



(12) **United States Patent**  
**Eriksen**

(10) **Patent No.:** **US 10,078,354 B2**  
(45) **Date of Patent:** **\*Sep. 18, 2018**

- (54) **COOLING SYSTEM FOR A COMPUTER SYSTEM**
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- (\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.  
  
This patent is subject to a terminal disclaimer.

- (21) Appl. No.: **15/626,393**
- (22) Filed: **Jun. 19, 2017**

- (65) **Prior Publication Data**  
US 2017/0329375 A1 Nov. 16, 2017

- (60) **Related U.S. Application Data**  
Continuation of application No. 15/347,938, filed on Nov. 10, 2016, now Pat. No. 9,715,260, which is a (Continued)

- (51) **Int. Cl.**  
**F28F 7/00** (2006.01)  
**G06F 1/20** (2006.01)  
(Continued)
- (52) **U.S. Cl.**  
CPC ..... **G06F 1/206** (2013.01); **G06F 1/20** (2013.01); **H05K 7/20154** (2013.01);  
(Continued)
- (58) **Field of Classification Search**  
CPC ..... G06F 1/206; G06F 1/20; G06F 2200/201; H05K 7/20154; H05K 7/20263; H05K 7/20272; F28D 15/00; F28F 2250/08  
(Continued)

- (56) **References Cited**  
**U.S. PATENT DOCUMENTS**  
3,810,509 A 5/1974 Kun  
4,109,707 A 8/1978 Wilson et al.  
(Continued)

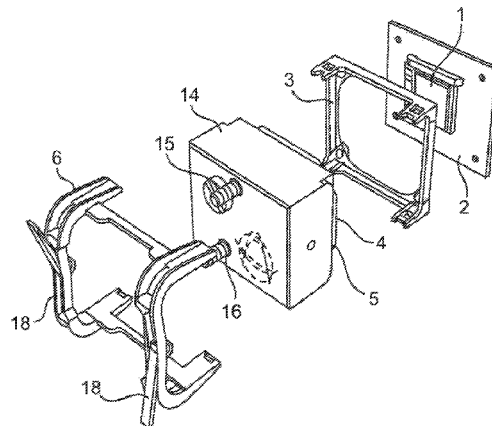
- FOREIGN PATENT DOCUMENTS**  
CN 2514544 Y 10/2002  
CN 1387311 A 12/2002  
(Continued)

- OTHER PUBLICATIONS**  
Office Action dated Mar. 23, 2016 in U.S. Appl. No. 13/942,922 (13 pages).  
(Continued)

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- (57) **ABSTRACT**  
A cooling system for a computer system comprises at least one unit such as a central processing unit (CPU) generating thermal energy and 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.

**19 Claims, 9 Drawing Sheets**



**Related U.S. Application Data**

continuation of application No. 13/942,922, filed on Jul. 16, 2013, which is a continuation of application No. 13/547,240, filed on Jul. 12, 2012, which is a continuation of application No. 12/826,768, filed on Jun. 30, 2010, now Pat. No. 8,240,362, which is a division of application No. 10/578,578, filed as application No. PCT/DK2004/000775 on Nov. 8, 2004, now Pat. No. 7,971,632.

- (51) **Int. Cl.**  
*H05K 7/20* (2006.01)  
*F28D 15/00* (2006.01)
- (52) **U.S. Cl.**  
 CPC ..... *H05K 7/20263* (2013.01); *H05K 7/20272* (2013.01); *F28D 15/00* (2013.01); *F28F 2250/08* (2013.01); *G06F 2200/201* (2013.01)
- (58) **Field of Classification Search**  
 USPC ..... 165/80.4  
 See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,520,298	A	5/1985	Abbondanti
4,563,620	A	1/1986	Komatsu
4,777,578	A	10/1988	Jahns
4,898,579	A	2/1990	Groshong et al.
5,001,548	A	3/1991	Iversen
5,006,924	A	4/1991	Frankeny et al.
5,070,936	A	12/1991	Carroll et al.
5,142,214	A	8/1992	Purson et al.
5,316,077	A	5/1994	Reichard
5,441,102	A	8/1995	Burward-Hoy
5,566,745	A	10/1996	Hill et al.
5,708,564	A	1/1998	Lin
5,731,954	A	3/1998	Cheon
5,763,951	A	6/1998	Hamilton et al.
5,784,257	A	7/1998	Tata
5,825,622	A	10/1998	Rife et al.
5,890,880	A	4/1999	Lustwerk
5,901,037	A	5/1999	Hamilton et al.
6,019,165	A	2/2000	Batchelder
6,021,844	A	2/2000	Batchelder
6,114,827	A	9/2000	Alvaro
6,141,217	A	10/2000	Nakahama et al.
6,166,907	A	12/2000	Chien
6,170,563	B1	1/2001	Hsieh
6,263,957	B1	7/2001	Chen et al.
6,305,463	B1	10/2001	Salmonson
6,343,478	B1	2/2002	Chang
6,408,937	B1	6/2002	Roy
6,415,860	B1	7/2002	Kelly et al.
6,447,270	B1	9/2002	Schmidt et al.
6,470,289	B1	10/2002	Peters
6,529,376	B2	3/2003	Hamman
6,551,734	B1	4/2003	Simpkins et al.
6,580,610	B2	6/2003	Morris et al.
6,668,911	B2	12/2003	Bingler
6,702,002	B2	3/2004	Wang
6,725,682	B2	4/2004	Scott
6,728,107	B2	4/2004	Tseng et al.
6,749,012	B2	6/2004	Gwin et al.
6,796,370	B1	9/2004	Doll
6,892,802	B2	5/2005	Kelly et al.
6,894,899	B2	5/2005	Wu et al.
6,915,653	B2	7/2005	Nakano et al.
6,945,315	B1	9/2005	Gektin et al.
6,952,345	B2	10/2005	Weber et al.
6,967,841	B1	11/2005	Chu et al.
6,972,954	B2	12/2005	Minamitani et al.

7,057,894	B2	6/2006	Chang
7,100,389	B1	9/2006	Wayburn
7,156,160	B2	1/2007	Lee et al.
7,215,546	B2	5/2007	Hata et al.
7,298,617	B2	11/2007	Campbell et al.
7,325,588	B2	2/2008	Malone et al.
7,325,591	B2	2/2008	Duan et al.
7,359,197	B2	4/2008	Stefanoski et al.
7,455,103	B2	11/2008	Sato et al.
7,544,049	B2	6/2009	Koga
7,591,302	B1	9/2009	Lenehan et al.
7,971,632	B2	7/2011	Eriksen
8,240,362	B2	8/2012	Eriksen
9,715,260	B2*	7/2017	Eriksen ..... G06F 1/20
2002/0117291	A1	8/2002	Cheon
2002/0171388	A1	11/2002	Seki
2003/0010050	A1	1/2003	Scott
2003/0039097	A1	2/2003	Igarashi
2003/0056939	A1	3/2003	Chu et al.
2003/0151895	A1	8/2003	Zuo
2004/0042176	A1	3/2004	Niwatsukino et al.
2004/0052048	A1	3/2004	Wu et al.
2004/0052049	A1	3/2004	Wu et al.
2004/0052663	A1	3/2004	Laing et al.
2004/0105232	A1	6/2004	Ito et al.
2004/0141275	A1	7/2004	Athari
2004/0190254	A1	9/2004	Hu et al.
2004/0233632	A1	11/2004	Chang
2005/0052847	A1	3/2005	Hamman
2005/0061482	A1	3/2005	Lee et al.
2005/0069432	A1	3/2005	Tomioka
2005/0083656	A1	4/2005	Hamman
2005/0098305	A1	5/2005	Lee et al.
2005/0126750	A1	6/2005	Yokozawa et al.
2005/0128705	A1	6/2005	Chu et al.
2005/0183848	A1	8/2005	Cheng et al.
2005/0243518	A1	11/2005	Hata et al.
2006/0113066	A1	6/2006	Mongia et al.
2006/0157230	A1	7/2006	Kawahara et al.
2006/0161311	A1	7/2006	Vinson et al.
2006/0169440	A1	8/2006	Chou et al.
2007/0000268	A1	1/2007	Crocker et al.

FOREIGN PATENT DOCUMENTS

CN	1510310	A	7/2004
CN	M24451		9/2004
CN	2658823	Y	11/2004
DE	195 34 423	A1	3/1997
EP	0105687	A1	4/1984
EP	0400455	A1	5/1990
EP	0574823	A2	12/1993
EP	0610826	A2	8/1994
JP	2002-151638	A	5/2002
JP	3452059		9/2003
KR	10-2003-0031027		4/2003
TW	159299		1/1995
TW	577588		2/2004
TW	I220468		8/2004
TW	M251442	U	11/2004
TW	M256682	U	2/2005
WO	WO 01/25881	A	4/2001
WO	WO 2005/017468	A2	2/2005
WO	WO 2005/045654	A2	5/2005
WO	PCT/DK2005/000310		11/2006
WO	WO 2006/119761		11/2006

OTHER PUBLICATIONS

Office Action dated Aug. 10, 2016 in U.S. Appl. No. 13/942,922 (18 pages).  
 Office Action dated Feb. 24, 2017 in U.S. Appl. No. 15/347,938 (11 pages).  
 Notice of Allowance dated May 15, 2017 in U.S. Appl. No. 15/347,938 (18 pages).

(56)

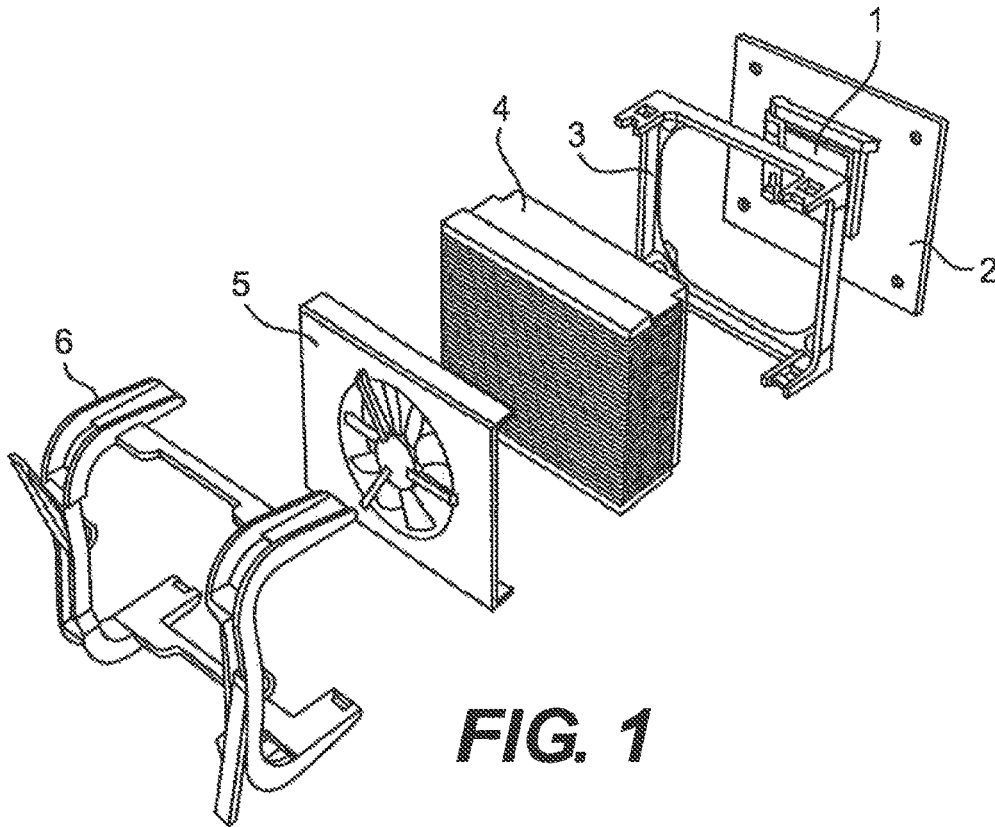
**References Cited**

OTHER PUBLICATIONS

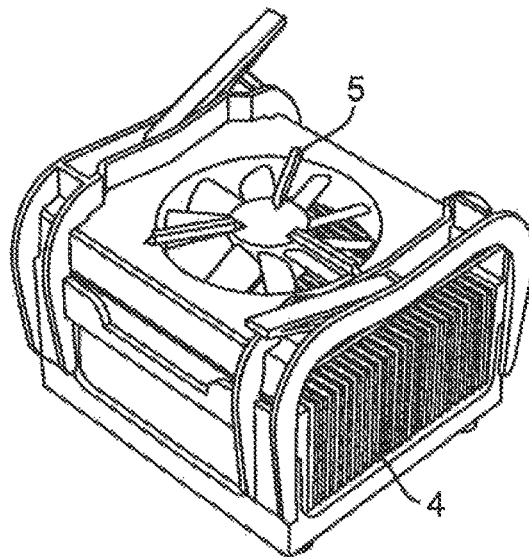
Office Action dated Oct. 6, 2016 in U.S. Appl. No. 13/861,593 (8 pages).  
Office Action dated Feb. 3, 2017 in U.S. Appl. No. 13/861,593 (18 pages).  
Notice of Allowance dated Jun. 7, 2017 in U.S. Appl. No. 13/861,593 (16 pages).  
Notice of Allowability with Examiner's Reason for Allowance dated May 17, 2012 in U.S. Appl. No. 12/826,768 (4 pages).  
Notice of Allowability with Examiner's Reason for Allowance dated May 23, 2012 in U.S. Appl. No. 13/269,234 (4 pages).  
Notice of Allowability with Examiner's Reason for Allowance dated Apr. 8, 2011 in U.S. Appl. No. 10/578,578 (9 pages).  
Order re: Claim Construction for U.S. Pat. Nos. 8,240,362 and 8,245,764 in U.S. District Court, Northern District of California, Case Nos. C-12-4498 EMC and C-13-0457 JST, filed Dec. 3, 2013 (18 pages).  
Third Party Observation for European Application No. EP20080100686 submitted on Aug. 15, 2014 (8 pages).  
Third Party Observation for European Application No. EP20080100686 submitted on Aug. 18, 2014 (7 pages).  
Office Action dated Aug. 22, 2007 in U.S. Appl. No. 10/578,578 (7 pages).  
Office Action dated Apr. 25, 2008 in U.S. Appl. No. 10/578,578 (10 pages).

Office Action dated Aug. 18, 2008 in U.S. Appl. No. 10/578,578 (9 pages).  
Office Action dated Mar. 20, 2009 in U.S. Appl. No. 10/578,578 (12 pages).  
Office Action dated Jul. 15, 2009 in U.S. Appl. No. 10/578,578 (13 pages).  
Office Action dated Apr. 13, 2010 in U.S. Appl. No. 10/578,578 (14 pages).  
Office Action dated Nov. 24, 2010 in U.S. Appl. No. 10/578,578 (10 pages).  
Office Action dated Nov. 23, 2011 in U.S. Appl. No. 12/826,802 (11 pages).  
Office Action dated Dec. 5, 2011 in U.S. Appl. No. 12/826,768 (14 pages).  
Office Action dated Dec. 20, 2011 in U.S. Appl. No. 13/269,234 (13 pages).  
Office Action dated Mar. 13, 2012 in U.S. Appl. No. 13/269,234 (12 pages).  
Office Action dated Mar. 27, 2012 in U.S. Appl. No. 11/919,974 (21 pages).  
Office Action dated Sep. 12, 2012 in U.S. Appl. No. 13/547,240 (11 pages).  
Office Action dated Jan. 16, 2013 in U.S. Appl. No. 13/547,240 (9 pages).

\* cited by examiner



**FIG. 1**



**FIG. 2**

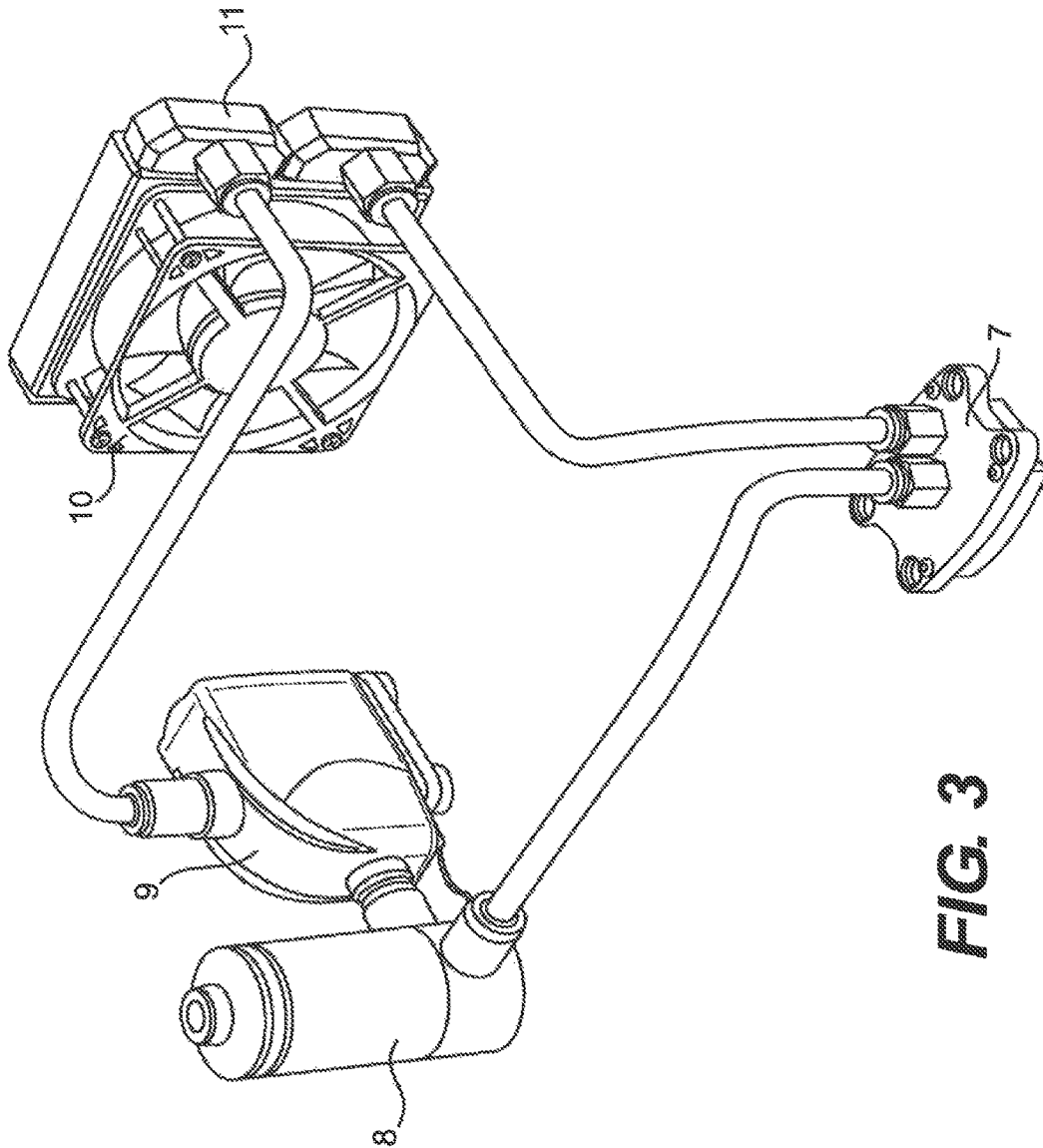


FIG. 3

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