computer system.

When stiffening and/or cooling fins 36 are provided at the exterior of the reservoir 14, the shape of and the number of fins may be decisive of whether the reservoir is to be made of plastic, perhaps by injection moulding, or is to be made of metal such as aluminium, perhaps by die casting. Also, the purpose of the fins i.e. just for stiffening the reservoir, or also or in stead for cooling purposes, may be decisive of whether the reservoir is to be made of plastic, perhaps by injection moulding, or is to be made of metal such as aluminium, perhaps by die casting.

The reservoir 14 or any other parts of the cooling system, which are possibly manufactured from a plastic material may be "metallised" in order to minimise liquid diffusion or evaporation of the liquid. The metal may be provided as a thin layer of metal coating provided on either or on both of the internal side or the external side of the plastic part.

The impeller 33 of the pump has a shape and a design intended only for one way rotation, in the embodiment shown a clock-wise rotation only. Thereby, the efficiency of the impeller of the pump is highly increased compared to impellers capable of and intended for both clock-wise and counter clock-wise rotation.

The increased efficiency of the impeller design results in the electric motor (not shown) driving the impeller of the pump possibly being smaller than otherwise needed for establishing a proper and sufficient flow of cooling liquid through the channels. In a preferred embodiment, the electric motor is an AC motor, preferably a 12V AC motor, although the impeller is intended for a DC motor. The contradictory use of an AC motor driving a DC impeller leads to the possibility of an even smaller motor needed for establishing the proper and sufficient flow of cooling liquid through the channels.

The impeller may be driven by an electrical motor at any voltage common in public electrical networks such as 110V AC power or 220V AC power. The power supply of the computer system converts the high voltage AC power to low voltage DC power. Thus, the impeller of the pump may be driven by either an AC or a DC electrical motor. As mentioned, preferably the impeller of the pump is driven by an AC electrical motor. Although being technically unnecessary to use an AC electrical motor and being electrically disadvantageous to use an AC electrical motor in a computer system supplying DC electrical power, this may be nevertheless be accomplished by converting part of the DC electrical power of the power supply of the computer system to AC electrical power for the AC motor of the pump.

In every aspect of the invention, where an AC motor is used for driving an impeller from a DC motor, although this way of configuring a pump is contradictory, the following preferred mode of operation is established for alleviating the disadvantages:

In order to be able to control direction of rotation of the impeller attached to the rotor and to optimise the conditions of maximum average torque value during starting, i.e. from zero speed up to the synchronous speed, an electronic control circuit is used. The electronic control circuit comprises a processing unit, which drives a static power switch, constituted for example by a triac arranged in series between the alternating-voltage power, which is obtained form the DC power supply of the computer system, and the AC motor. The same series network also includes a detector for the current I which flows through the triac and then through the AC motor. The output of the current detector is an input signal for the electronic processing unit.

The electronic control circuit may also comprise a number or sensors suitable for detecting the position and polarity of the permanent magnets comprised in the rotor of the AC motor, both when the rotor is moving and when it is in particular operating conditions, or when it is motionless or stalled at zero speed. The number of position sensors may be Hall sensors, encoders or optical or electro-mechanical sensors capable of establishing and/or measuring the position of the rotor. The output signal from the number of position sensors is an input signal for the electronic processing unit.

Alternatively, the output signal from the position sensor may be phase shifted by means of an electronic phase shifting circuit before the output signal is sent to the input of the electronic processing unit.

A third signal may be input to the processing unit, said third signal enabling the processing unit to detect the polarity of the AC voltage applied to the AC motor. However, the third signal is not compulsory.

The signals input to the electronic processing unit are converted into digital form and after being processed by the processing unit, an output signal is provided by the processing unit. The output signal is used for closing or opening the static switch constituted by a triac arranged in series with the AC motor.

In the electronic processing unit, the current signal provided by the current sensor enters a zero-crossing detector which provides in output a logical "1" signal indicating that said current approaches zero with a positive or negative deviation from the zero value of said current. This deviation depends on the type of motor used and on its application, as well as on the type of static power switch being used. The signal arriving from the position sensor enters a phase-shift and processing circuit the output whereof is 1 or 0 according to the position and polarity of the rotor.

In the electronic processing unit, the phase shifted position signal as well as the signal processed from the AC voltage, enter an electronic logic XOR gate which outputs a "1" signal if the digital value of the AC voltage is equal to "0" and the digital value of the phase shifted position signal is equal to "1" or the digital value of the AC voltage is equal to "1" and the digital value of the phase shifted position signal is equal to "0".

The output of the zero-crossing detector and the output of the XOR gate, thus in digital form, enter an electronic logic AND gate which provides in output the control signal for closing or opening the static power switch.

The AND gate with two inputs and the signal processing system allow determining two conditions: 1) the AC voltage signal is positive, the current is proximate to zero, and the rotor rotation angle is between 0 degrees and 180 degrees; 2) the AC voltage signal is negative, the current is proximate to zero, and the rotor rotation angle is between 180 degrees and 360 degrees. These two conditions provide the same rotation direction of the rotor of the AC motor.

Fig. 18 shows an embodiment of an AC motor in which one stator pole 54 is longer than the other stator pole 55 by an amount indicated by l. With this configuration the permanent-magnet rotor 39 with an ideal line 56 separating the north N and the south S of the rotor, is positioned so that the ideal line 56 do not coincide with the median axis 57 of the stator 37, but so that the ideal line 56 is tilted by a certain angle α in respect to the median 57 of the stator 37.

Two energising windings 58, 59 are provided on the two poles 54,55 of the stator 37, respectively, and the energising windings are connected in series and are powered, through terminals (not shown), by an AC power source. With this configuration of the AC motor, the motor is able to start more easily in an intended rotational direction of the rotor.

In a preferred embodiment of the invention, the control electronics supplies the AC motor with only a half-wave voltage signal during start up, thereby providing torque pulses to the rotor. Since only a half-wave voltage signal is supplied to the motor, the torque pulses are always unidirectional and will therefore force the rotor to start rotating in a required direction. The required direction of rotation is determined by the design of the impeller attached to the rotor and by polarity of the half-wave voltage signal.

After some amount of time, in which a number of half-wave voltage signals has been supplied to the motor, the rotor will stop rotating at a certain position e.g. as shown in the figure. Thus, the rotor is brought into a determined steady state position that is independent of its start position. Subsequent to this process, the AC motor is supplied with a full-wave voltage signal that will accelerate the rotor until the motor enters synchronous operation, that is, when the rotor rotates with the same cyclic frequency as the frequency of the AC voltage source.

The initial polarity of the AC voltage signal is determinative for the resulting direction of rotation of the rotor, thus if the initial voltage is positive with an increasing amplitude, the rotor will start rotating in one direction, whereas if the voltage is negative with a decreasing amplitude, the rotor will start rotating in an opposite direction.

The number of half-waves required for bringing the rotor into a determined steady state position, where the rotor stops rotating, depends on the characteristics of the motor such as moment of inertia and the external load applied to the rotor. Thus, the number of half-waves required is based on empirical analysis of a particular motor in particular load conditions.

The half-wave voltage signal and the corresponding half-wave current signal supplied to the motor will have an appearance as shown in Fig. 19.

In an alternative embodiment the control electrics used to drive the AC motor shown if Figure 18 is configured so that that the control electronics dictates the AC motor to stop at a predetermined position by supplying the motor with a number of half-wave voltage signals subsequent to the synchronous operation in which the motor was supplied with a full-wave voltage signal. Thus, at the time the motor needs to be started again, the rotor is already in a position so that only the polarity of the full-wave AC voltage signal supplied to the motor must be chosen so that the resulting direction of rotation of the rotor is in conformity with the terminal position of the rotor at the last operation.

According to this method, the initial step of bringing the rotor into a determined steady state position by supplying the motor with a number of half-wave voltage signals is not required. Even in the alternative, it will be possible to both terminate the full-wave power supply with a number of half-wave voltage signals as well as commencing the full-wave power supply by initially supplying the motor with a number of half-wave signals. However, this is more cumbersome, but nevertheless more safe.

Fig. 19 shows a voltage signal V and a current signal I applied to the AC motor as well as the position signal of the rotor. Initially the rotor stands still, which is represented by the straight line L. The electronic control circuit controls the static power switch so that the voltage signal V and the current signal I are present as half-waves. Thus, the rotor receives torque pulses due to the current-voltage combination; these pulses are always one-way directional and tend to start the rotor moving in the required direction. Subsequent to the start-up phase, the rotor enters into its synchronous operation.

Thus, an AC signal is generated, preferably a 12 V AC signal, possibly by means of digital electric pulses from the 12 V DC power supply of the computer's power supply. Based on a possible sensor output relating to the impeller position, a decision is made of how to initiate the AC power signal, i.e. with a negative or positive half-wave, and by doing making sure the impeller starts in the same rotational direction each time andthus the performance benefits of the AC pump is similar to those of a DC pump.

Alternatively, the magnetic field sensor is omitted, and instead of reading the impeller position, the impeller is forced to be in the same position every time the impeller starts. To be sure the impeller is in a defined position before start, a signal is supplied to the stator of tha AC motor for a defined period of time. The signal is supplied perhaps three times in a row according to the curvature of the electrical power source. The pulses must be within the same half-wave part of a signal period. The frequency of the pulsed signal is arbitrary, but may be 50/60 Hz, although, despite the fact that under normal circumstances an AC pump being driven by the AC signal from the power outlet of the public electrical power network and transformed from 230/115 V to 12V would not function, as there is no chance of changing the sine signal from the public network.

By this way the impeller will be forced to the right polarity before start, and the pump will start turning the impeller in a defined way of rotation when the power signal full-wave is supplied. The full-wave power signal, which is supplied, must start in the opposite signal half-wave amplitude than that of the initial half-wave pulses, that was supplied before start of the full-wave power signal.

The invention has been described with reference to specific embodiments and with reference to specific utilisation, it is to be noted that the different embodiments of the invention may be manufactured, marketed, sold and used separately or jointly in any combination of the plurality of embodiments. In the above detailed description of the invention, the description of one embodiment, perhaps with reference to one or more figures, may be incorporated into the description of another embodiment, perhaps with reference to another or more other figures, and vice versa. Accordingly, any separate embodiment described in the text and/or in the drawings, or any combination of two or more embodiments is envisaged by the present application.

CLAIMS

1. A cooling system for a computer system, said computer system comprising
- at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit and comprising
- a reservoir having an amount of cooling liquid, said cooling liquid intended for accumulating and transferring of thermal energy dissipated from the processing unit to the cooling liquid,
- a heat exchanging interface for providing thermal contact between the processing unit and the cooling liquid for dissipating heat from the processing unit to the cooling liquid,
- a pumping means being provided as part of an integrate element, said integrate element comprising the heat exchanging interface, the reservoir and the pump,
- said pump intended for pumping the cooling liquid into the reservoir, through the reservoir and from the reservoir to a heat radiating means,
- said heat radiating means intended for radiating thermal energy from the cooling liquid, dissipated to the cooling liquid, to surroundings of the heat radiating means.

2. A cooling system according to claim 1, wherein the entire pump is placed inside the reservoir with at least an inlet or an outlet leading to the cooling liquid in the reservoir.

3. A cooling system according to claim 1, wherein the pumping member of the pump and a movable driven part of the motor of the pump, such as a rotor of en electrical motor, is placed inside a liquid-containing interior of the reservoir, embedded in the cooling liquid, and wherein a stationary driving part of the motor of the pump, such as a stator of an electrical motor, is placed outside the liquid-containing interior of the reservoir.

4. A cooling system according to claim 1, wherein the entire pump is placed outside the reservoir in the immediate vicinity of the reservoir, and wherein at least an inlet or an outlet of the pump is leading directly to the cooling liquid in the reservoir.

5. A cooling system according to any of the preceding claims, wherein an inlet of the pump is positioned in immediate vicinity of the heat exchanging interface for thereby obtaining a turbulence of flow of the cooling liquid in the immediate vicinity of the heat exchanging interface.

6. A cooling system according to any of the preceding claims, wherein an outlet of the pump is positioned in immediate vicinity of the heat exchanging interface for thereby obtaining a turbulence of flow of the cooling liquid in the immediate vicinity of the heat exchanging interface.

7. A cooling system according to any of the preceding claims, wherein a pumping member such as an impeller of the pump is positioned in immediate vicinity of the heat exchanging interface for thereby obtaining a turbulence of flow of the cooling liquid in the immediate vicinity of the heat exchanging interface.

8. A cooling system according to any of the preceding claims, wherein the pumping member of the pump is intended for only one-way of displacement for pumping, such as one-way rotation for pumping, and where the pumping member is driven by a motor capable of two-way displacement when operating, such as both clockwise and counter-clockwise rotation when operating.

9. A cooling system according to any of the preceding claims, wherein the pump is selected from the following types: Bellows pump, centrifugal pump, diaphragm pump, drum pump, flexible liner pump, flexible impeller pump, gear pump, peristaltic tubing pump, piston pump, processing cavity pump, pressure washer pump, rotary lobe pump, rotary vane pump and electro-kinetic pump.

10. A cooling system according to any of the preceding claims, wherein driving means for driving the pump is selected among the following driving means: electrically operated rotary DC motor, electrically operated rotary AC motor, piezo-electrically operated motor, permanent magnet operated motor, fluid-operated motor, capacitor-operated motor.

11. A cooling system according to any of claims 8-10, wherein the pumping member of the pump is a one-way rotational impeller of a centrifugal pump, and wherein the motor of the pump is an electrical rotary AC motor driven by AC electrical power.

12. A cooling system according to any of the preceding claims, wherein one or more of the following means are provided inside the reservoir for increasing the heat absorption by the cooling liquid: channels or segments inside the reservoir, an uneven surface being provided on a physical surface of the heat exchanging interface, a heat sink with segments provided inside the reservoir and being in thermal contact with the cooling liquid.

13. A cooling system according to any of the preceding claims, wherein the heat exchanging interface is a heat exchanging surface being in close thermal contact with the processing unit for dissipating heat from the processing unit to the cooling liquid via the heat exchanging surface.

14. A cooling system according to any of the preceding claims, where the heat exchanging interface is a free surface of the processing unit, said free surface of the processing unit having direct access to the cooling liquid for dissipating heat from the processing unit directly to the cooling liquid.

15. A cooling system for a computer system, said computer system comprising
- at least one unit such as a central processing unit (CPU) generating thermal energy and said cooling system intended for cooling the at least one processing unit and comprising
- a reservoir having an amount of cooling liquid for accumulating and transferring of thermal energy dissipated from the processing unit to the cooling liquid,
- a heat exchanging interface for providing thermal contact with the processing unit and the cooling liquid for dissipating heat from the processing unit to the cooling liquid,
- a pump intended for pumping the cooling liquid into the reservoir, through the reservoir and from the reservoir to a heat radiating means, and
- said cooling system further comprising a pump wherein the pump is driven by an AC electrical motor powered by a DC electrical power supply of the computer system,
- where at least part of the DC electrical power from said power supply is intended for being converted to AC electrical power being supplied to the electrical motor.

16. A cooling system according to claim 15, wherein the pump is selected from the following types: Bellows pump, centrifugal pump, diaphragm pump, drum pump, flexible liner pump, flexible impeller pump, gear pump, peristaltic tubing pump, piston pump, processing cavity pump, pressure washer pump, rotary lobe pump, rotary vane pump and electro-kinetic pump.

17. A cooling system according to claim 15 or 16, wherein one or more of the following means are provided inside the reservoir for increasing the heat absorption by the cooling liquid: channels or segments inside the reservoir, an uneven surface being provided on a physical surface of the heat exchanging interface, a heat sink with segments provided inside the reservoir and being in thermal contact with the heat exchanging surface.

18. A cooling system according to any of claims 15-17, where the heat exchanging interface is a heat exchanging surface being in close thermal contact with the processing unit for dissipating heat from the processing unit to the cooling liquid via the heat exchanging surface.

19. A cooling system according to any of the claims 15-17, where the heat exchanging interface is a free surface of the processing unit, said free surface of the processing unit having direct access to the cooling liquid for dissipating heat from the processing unit directly to the cooling liquid,

20. A cooling system according to any of the claims 1-19, wherein a motor is intended both for driving the pump for pumping the cooling liquid and for driving a fan for establishing a flow of air in the vicinity of the reservoir.

21. A cooling system according to any of the claims 1-19, wherein a motor is intended both for driving the pump for pumping the cooling liquid and for driving a fan for establishing a flow of air in the vicinity of the heat radiating means.

22. A cooling system according to any of the claims 1-19, wherein a motor is intended both for driving the pump for pumping the cooling liquid, and for driving the a fan for establishing a flow of air in the vicinity of the reservoir, and for driving a fan for establishing a flow of air in the vicinity of the heat radiating means.

23. A cooling system according to any of the preceding claims, wherein the heat exchanging interface is an element being separate from the reservoir, and where the heat exchanging interface is secured to the reservoir in a manner so that the heat exchanging interface constitutes part of the reservoir when being secured to the reservoir.

24. A cooling system according to any of claims 1-22, wherein the heat exchanging interface constitutes an integrate part of the reservoir, and where the heat exchanging interface extends along an area of a surface of the reservoir, said area of surface being intended for facing the processing unit and said area of surface being intended for close thermal contact with the processing unit.

25. A cooling system according to any of claims 1-22, wherein the heat exchanging interface is constituted between a free surface of the processing unit and the cooling liquid in the reservoir, and where the heat exchanging interface is capable of establishing the close thermal contact with the processing unit through an aperture provided in the reservoir, and where the aperture extends along an area of the surface of the reservoir, said area of surface being intended for facing the processing unit.

26. A method of cooling a computer system comprising at least one unit such as a central processing unit (CPU) generating thermal energy and said method utilising a cooling system for cooling the at least one processing unit and, said cooling system comprising
- a reservoir, at least one heat exchanging interface and a pumping means, said method of cooling comprising the steps of
establishing, or defining, or selecting an operative status of the pumping means
- controlling the operation of the motor of the pumping means in response to the following parameters; the necessary direction of movement for obtaining a pumping action of a pumping member of the pumping means, the possible direction of movement of a driving part of the motor of the pumping means, and
- in accordance with the operative status being established, defined or selected, controlling the operation of the computer system in order to achieve the necessary direction of movement of the driving part of the motor for establishing the necessary direction of movement for obtaining he pumping action of the pumping member.

27. A method according to claim 26, said method being applied to a cooling system where the pumping member is a rotary impeller having a one-way direction for obtaining a pumping action, and where the motor of the pumping means is an electrical AC motor having a rotor constituting the driving part of the motor, and
said method comprising the step of establishing, or defining, or selecting a rotary position of the rotor of the electrical AC motor, and applying at least one half-wave of an AC power signal to the stator of the AC motor before applying a full-wave AC power signal.

28. A method according to claim 26, said method being applied to a cooling system where the pumping member is a rotary impeller having a one-way direction for obtaining a pumping action, and where the motor of the pumping means is an electrical AC motor having a rotor constituting the driving part of the motor, and
said method comprising the step of establishing, or defining, or selecting a rotary position of the rotor of the electrical AC motor, and applying at least one half-wave of an AC power signal to the stator of the AC motor after having applied the full-wave AC power signal.

29. A method according to claim 26, said method being applied to a cooling system where the pumping member is a rotary impeller having a one-way direction for obtaining a pumping action, and where the motor of the pumping means is an electrical AC motor having a rotor constituting the driving part of the motor, and
said method comprising the step of establishing, or defining, or selecting a rotary position of the rotor of the electrical AC motor, and terminating a full-wave AC power signal having been applied with a selected known orientation of the last half-wave of the AC power signal.

30. A method of cooling a computer system comprising at least one unit such as a central processing unit (CPU) generating thermal energy and said method utilising a cooling system for cooling the at least one processing unit and, said cooling system comprising
- a reservoir, at least one heat exchanging interface, a pumping means and an air blowing fan, said method of cooling comprising the steps of
- applying one of the following possibilities of how to operate the computer system: establishing, or defining, or selecting an operative status of the computer system
- controlling the operation of at least one of the following means of the computer system; the pumping means and the air blowing fan in response to at least one of the following parameters; a surface temperature of the heat generating processing unit, an internal temperature of the heat generating processing unit, or a processing load of the CPU and
- in accordance with the operative status being established, defined or selected, controlling the operation of the computer system in order to achieve at least one of the following conditions; a certain cooling performance of the cooling system, a certain electrical consumption of the cooling system, a certain noise level of the cooling system.

31. A method according to claim 32 for cooling a computer system, wherein the operation of the air blowing fan is controlled before any control of the operation of the pumping means in order to achieve the at least one selected condition of the cooling system.

32. A method according to claim 32 or 33 for cooling a computer system, wherein said computer system further comprises an operative system or an alike means comprising a means for measuring the CPU load and/or the CPU temperature, and wherein said method of cooling said CPU further comprises the step of
- using a measurement, performed by said BIOS or alike means, of the CPU load and/or the CPU temperature for controlling said cooling system.

33. A method according to claim 32 for cooling a computer system, wherein said cooling system further comprises a temperature measuring means for measuring a temperature of the CPU, and wherein said method of cooling said CPU further comprises the step of
- using a measurement, performed by said temperature measurement means, of the CPU temperature for controlling said cooling system.

34. A method for cooling a computer system, wherein said cooling system further comprises a pumping means with an impeller for pumping the cooling liquid through a pump chamber, said pumping means being driven by an AC electrical motor with a stator and a rotor, and said pumping means being provided with a means for sensing a position of the rotor, and wherein the method comprises the following steps

- initially establishing a preferred rotational direction of the rotor of the electrical motor
- before start of the electrical motor, sensing the angular position of the rotor
- during start, applying an electrical AC signal to the electrical motor and selecting the signal value, positive or negative, of the AC signal at start of the electrical motor
- said selection being made according to the preferred rotational direction, and
- said application of the AC signal being performed by the computer system for applying the AC voltage from the electrical power supply of the computer system during conversions of the electrical DC voltage of the power supply to AC voltage for the electrical motor.

35. A method according to claim 34, where sensing the angular position of the rotor is accomplished by a number Hall-sensors placed at angular intervals for detection of the rotor's magnetic poles, the number of sensors corresponding to the number of magnetic poles establishing the mechanical angle, and corresponding to the electrical angle.

36. A method according to claim 34 or claim 35, where application of the electrical AC voltage to the electrical motor and selection of the signal value, positive or negative, of the AC voltage at start of the electrical motor is accomplished by the operating system of the computer system and is communicated to an DC/AC converter of the computer system.

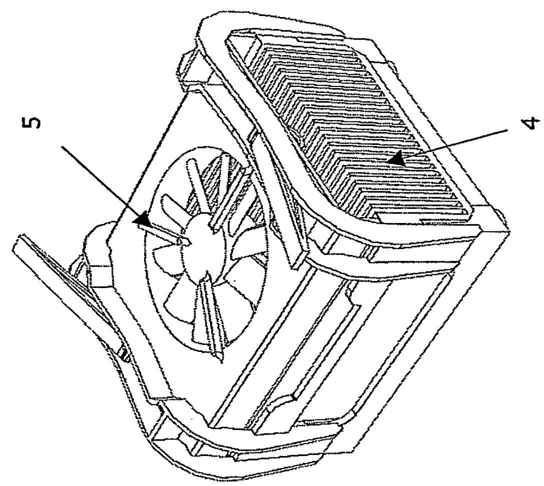

FIG. 2

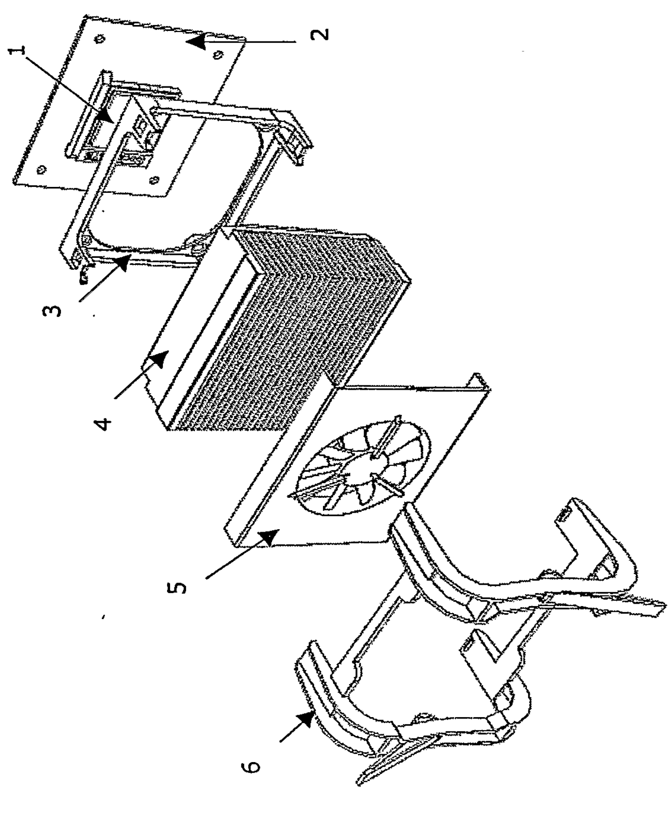

FIG. 1

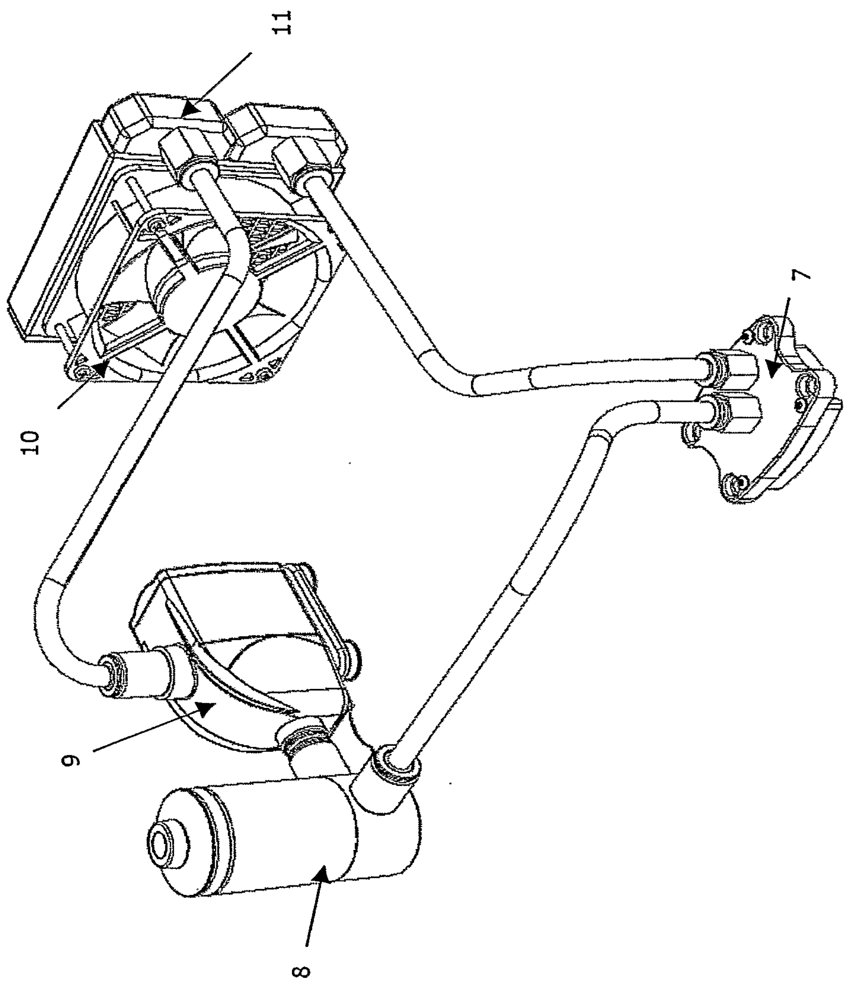

FIG. 3

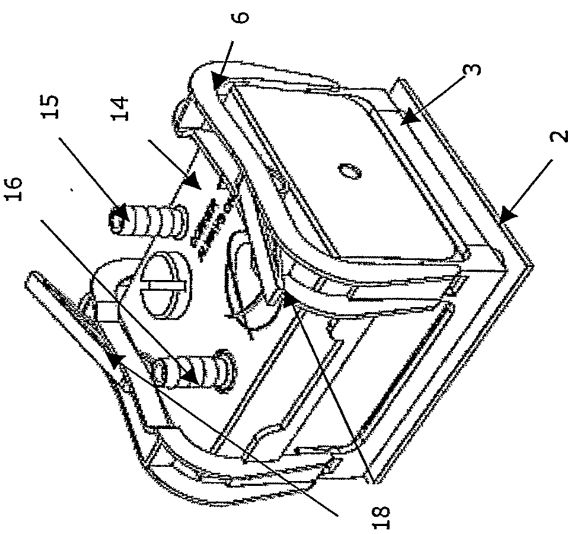

FIG. 5

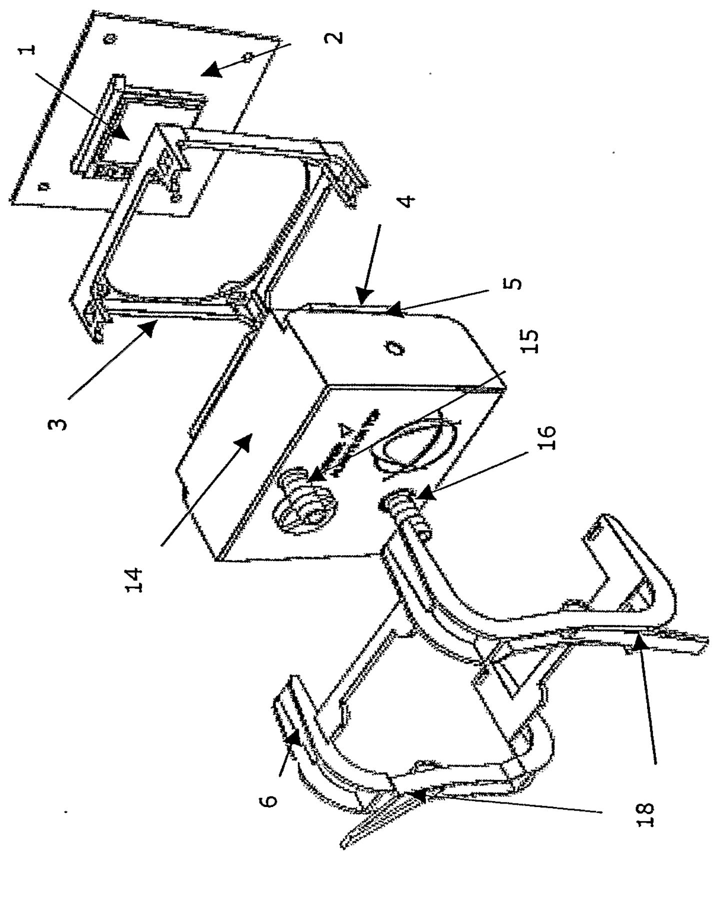

FIG. 4

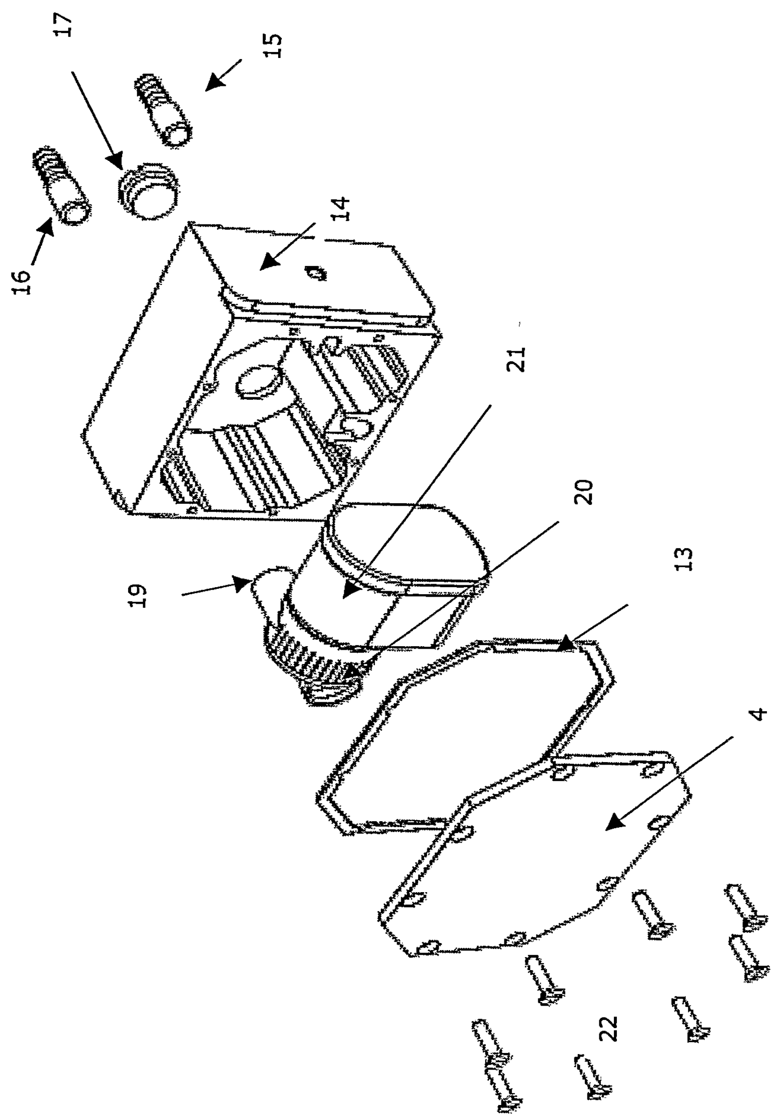

FIG. 6

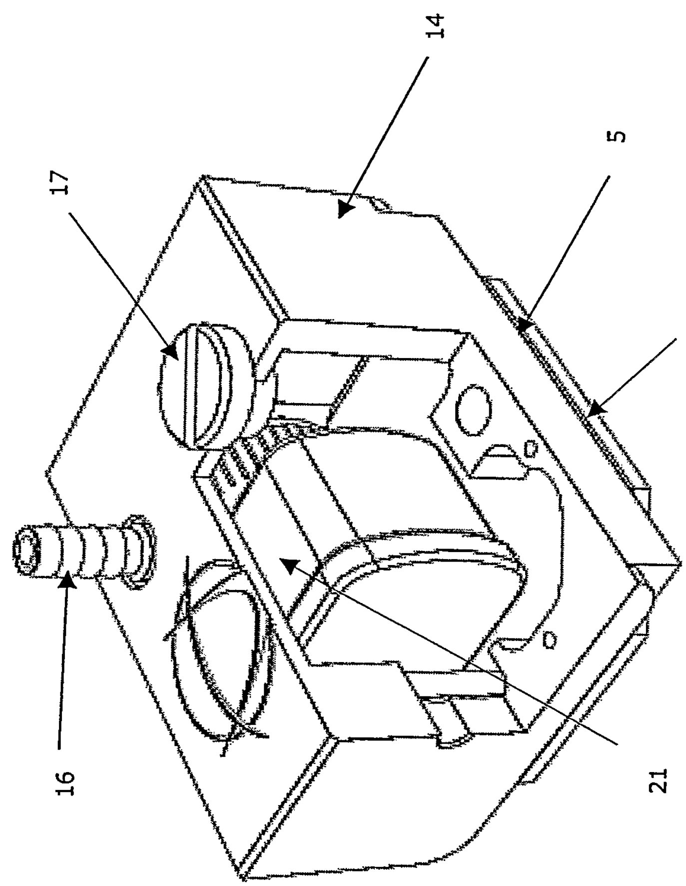

FIG. 7

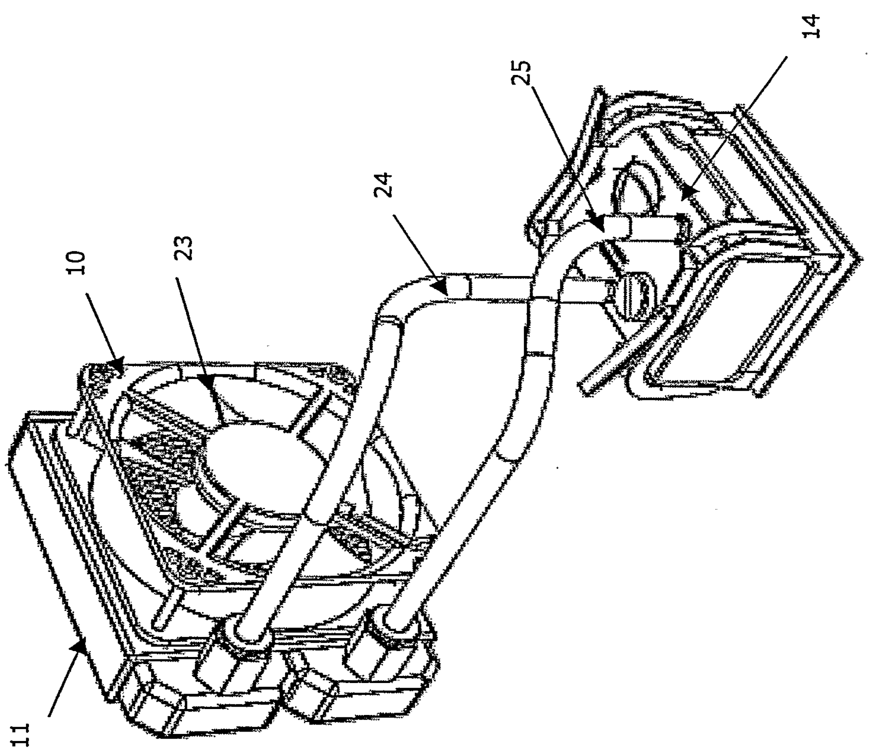

FIG. 8

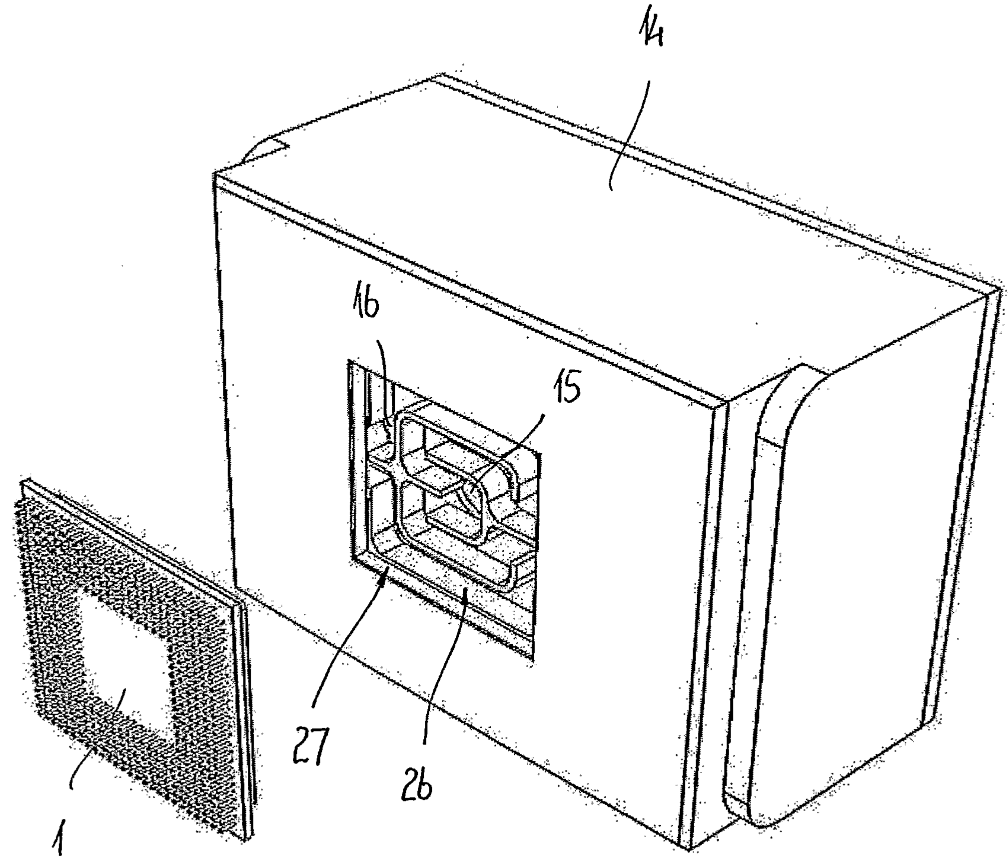

FIG. 9

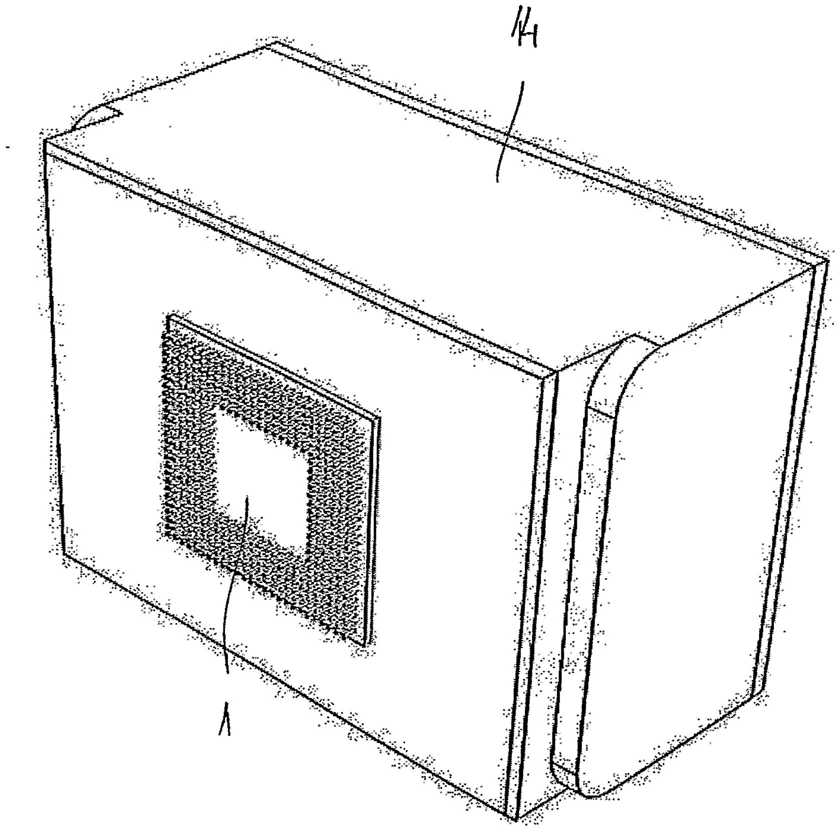

FIG. 10

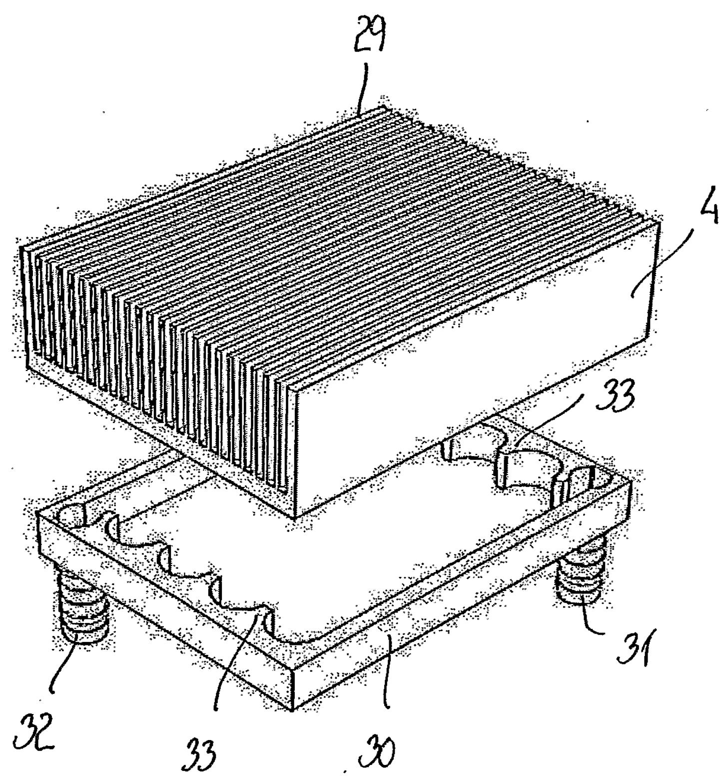

FIG. 11

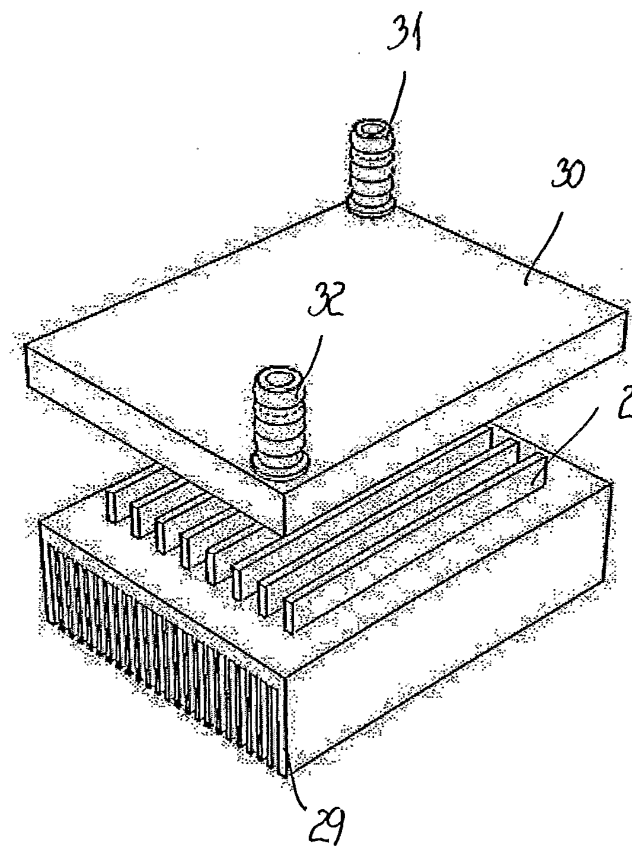

FIG. 12

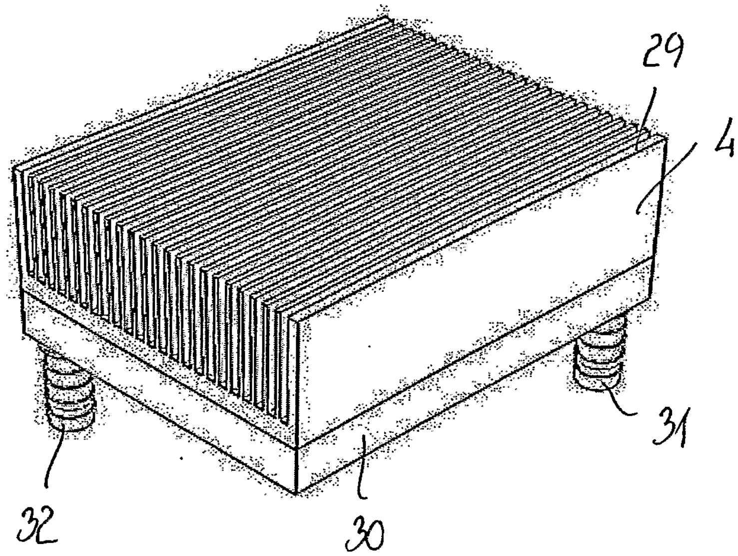

FIG. 13

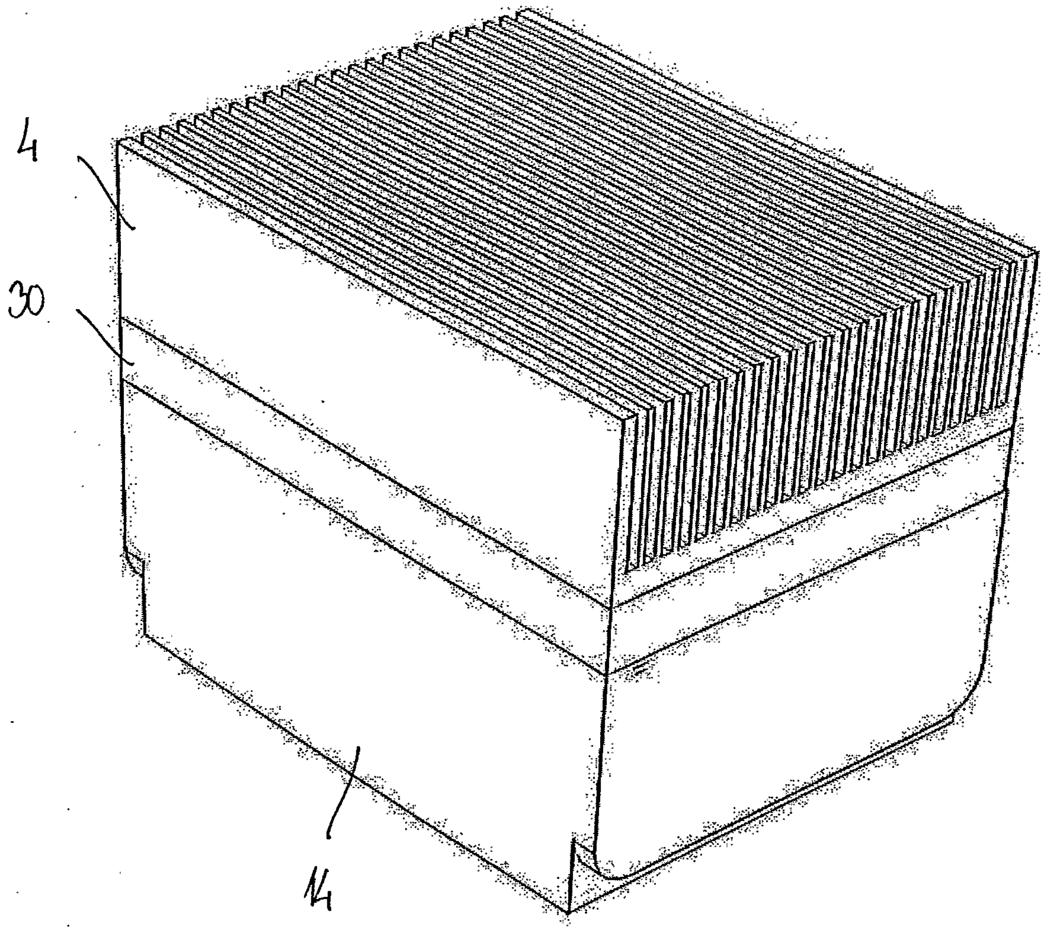

FIG. 14

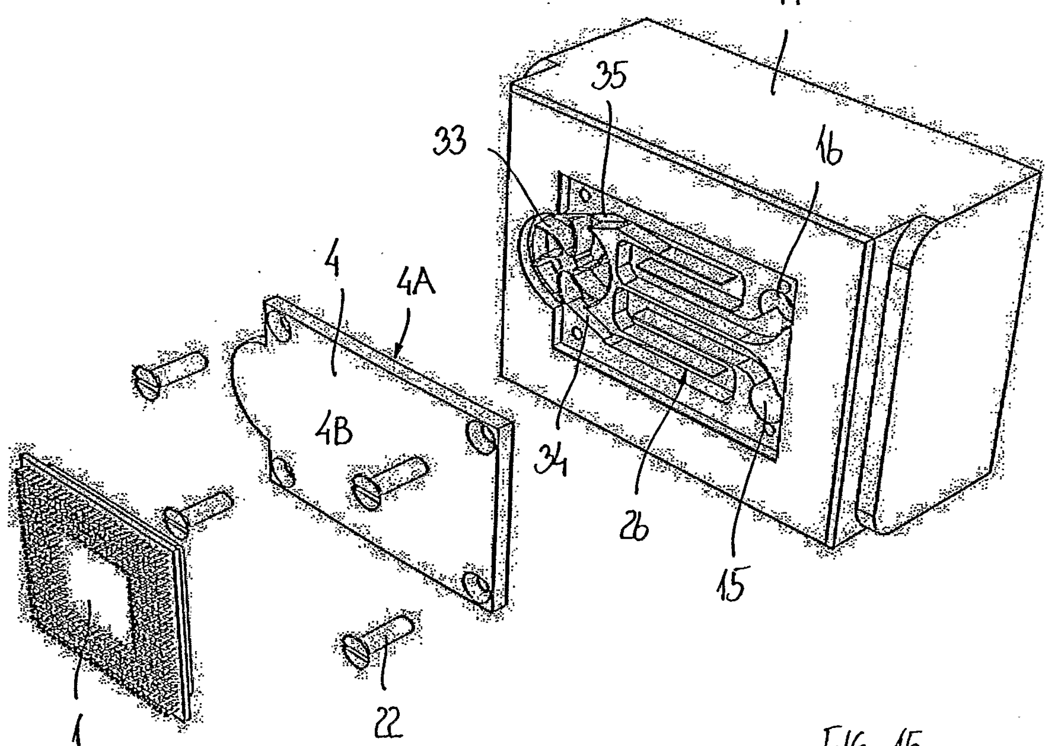

FIG. 15

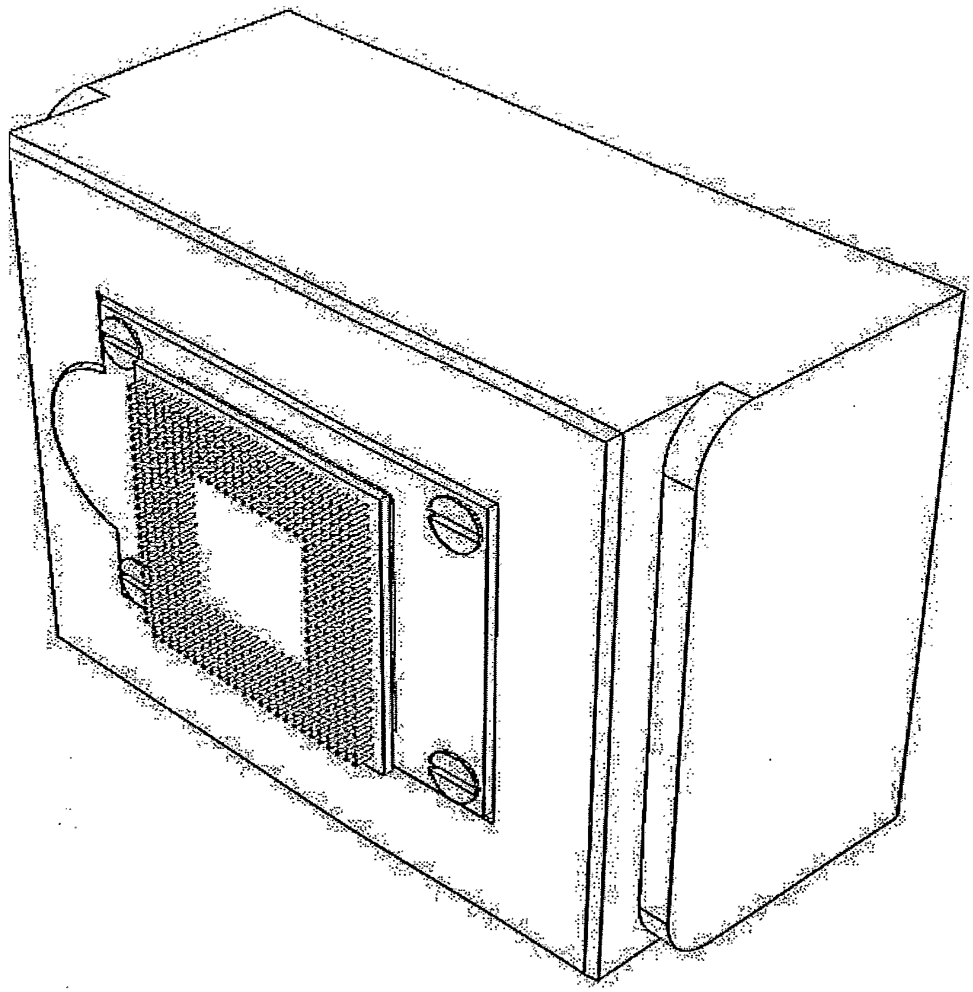

FIG. 1b

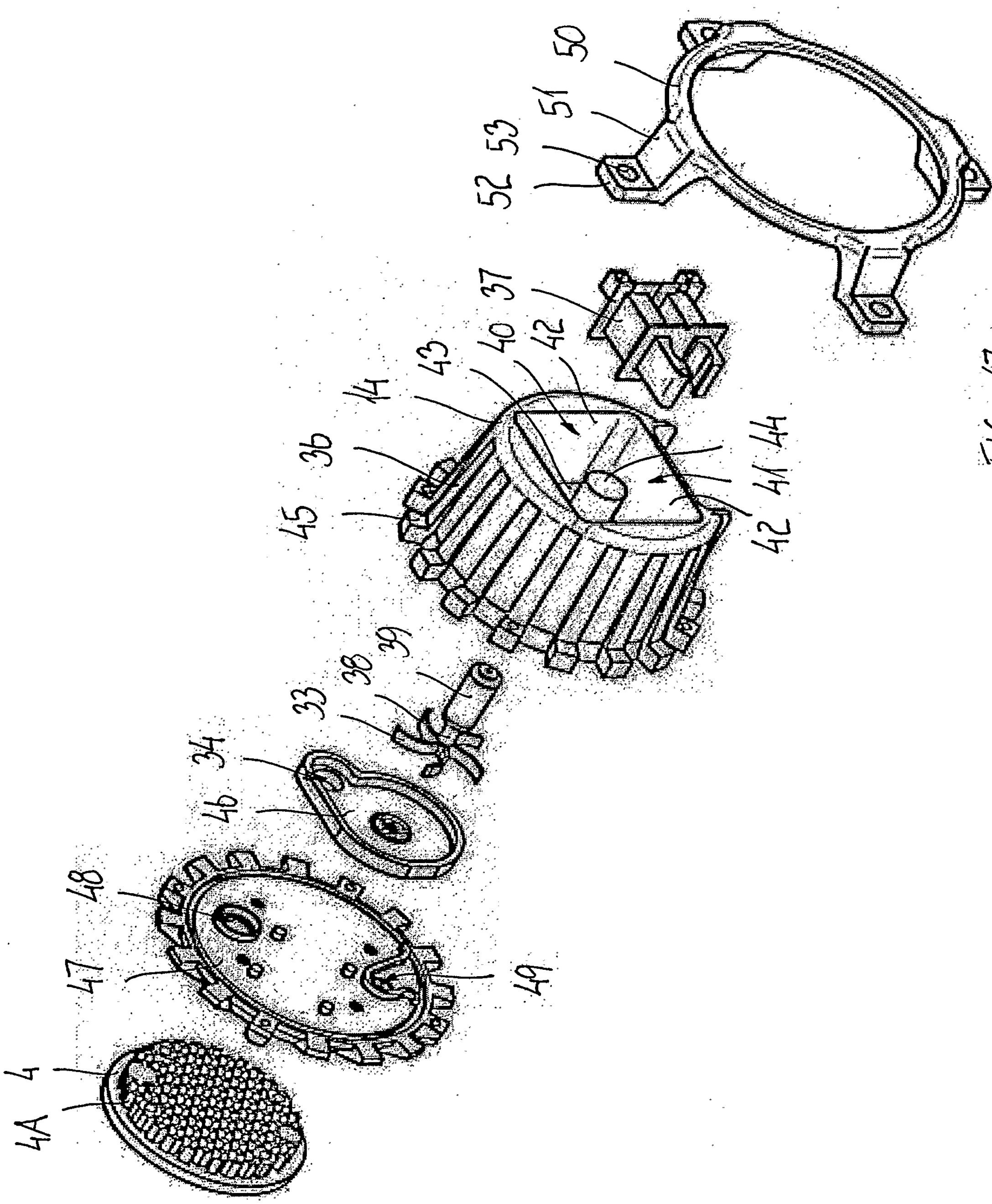

FIG. 17

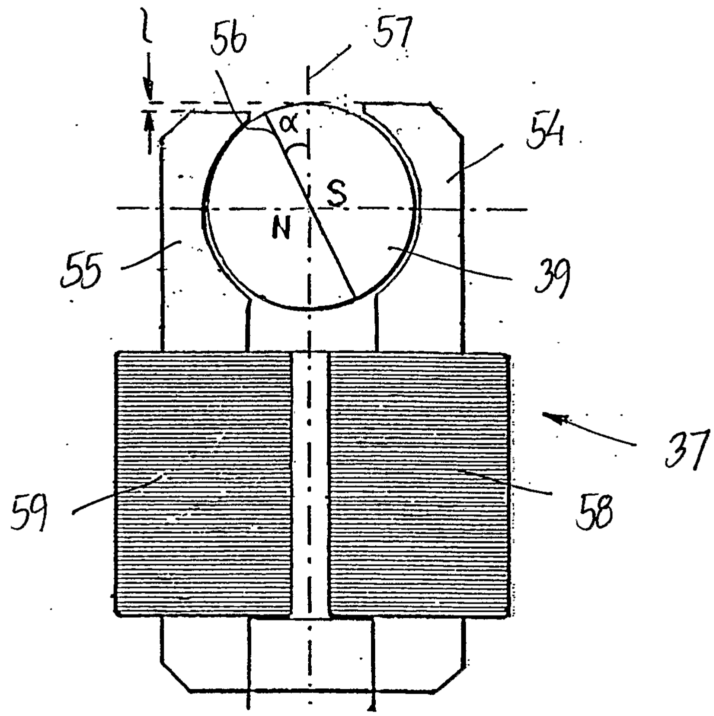

FIG. 18

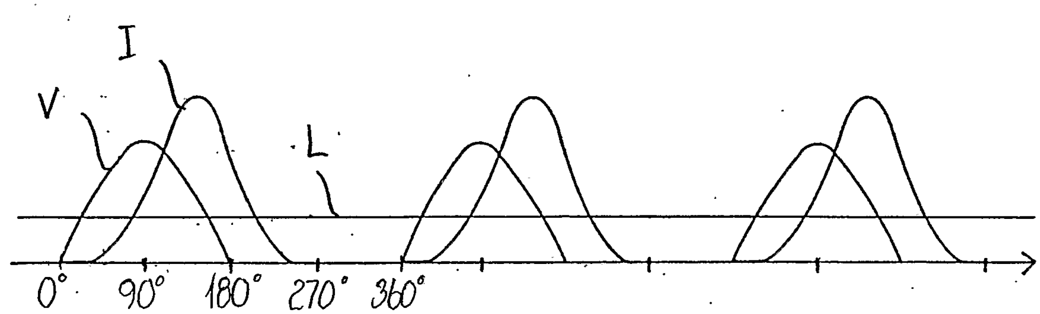

FIG. 19

INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2005/000310

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F1/20 H02P6/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06F H02P F04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/052049 A1 (WU BO JIU ET AL) 18 March 2004 (2004-03-18) paragraph [0011] paragraph [0021] - paragraph [0025]; figure 1	1-14, 20-25
X	US 6 019 165 A (BATCHELDER ET AL) 1 February 2000 (2000-02-01) column 4, line 64 - column 11, line 56; figures 2-12	1-14, 20-25
X	US 2005/061482 A1 (LEE HSIEH KUN ET AL) 24 March 2005 (2005-03-24) paragraph [0004] - paragraph [0029]; figures 1-3	1-14, 20-25

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 April 2006	08/05/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Legrand, J-C

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2005/000310

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 263 957 B1 (CHEN SHIAW-JONG S ET AL) 24 July 2001 (2001-07-24) column 3, line 17 - column 5, line 7; figures 1-3	1-14, 20-25
X	US 2003/010050 A1 (SCOTT ALEXANDER ROBIN WALTER) 16 January 2003 (2003-01-16)	15-19
Y	paragraph [0054] - paragraph [0105]; figures 1-19	26-29, 34-36
Y	EP 0 574 823 A (ASKOLL S.P.A) 22 December 1993 (1993-12-22) column 1, line 1 - line 45 column 2, line 43 - column 6, line 52; figures 1-6	26-29, 34-36
A	EP 0 610 826 A (ASKOLL S.P.A) 17 August 1994 (1994-08-17) the whole document	26-29, 34-36
A	US 4 563 620 A (KOMATSU ET AL) 7 January 1986 (1986-01-07) column 2, line 14 - line 40 column 3; figures 1-4 claim 3	28,29
E	WO 2005/045654 A (ASETEK A/S; ERIKSEN, ANDRE, SLOTH) 19 May 2005 (2005-05-19) the whole document	1-29, 34-36

INTERNATIONAL SEARCH REPORT

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☒ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

   1-29,34-36

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-14,20-25

   A cooling system for a computer system comprising:
   - a reservoir having an amount of cooling liquid;
   - a heat exchanging interface;
   - a pumping means;
   - a heat radiating means;
   - where the pump, the heat exchanging interface and the reservoir are provided as an integrate element.

   ---

2. claims: 15-19, 26-29, 34-36

   A cooling system for a computer system comprising:
   - a reservoir having an amount of cooling liquid;
   - a heat exchanging interface;
   - a pumping means;
   - a heat radiating means;
   - where the pump is driven by an AC electrical motor powered by a DC electrical power supply of the computer system, where at least part of the DC electrical power from said power supply is intended for being converted to AC electrical power being supplied to the electrical motor.

   ---

3. claims: 30-33

   A method of cooling a computer system, said cooling system comprising:
   - a reservoir having an amount of cooling liquid;
   - a heat exchanging interface;
   - a pumping means;
   - a heat radiating means;
   - a fan;

   and said method of cooling comprising the steps of:
   - controlling the operation of the pump or the fan depending on the temperature or the processing load of the CPU;
   - controlling the operation of the computer system according to an operating status of the computer in order to achieve a certain cooling performance, electrical consumption or noise level.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/DK2005/000310

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
US 2004052049	A1	18-03-2004	US	2004052048	A1	18-03-2004
US 6019165	A	01-02-2000	NONE			
US 2005061482	A1	24-03-2005	TW	244513	Y	21-09-2004
US 6263957	B1	24-07-2001	NONE			
US 2003010050	A1	16-01-2003	CA	2352997	A1	13-01-2003
EP 0574823	A	22-12-1993	AT	163813	T	15-03-1998
			CA	2097672	A1	18-12-1993
			DE	69317156	D1	09-04-1998
			DE	69317156	T2	25-06-1998
			ES	2116368	T3	16-07-1998
			IT	1259115	B	11-03-1996
			JP	6078583	A	18-03-1994
			US	5434491	A	18-07-1995
EP 0610826	A	17-08-1994	IT	1263644	B	27-08-1996
US 4563620	A	07-01-1986	JP	59188383	A	25-10-1984
WO 2005045654	A	19-05-2005	NONE			

Appendix K to the Request for *Inter Partes* Reexamination of

In re Patent of	:	Andre Sloth Eriksen
U.S. Patent No.	:	8,245,764
Application No.	:	13/269,234
Issue Date	:	August 21, 2012
Filing Date	:	October 7, 2011
Title	:	COOLING SYSTEM FOR A COMPUTER SYSTEM

APPENDIX K - Comparison of claim 15 in the '764 Patent to cancelled claim 113 from Parent Application

Rejected and Cancelled Claim 113 from the Parent Application	Issued Claim 15 in the '764 Patent
A cooling system for a heat-generating component, comprising: a pump adapted to circulate a cooling liquid, the pump including: an impeller exposed to the cooling liquid; and a stator isolated from the cooling liquid; a reservoir including an impeller cover, an intermediate member and a heat exchange interface, wherein a top wall of the reservoir and the impeller cover define a pump chamber for housing the impeller, and the intermediate member and the heat exchange interface define a thermal exchange chamber, the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together; and wherein a first side of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and a second side of the heat-exchanging interface opposite the first side is configured to be placed in thermal contact with a surface of the heat-generating component; and a liquid-to-air heat exchanger fluidly coupled to the reservoir using flexible conduits, the heat exchanger being configured to be positioned remote from the reservoir.	A cooling system for a heat-generating component, comprising: a pump adapted to circulate a cooling liquid, the pump including: an impeller exposed to the cooling liquid; and a stator isolated from the cooling liquid; a reservoir including an impeller cover, an intermediate member and a heat exchange interface, wherein a top wall of the reservoir and the impeller cover define a pump chamber for housing the impeller, and the intermediate member and the heat exchange interface define a thermal exchange chamber, the pump chamber and the thermal exchange chamber being spaced apart from each other in a vertical direction and fluidly coupled together; and wherein a first side of the heat-exchanging interface is in contact with a cooling liquid in the thermal exchange chamber and a second side of the heat-exchanging interface opposite the first side is configured to be placed in thermal contact with a surface of the heat-generating component; and a liquid-to-air heat exchanger fluidly coupled to the reservoir using flexible conduits, the heat exchanger being configured to be positioned remote from the reservoir.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	Andre Sloth Ericksen
Filer:	Lloyd L. Pollard II/Tracie Semenchalam
Attorney Docket Number:	COOL-1.012

Filed as Large Entity

inter partes reexam Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Request for inter reexamination	1813	1	8800	8800
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
		Total in USD ($)		**8800**

Electronic Acknowledgement Receipt

EFS ID:	13758305
Application Number:	95002386
International Application Number:	
Confirmation Number:	7254
Title of Invention:	COOLING SYSTEM FOR A COMPUTER SYSTEM
First Named Inventor/Applicant Name:	Andre Sloth Ericksen
Customer Number:	22874
Filer:	Lloyd L. Pollard II/Tracie Semenchalam
Filer Authorized By:	Lloyd L. Pollard II
Attorney Docket Number:	COOL-1.012
Receipt Date:	15-SEP-2012
Filing Date:	
Time Stamp:	03:46:53
Application Type:	inter partes reexam

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$8800
RAM confirmation Number	11338
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1	Transmittal of New Application	Reexam_Transmittal.pdf	129835 9cceb8479e65d3b40bcec254316c6d39856eef80	no	3
Warnings:					
Information:					
2	Receipt of Original Inter Partes Reexam Request	Request.pdf	1828170 f6826368fd8def6d36d6fa479f8ec221b66238f0	no	184
Warnings:					
Information:					
3	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Appendix_A.pdf	2399543 c03920574427c52a43a91dd0f09b728fdb0b5c2d	no	30
Warnings:					
Information:					
4	Reexam - Info Disclosure Statement Filed by 3rd Party	Appendix_B.pdf	261143 18d0da3bf4dd755548253008229401 6303f7e346	no	3
Warnings:					
Information:					
5	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Appendix_C.pdf	856327 facd61ea46a9e4765c569c87d72917042d7ff169	no	12
Warnings:					
Information:					
6	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Appendix_D.pdf	8593943 34e6b01702c900da2ca4413bbc7343c4bd3ec701	no	118
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Warnings:					
Information:					
9	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Appendix_G.pdf	827835 85d01f1243c9f50adebe7b83b2b21dc9bb7dcc70	no	9
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Information:					

10	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Appendix_H.pdf	764202 1f49d679f0674fd5bb38b3059b6658b5a8af7af9	no	13
Warnings:					
Information:					
11	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Appendix_I.pdf	1284603 5727e7f7501671151dc8b0bb85eb4346c57ecb24	no	18
Warnings:					
Information:					
12	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Appendix_J.pdf	3478175 ea804cb2f157613f51c2893e875c7548af698920	no	66
Warnings:					
Information:					
13	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Appendix_K.pdf	202489 6845ff1e813053e63cc14de6053d6ac92d0c3a14	no	2
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Warnings:					
Information:					
		Total Files Size (in bytes):	23313554		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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Bib Data Sheet

CONFIRMATION NO. 7254

SERIAL NUMBER	FILING OR 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
95/002,386	09/15/2012 RULE	165	3993	COOL-1.012

APPLICANTS

8245764, Residence Not Provided;
ASETEK A/S, BRONDERSLEV, DENMARK;
GANZ LAW, P.C. (3RD. PTY. REQ.), HILLSBORO, OR;
COOLIT SYSTEMS, INC.US, Residence Not Provided;
GANZ LAW, P.C., HILLSBORO, OR

** **CONTINUING DATA** *************************

This application is a REX of 13/269,234 10/07/2011 PAT 8245764
which is a CON of 11/919,974 01/06/2009
which is a 371 of PCT/DK2005/000310 05/06/2005

** **FOREIGN APPLICATIONS** ********************

	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed ☐ yes ☐ no 35 USC 119 (a-d) conditions met ☐ yes ☐ no ☐ Met after Allowance Verified and Acknowledged _______ Examiner's Signature _______ Initials				

ADDRESS
22852

TITLE

COOLING SYSTEM FOR A COMPUTER SYSTEM

FILING FEE RECEIVED	FEES: Authority has been given in Paper No. _________ to charge/credit DEPOSIT ACCOUNT No. _________ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other ____________ ☐ Credit