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Application Number: **12460139** Issue Date: **11/06/2012**

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- Patent Grant with Color/Grayscale Drawings

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Form Revision Date: December 9, 2011

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/460,139	11/06/2012	8305840	038495/369324	9769

826 7590 10/17/2012

ALSTON & BIRD LLP
BANK OF AMERICA PLAZA
101 SOUTH TRYON STREET, SUITE 4000
CHARLOTTE, NC 28280-4000

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 284 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Brian T. Maguire, Broken Arrow, OK;

Change(s) applied to document, /D.S./ 5/16/2012

Amendments to the Specification

At page 11, please amend paragraph 0056 as follows:

[0055] ~~[0056]~~ The sonar signal processor 32 may be any means such as a device or circuitry operating in accordance with software or otherwise embodied in hardware or a combination of hardware and software (e.g., a processor operating under software control or the processor embodied as an application specific integrated circuit (ASIC) or field programmable gate array (FPGA) specifically configured to perform the operations described herein, or a combination thereof) thereby configuring the device or circuitry to perform the corresponding functions of the sonar signal processor 32 as described herein. In this regard, the sonar signal processor 32 may be configured to analyze electrical signals communicated thereto by the transceiver 34 to provide sonar data indicative of the size, location, shape, etc. of objects detected by the sonar system 30. In some cases, the sonar signal processor 32 may include a processor, a processing element, a coprocessor, a controller or various other processing means or devices including integrated circuits such as, for example, an ASIC, FPGA or hardware accelerator, that is configured to execute various programmed operations or instructions stored in a memory device. The sonar signal processor may further or alternatively embody multiple compatible additional hardware or hardware and software items to implement signal processing or enhancement features to improve the display characteristics or data or images, collect or process additional data, such as time, temperature, GPS information, waypoint designations, or others, or may filter extraneous data to better analyze the collected data. It may further implement notices and alarms, such as those determined or adjusted by a user, to reflect depth, presence of fish, proximity of other watercraft, etc. Still further, the processor, in combination with suitable memory, may store incoming transducer data or screen images for future playback or transfer, or alter images with additional processing to implement zoom or lateral movement, or to correlate data, such as fish or bottom features to a GPS position or temperature. In an exemplary embodiment, the sonar signal processor 32 may execute commercially available software for controlling the transceiver 34 and/or transducer array 36 and for processing data received therefrom. Further capabilities of the sonar signal processor 32 and other aspects related to the sonar module are described in U.S.

Substitute for form 1449/PTO (Revised 07/2007) **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** *(Use as many sheets as necessary)*	**Complete if Known**
Application Number	12/460,139
Filing Date	July 14, 2009
First Named Inventor	Brian T. Maguire
Art Unit	3662
Examiner Name	Not Yet Assigned /James Hulka/
Sheet 1 of 1	Attorney Docket Number 038495/369324

Change(s) applied to document, /A.E.M./ 5/30/2012

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.	Document Number Number - Kind Code (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages of Relevant Figures Appear
	1	US-3,618,006	11-02-1971	~~The Boeing Company~~ Wright	
	2	US-4,879,697	11-07-1989	Lowrance, et al.	
	3	US-5,184,330	02-02-1993	Adams, et al.	
	4	US-5,694,372	12-02-1997	Perennes	
		US-			
		US-			
		US-			
		US-			

FOREIGN PATENT DOCUMENTS

Examiner Initials	Cite No.	Foreign Patent Document Country Code - Number Kind Code (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	English Language Translation Attached
	5	WO 98/15846	04-16-1998	Rowe-Deines Instruments, Incorporated		

OTHER 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, page(s) , volume-issue number(s), publisher, city and/or country where published.	English Language Translation Attached
	6	International Search Report and Written Opinion mailed October 6, 2010, for International Application No. PCT/US2010/039443	

Examiner Signature	/James Hulka/	Date Considered	07/26/2011

*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.

Submitted: October 28, 2010 RAY-1002

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

PART B - FEE(S) TRANSMITTAL

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826 7590 07/23/2012

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I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/460,139	07/14/2009	Brian T. Maguire	038495/369324	9769

TITLE OF INVENTION: DOWNSCAN IMAGING SONAR

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1740	$300	$0	$2040	10/23/2012

EXAMINER	ART UNIT	CLASS-SUBCLASS
HULKA, JAMES R	3645	367-088000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
   - ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
   - ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

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   (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
   (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

   1 Alston & Bird LLP
   2
   3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: NAVICO, INC.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): TULSA, OKLAHOMA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
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- ☒ Publication Fee (No small entity discount permitted)
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- ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

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Authorized Signature ____________ Date September 26, 2012

Typed or printed name Patrick L. Kartes Registration No. 64,678

Electronic Patent Application Fee Transmittal

Application Number:	12460139
Filing Date:	14-Jul-2009
Title of Invention:	DOWNSCAN IMAGING SONAR
First Named Inventor/Applicant Name:	Brian T. Maguire
Filer:	Patrick L. Kartes
Attorney Docket Number:	038495/369324

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl issue fee	1501	1	1740	1740
Publ. Fee- early, voluntary, or normal	1504	1	300	300

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**2040**

Electronic Acknowledgement Receipt

EFS ID:	13847166
Application Number:	12460139
International Application Number:	
Confirmation Number:	9769
Title of Invention:	DOWNSCAN IMAGING SONAR
First Named Inventor/Applicant Name:	Brian T. Maguire
Customer Number:	826
Filer:	Patrick L. Kartes
Filer Authorized By:	
Attorney Docket Number:	038495/369324
Receipt Date:	26-SEP-2012
Filing Date:	14-JUL-2009
Time Stamp:	18:14:00
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$2040
RAM confirmation Number	7546
Deposit Account	160605
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1	Issue Fee Payment (PTO-85B)	369324_Issue_Fee_Transmittal.pdf	113870 1572359011ca376dac0bcca720e647d586d8ca43	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	32172 ec20140e7cbaecaba878de80f6404e0c9d2f3a8e	no	2
Warnings:					
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			Total Files Size (in bytes):	146042	

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New International Application Filed with the USPTO as a Receiving Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/460,139	07/14/2009	Brian T. Maguire	038495/369324	9769

826 7590 08/14/2012

ALSTON & BIRD LLP
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EXAMINER	
HULKA, JAMES R	

ART UNIT	PAPER NUMBER
3645	

NOTIFICATION DATE	DELIVERY MODE
08/14/2012	ELECTRONIC

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APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR / PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
12/460,139	14 July, 2009	MAGUIRE, BRIAN T.	038495/369324

	EXAMINER	
ALSTON & BIRD LLP BANK OF AMERICA PLAZA 101 SOUTH TRYON STREET, SUITE 4000 CHARLOTTE, NC 28280-4000	JAMES HULKA	
	ART UNIT	PAPER
	3645	20120803

DATE MAILED:

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Commissioner for Patents

IDS dated 31 July 2012 has been considered, and is attached to this office action.

/ISAM ALSOMIRI/ Supervisory Patent Examiner, Art Unit 3645	/J. H./ Examiner, Art Unit 3645

PTO-90C (Rev.04-03)

Substitute for form 1449/PTO (Revised 07/2007)				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/460,139
(Use as many sheets as necessary)				Filing Date	July 14, 2009
				First Named Inventor	Maguire
				Art Unit	3645
				Examiner Name	J. R. Hulka
Sheet	1	of	4	Attorney Docket Number	038495/369324

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.	Document Number Number - Kind Code (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages of Relevant Figures Appear
	1	US-3,975,704	08-17-1976	Klein	
	2	US-5,675,552	10-07-1997	Hicks et al.	
	3	US-6,445,646	09-03-2002	Handa et al.	

FOREIGN PATENT DOCUMENTS

Examiner Initials	Cite No.	Foreign Patent Document Country Code – Number Kind Code (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	English Language Translation Attached
	4	JP 4-357487 A	12-10-1992	Furuno Electric Co.		*
	5	WO 84/01833 A1	05-10-1984	Levy		
	6	WO 03/009276 A2	01-30-2003	Tera Tech Corp		
		*Abstract only				

OTHER 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, page(s) , volume-issue number(s), publisher, city and/or country where published.	English Language Translation Attached
	7	International Search Report for Application No. PCT/US05/27436 dated November 20, 2007; 1 page	
	8	International Preliminary Report on Patentability for Application No. PCT/US05/27436 dated December 6, 2007; 5 pages	
	9	Translation of Notice of Reason(s) for Rejection for Japanese Application No. 2007-524919 dated August 16, 2011; 4 pages	
	10	Communication [extended European Search Report] for European Application No. 05782717.2-2220 dated August 31, 2011; 12 pages	

Examiner Signature	/James Hulka/	Date Considered	08/03/2012

*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. LEGAL02/33545027v1

Submitted July 31, 2012

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Substitute for form 1449/PTO (Revised 07/2007)				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(Use as many sheets as necessary)*				Application Number	12/460,139
				Filing Date	July 14, 2009
				First Named Inventor	Maguire
				Art Unit	3645
				Examiner Name	J. R. Hulka
Sheet	2	of	4	Attorney Docket Number	038495/369324

OTHER 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, page(s), volume-issue number(s), publisher, city and/or country where published.	English Language Translation Attached
	11	Communication for European Patent Application No. 05782717.2-2220 dated May 11, 2012; 9 pages	
	12	AUSTRALIAN GOVERNMENT, DEPARTMENT OF SUSTAINABILITY, ENVIRONMENT, WATER, POPULATION AND COMMUNITIES; Fact Sheet – The RV Tangaroa; date unknown; 3 pages	
	13	BLONDEL, PHILIPPE; The Handbook of Sidescan Sonar; © 2009; 316 pages	
	14	CALCUTT, RON; Lowrance Book of Sonar & GPS; © 1986; and Lowrance Book of Sonar & GPS Update; 1997; collectively 122 pages	
	15	DERROW, II, ROBERT W. ET AL., A Narrow-Beam, Side-Looking Sonar for Observing and Counting Fish in Shallow Aquaculture Ponds; 1996; 34 pages	
	16	DSME E&R LTD.; Remotely Operated Sonar Boat System (SB-100S); http://dsmeu.en.ec21.com/Remotely_Operated_Sonar_Boat_System-618904_2479905.html; printed on February 12, 2010; 3 pages	
	17	EAGLE ELECTRONICS; Ultra 3D Installation and Operation Manual; © 2002; 24 pages	
	18	FURUNO ELECTRIC CO., LTD.; Side Looking Sonar, Model SL-16, 1983; 4 pages	
	19	GEOACOUSTICS; GeoPulse, Profiler System; February 2006, 2 pages	
	20	HUMMINBIRD 1198C Review for Catfishing, Catfishing "How To" Catfishing Techniques, October 31, 2011, 9 pages	
	21	IMAGENEX TECHNOLOGY CORP., Model 881 SportScan, Single or Dual Frequency Digital Sidescan Sonar, Software User's Manual; May 9, 2003; 16 pages	
	22	KLEIN ASSOCIATES, INC.; Modular Side Scan Sonar and Sub-Bottom Profiler System Components for Customized Configurations; date unknown; 10 pages	
	23	KLEIN, MARTIN; Side Scan Sonar; UnderSea Technology; April 1967; 4 pages	
	24	KLEIN, M. ET AL., Sonar—a modern technique for ocean exploitation; IEEE Spectrum; June 1968; pp. 40-46 and Authors page	
	25	KLEIN, MARTIN; New Developments in Side Scan Sonar for Hydrography; date unknown; 14 pages	

Examiner Signature	/James Hulka/	Date Considered	08/03/2012

*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. LEGAL02/33545027v1

Submitted July 31, 2012

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

Substitute for form 1449/PTO (Revised 07/2007) **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** *(Use as many sheets as necessary)*	Complete if Known	
	Application Number	12/460,139
	Filing Date	July 14, 2009
	First Named Inventor	Maguire
	Art Unit	3645
	Examiner Name	J. R. Hulka
Sheet 3 of 4	Attorney Docket Number	038495/369324

OTHER 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, page(s) , volume-issue number(s), publisher, city and/or country where published.	English Language Translation Attached
	26	KLEIN, MARTIN; Side Scan Sonar; Offshore Services; April 1977, pp. 67, 68, 71, 72, 75	
	27	KLEIN, MARTIN; New Capabilities of Side Scan Sonar Systems; date unknown; pp. 142-147	
	28	KLEIN, MARTIN; Sea Floor Investigations Using Hybrid Analog/Digital Side Scan Sonar; date unknown; 18 pages	
	29	KONGSBERG MARITIME AS; Side Looking Transducer, 200 kHz – 0.5x49, 200 kHz side looking transducer for shallow water and surveying and high resolution; date unknown; 2 pages	
	30	KONGSBERG SIMRAD AS; ConCat Containerised Catamaran, Inshore hydrographic survey vessel that fits in a container, Rev. B, April 2004; 4 pages	
	31	KVITEK, RIKK ET AL.; Final Report, Early Implementation of Nearshore Ecosystem Database Project Tasks 2 and 3; http://seafloor.csumb.edu/taskforce/html%202%20web/finalreport.htm; July 29, 1999; 92 pages	
	32	LAW, G., Sideways Glance, Side- and down-scan Imaging Open New Windows in Fishing Finding, Electronics, November 2011, pp. 28-29	
	33	LEONARD, JOHN L.; Cooperative Autonomous Mobile Robots; date unknown; 11 pages	
	34	Maritime surveys takes delivery of SeaBat 8160; Sea Technology, Jul 2001; http://findarticles.com/p/articles/mi_qa5367/is_200107/ai_n21475675/; webside printed June 30, 2010	
	35	MARINE SONIC TECHNOLOGY, LTD.; Sea Scan® PC Side Scan Sonar System Information/Specifications Sheet; September 9, 2002; 10 pages	
	36	MESOTECH; Mesotech Model 971 Sonar System Summary; March 26, 1985, 2 pages	
	37	OUGHTERSON, B., Sophisticated Sonar Reveals Detailed Images Recently Unimaginable. Is It Too Much too Soon?, Basic Instincts, pp. 75-78	
	38	RAYMARINE, L750 Fishfinder, Operation Handbook; date unknown; 93 pages	
	39	RAYTHEON MARINE COMPANY; Installation Instructions; October 1998; 2 pages	

Examiner Signature	/James Hulka/	Date Considered	08/03/2012

*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. LEGAL02/33545027v1

Submitted July 31, 2012

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

Substitute for form 1449/PTO (Revised 07/2007)				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(Use as many sheets as necessary)*				Application Number	12/460,139
				Filing Date	July 14, 2009
				First Named Inventor	Maguire
				Art Unit	3645
				Examiner Name	J. R. Hulka
Sheet	4	of	4	Attorney Docket Number	038495/369324

OTHER 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, page(s) , volume-issue number(s), publisher, city and/or country where published.	English Language Translation Attached
	40	REMTECHSROY GROUP; Side Scan Sonar-Remotely Operated Vehicle Surface; http://remtechnology.en.ec21.com/Side_Scan_Sonar_Remotely_Operated-2902034_2902230.html; printed on February 12, 2010; 4 pages	
	41	RESON INC.; SeaBat 8101 Product Specification, 240kHz Multibeam Echo Sounder; © 1999; 2 pages	
	42	RESON; SeaBat 8101; Multibeam acoustic echosounder; date unknown; 1 page	
	43	RESON; SeaBat 8160 Product Specification, Multibeam Echosounder System; date unknown; 2 pages	
	44	RUSSELL-CARGILL, W.G.A. ed.; Recent Developments in Side Scan Sonar Techniques; © 1982; 141 pages	
	45	SIMRAD; Product Specifications, Simrad EA 500 Side-looking Option; February 1992, 1 page	
	46	TECHSONIC INDUSTRIES, INC., Humminbird Wide fish wide open!; brochure, 1997; 4 pages	
	47	TECHSONIC INDUSTRIES, INC.; Humminbird GPS brochure; © 1992; 10 pages	
	48	TELEFLEX ELECTRONIC SYSTEMS; Humminbird 1997; © 1996; 24 pages	
	49	The Norwegian and Finnish navies performing operations with the Kongsberg Hugin AUV and minesniper mine disposal vehicle in Finnish waters; FFU nytt; No. 3, November 2003; p. 12	
	50	TRABANT, PETER K.; Applied High-Resolution Geophysical Methods, Offshore Geoengineering Hazards; © 1984; 265 pages	
	51	TRITECH INTERNATIONAL LIMITED; StarFish; 450H Hull-Mounted Sidescan System; date unknown; 2 pages	
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Examiner Signature	/James Hulka/	Date Considered	08/03/2012

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Submitted July 31, 2012

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

Substitute for form 1449/PTO (Revised 07/2007)	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(Use as many sheets as necessary)*	Application Number	12/460,139
	Filing Date	July 14, 2009
	First Named Inventor	Maguire
	Art Unit	3645
	Examiner Name	J. R. Hulka
Sheet *1* of 4	Attorney Docket Number	038495/369324

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Sheet 2 of 4	Attorney Docket Number	038495/369324

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Sheet 3 of 4	Attorney Docket Number	038495/369324

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Espacenet

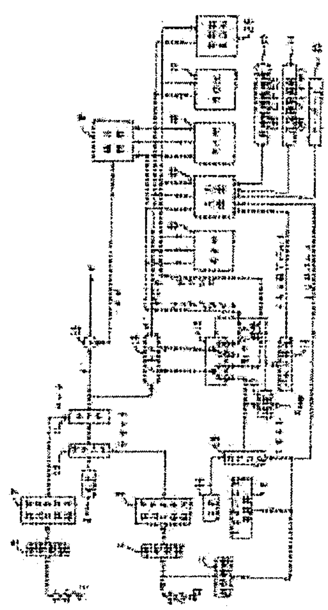
Bibliographic data: JP4357487 (A) — 1992-12-10

SIDE LOOKING SONAR

Inventor(s):	MORIMATSU HIDEJI; SHIBUYA SHOZO +
Applicant(s):	FURUNO ELECTRIC CO +
Classification:	**- international:** ***G01S15/89;*** (IPC1-7): G01S15/89 **- European:**
Application number:	JP19910172240 19910712
Priority number(s):	JP19910172240 19910712; JP19900212189 19900810

Abstract of JP4357487 (A)

PURPOSE:To measure the position of an object under water accurately by a method wherein a phase difference is determined at input points of two receivers with respect to a measuring point by calculation and a phase difference is measured with two receivers for the same measuring point to obtain a deviation of phase so that the phase difference measured is corrected by the deviation of phase.
CONSTITUTION:When a trigger pulse from a trigger pulse generator 3 is inputted into a CPU21 through an input device 22, a measuring position of own ship and the bearing of navigation are read in form a highly accurate position measuring device 23 and a bearing measuring device 24 to determine an intersection with a contour line based on the value and a probing range inputted from a keyboard 25 beforehand. Distances are determined from the centers of receivers R1 and R2 to the sea surface below the intersection to obtain a phase difference phi'' corresponding thereto. A phase difference phi' is measured between two receivers for the same measuring point to obtain phi'-phi''=dphi as deviation of phase between the two receivers. The phase difference measured actually thereafter is corrected by the deviation dphi of phase to remove the deviation of phase difference generated between two receiving systems thereby measuring the position of an object under water accurately.



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20 of 737

Last updated: 14.03.2012 Worldwide Database 5.7.38; 92p

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(43)公開日　平成４年(1992)12月10日

(51)Int.Cl.⁵	識別記号	庁内整理番号	F I	技術表示箇所
G01S 15/89	A	8113－5J		

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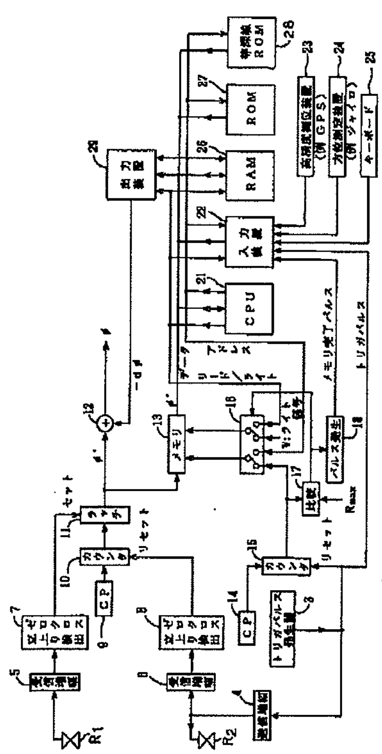
(54)【発明の名称】　サイドルツキングソナー

(57)【要約】

【目的】　２つの受信系間で生じ位相のずれをなくして正確な水中探知を可能にする。

【構成】　予め正確に測定されたある測定点に対し、計算により、２つの受波器の入力点での位相差φ”を求めておき、そして同じ測定点に対して２つの受波器により位相差φ'を測定し、φ'－φ”＝ｄφを２つの受信系間での位相のずれとして、これ以降に実際に測定した位相差をこの位相のずれｄφで補正することにより、２組の受信系間で生じる位相差のずれを除去して水中物体の位置を正確に測定する。



1

【特許請求の範囲】

【請求項1】　鉛直線に対し所定角を形成する直線上の所定距離離れた位置に設けられた一対の第1および第2の受波器を備え、いずれか一方の受波器より、垂直方向に広くて水平方向に狭い送波ビームを形成し、前記ビームのエコーを第1及び第2の受波器で捕捉し、これら第1および第2の受波器にそれぞれ接続される第1および第2の受信回路より得られる両受信号間の位相差を位相差検出手段で検出し、該位相差とエコーの帰来に要した時間とに基づき被探知物体の深度および自船からの被探知物体までの水平距離を算出表示するサイドルッキングソナーにおいて、予め計測した海底の深度情報を記憶する深度情報記憶手段と；海底のある測定点よりのエコーに対して上記位相差検出手段で検出された位相差φ'と、前記と同じ測定点に対して前記深度情報記憶手段より読み出した深度及び、測位装置で得られる前記測定点に対する自船位置の水平距離により求められる、第1および第2の受波器の入力点での位相差φ"とから、第1の受波器および受信回路と、第2の受波器および受信回路との位相特性の差異により、両受信系を通過する信号間に生じる位相のずれとしてφ'－φ"＝dφを演算する位相ずれ演算手段と；測定時に前記位相差検出手段で検出される位相差を、前記位相ずれ演算手段で演算された位相のずれdφで補正する補正手段と；を備えたことを特徴とするサイドルッキングソナー。

【請求項2】　鉛直線に対し所定角を形成する直線上の所定距離離れた位置に設けられた一対の第1および第2の受波器を備え、いずれか一方の受波器より、垂直方向に広くて水平方向に狭い送波ビームを形成し、前記ビームのエコーを第1及び第2の受波器で捕捉し、これら第1および第2の受波器にそれぞれ接続される第1および第2の受信回路より得られる両受信号間の位相差を位相差検出手段で検出し、該位相差とエコーの帰来に要した時間とに基づき被探知物体の深度および自船からの被探知物体までの水平距離を算出表示するサイドルッキングソナーにおいて、当該サイドルッキングソナーの送受波ビームと一部重なる多数のペンシル形送受波ビームを自船の下方および側方に形成し、エコーの帰来するまでに要する時間と、各ペンシルビームの方向から被探知物体の深度および自船からの被探知物体までの水平距離を算出するスキャニングソナーで計測した前記深度および水平距離を受ける深度情報入力部と；水中のある測定対象よりのエコーに対して上記位相差検出手段で検出された位相差φ'と、前記深度情報入力部に入力された、前記同じ測定対象に対する深度および水平距離により求められる、第1および第2の受波器の入力点での位相差φ"とから、第1の受波器および受信回路と、第2の受波器および受信回路との位相特性の差異により、両受信系を通過する信号間に生じる位相のずれとしてφ'－φ"＝dφを演算する位相ずれ演算手段と；測定時に前記位相差検出手段で検出される位相差を、前記位相ずれ演算手段で演算された位相のずれdφで補正する補正手段と；を備えたことを特徴とするサイドルッキングソナー。

2

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、自船の側方に対し広範囲に水中を探知するサイドルッキングソナーに関する。

【0002】

【従来の技術】サイドルッキングソナーは、図1に示すように、自船の両舷に装備した送受波器から左右に拡がる扇状の超音波ビーム(例えば扇形角60°、航行方向の拡がり角1.6°)を送波し、そのエコーを同送受波器にて検出することにより、海底の起伏、底質変化、魚群等を検出レベルに応じて濃淡あるいは色別表示するものである。

【0003】図2は送受波器の取り付け例を示しており、両舷にそれぞれ二つの受波器R_1, R_2を備え、一方の受波器R_2は送波兼用としている。以下に、これらの送受波器を用いた水中物体の深度および水平距離の測定法を図3を用いて説明する。

【0004】R_1およびR_2は右舷側の受波器であり、Sを水中物体とする。両受波器R_1, R_2間の距離をD、鉛直方向に対して両受波器R_1, R_2を結ぶラインのなす角度をα、両受波器R_1, R_2の中点Oと水中物体Sとを結ぶ線分OSの長さをr、中点Oに対する水中物体Sの水平および深度をh, d、両受波器R_1, R_2を結ぶラインに垂直な方向と線分OSのなす角度をθとする。

【0005】線分R_1－Sと線分R_2－Sとの長さの差をΔYとすると、

$$\Delta Y = 2\cdot(D/2)\cdot\sin\theta \quad (1)$$

とみなせ、用いた音波の波長をλとするとΔYにおける位相差φは、

$$\phi = 360^\circ\cdot\Delta Y/\lambda$$
$$= 360^\circ\cdot D\cdot\sin\theta/\lambda \quad (2)$$

となる。(2)式より、

$$\theta = \sin^{-1}\{\phi\cdot\lambda/(360^\circ\cdot D)\} \quad (3)$$

中点Oからみた水中物体Sの方向をθhとすると、

$$\theta h = \alpha + \theta \quad (4)$$

が得られる。

【0006】水中音速をc、線分OSを音波が往復する時間をtとすると直線距離rは、

$$r = t\cdot c/2 \quad (5)$$

従って、

$$d = r\cdot\sin\theta h \quad (6)$$
$$h = r\cdot\cos\theta h \quad (7)$$

が得られる。尚、tは、O－Sを往復する時間であるが、R_2－S≒O－Sとみなせるので線分R_2－Sを往復する時間とした。

【0007】このように、受波器R_2で送波したビームに伴う同一水中物体よりのエコーを二つの受波器R_1, R

$_2$にて受波し、このときの受波信号の位相差、つまり距離差を測定することにより、二つの受波器に対する水中物体の方向が求まる。一方、水中物体Ｓまでの直線距離ｒは、音波の要した往復時間より求まるので(6)および(7)式から水中物体の深度ｄおよび自船直下からの水平距離ｈが決定される。

【０００８】

【発明が解決しようとする課題】上記の従来の測定装置では、各舷毎に受波器およびこれらに接続される受信回路の２組の受信系が設けられているため、上記位相差を正確に求めるためには、２組の受信系の間で位相特性が同じになるように、つまり両受信系で生じる位相遅れが等しくなるように調整する必要があるが、経年変化や温度変化等により、受波器および受信回路で位相特性に差が生じ、測定した前記位相差にこのような位相特性の差異による位相のずれが含まれると、水中物体の正確な位置を測定できなくなるといった課題があった。本発明は、上述した課題を解決するためになされたものであり、２組の受信系間で生じる位相のずれを補正することにより、水中物体の位置を正確に測定できるサイドルッキングソナーを提供することを目的とする。

【０００９】

【課題を解決するための手段】第１発明のサイドルッキングソナーは、鉛直線に対し所定角を形成する直線上の所定距離離れた位置に設けられた一対の第１および第２の受波器を備え、いずれか一方の受波器より、垂直方向に広くて水平方向に狭い送波ビームを形成し、前記ビームのエコーを第１及び第２の受波器で捕捉し、これら第１および第２の受波器にそれぞれ接続される第１および第２の受信回路より得られる両受信号間の位相差を位相差検出手段で検出し、該位相差とエコーの帰来に要した時間とに基づき被探知物体の深度および自船からの被探知物体までの水平距離を算出表示するサイドルッキングソナーにおいて、予め計測した海底の深度情報を記憶する深度情報記憶手段と；海底のある測定点よりのエコーに対して上記位相差検出手段で検出された位相差ϕ'と、前記と同じ測定点に対して前記深度情報記憶手段より読み出した深度及び、測位装置で得られる前記測定点に対する自船位置の水平距離により求められる、第１および第２の受波器の入力点での位相差ϕ''とから、第１の受波器および受信回路と、第２の受波器および受信回路との位相特性の差異により、両受信系を通過する信号間に生じる位相のずれとして$\phi'-\phi''=d\phi$を演算する位相ずれ演算手段と；測定時に前記位相差検出手段で検出される位相差を、前記位相ずれ演算手段で演算された位相のずれ$d\phi$で補正する補正手段と；を備えたことを特徴とする。

【００１０】第２発明のサイドルッキングソナーは、鉛直線に対し所定角を形成する直線上の所定距離離れた位置に設けられた一対の第１および第２の受波器を備え、いずれか一方の受波器より、垂直方向に広くて水平方向に狭い送波ビームを形成し、前記ビームのエコーを第１及び第２の受波器で捕捉し、これら第１および第２の受波器にそれぞれ接続される第１および第２の受信回路より得られる両受信号間の位相差を位相差検出手段で検出し、該位相差とエコーの帰来に要した時間とに基づき被探知物体の深度および自船からの被探知物体までの水平距離を算出表示するサイドルッキングソナーにおいて、当該サイドルッキングソナーの送受波ビームと一部重なる多数のペンシル形送受波ビームを自船の下方および側方に形成し、エコーの帰来するまでに要する時間と、各ペンシルビームの方向から被探知物体の深度および自船からの被探知物体までの水平距離を算出するスキャニングソナーで計測した前記深度および水平距離を受ける深度情報入力部と；水中のある測定対象よりのエコーに対して上記位相差検出手段で検出された位相差ϕ'と、前記深度情報入力部に入力された、前記同じ測定対象に対する深度および水平距離により求められる、第１および第２の受波器の入力点での位相差ϕ''とから、第１の受波器および受信回路と、第２の受波器および受信回路との位相特性の差異により、両受信系を通過する信号間に生じる位相のずれとして$\phi'-\phi''=d\phi$を演算する位相ずれ演算手段と；測定時に前記位相差検出手段で検出される位相差を、前記位相ずれ演算手段で演算された位相のずれ$d\phi$で補正する補正手段と；を備えたことを特徴とする。

【００１１】

【作用】図４において、ある海底点からのエコーが受波器R_1およびR_2に入射するときの位相差がϕであっても、受波器R_1および受信回路S_1で生じる位相遅れを$d\phi_1$、受波器R_2および受信回路S_2で生じる位相遅れを$d\phi_2$とすると、位相差検出回路Ｔより出力される位相差ϕ'は、

$$\phi'=\phi+(d\phi_1-d\phi_2) \quad (8)$$

となる。$d\phi_1-d\phi_2=d\phi$が二つの受信系間で生じる位相のずれである。

【００１２】一方、等深線図などから各海底点に対する深度を記憶させた深度情報記憶手段から読み出し、この深度と、前記測定点に対して測位装置の出力する自船位置を用いて演算した自船からの水平距離とに基づき、第１および第２の受波器の入力点での位相差ϕ''が演算により求められる。深度情報記憶手段から読み出した深度が正確でかつ、二つの受信系統間で位相のずれがなければ、$\phi''=\phi'$となるが実際には二つの受信系統間に位相のずれ$d\phi$があり、この位相のずれ$d\phi$は、次式で求まる。

$$\phi'-\phi''=d\phi \quad (9)$$

【００１３】このようにして位相差のずれ$d\phi$がわかれば、測定時に位相差検出手段で検出された位相差ϕ'に対して、補正手段により位相差のずれ$d\phi$で補正すれ

ば、前記位相差φ'に含まれていた位相差のずれdφが除去される。

【0014】第2発明は、上記の予め計測した海底の深度情報に代えて、スキャニングソナーによる正確な深度情報を用いるものであり、ここでサイドルッキングソナーとスキャニングソナーとの相異点について説明する。サイドルッキングソナーは図5に示すように、船底から船首方向には狭い角度(φL)で左舷および右舷方向にはそれぞれ広い角度(θL)の送受波ビーム100を形成することにより、X、Yで示す領域が探査される。このソナーは、航行方向の分解能が優れており、これにより海底を探査すれば水中俯瞰図ともいうべきものが得られ、例えば朝日に照らされた山々を飛行機から眺めているかのごとく、遠方まで海底の起伏が陰影でもって細かに表示されるので海底質を的確に知ることができる。しかし、このソナーでは、上述した両受波系統における位相差が原因で探知物体に対する深度および水平距離が不正確であるという欠点がある。

【0015】一方、スキャニグソナーでは図6に示すように、船底より、船首方向に狭く(例えば1.6°)、両舷側方向に扇状に広い(90°)送波ビーム101を形成し、一方、この送波ビーム101と直交するように、船首方向に広く(20°)、側方向に狭い(2°)受波ビーム102を形成し、かつこの受波ビーム102を側方向に走査することにより、送波ビーム101による領域Zが順に探査される。船の真下付近での探知物体の深度および水平距離を正確に検出できるという利点があるが、俯角が小さくなる側方遠方で分解能が悪くなり、そのため海底の細かな起伏がわからず、深度および水平距離も不正確になるという欠点がある。

【0016】このようにスキャニングソナーにおいては船の直下方向で高い分解能が得られるので、この直下方向の正確な探査結果でもってサイドルッキングソナーにおける両送受波系統の位相差を補正しようとしたものであり、その具体的な構成については実施例にて説明することとする。

【0017】

【実施例】図7は、本発明のサイドルッキングソナーの一実施例を示す制御ブロック図であり、この図7では、右舷側の2つの受波器R_1、R_2の受信系における位相差を検出する部分のみを示しており、左舷側も同じ構成となる。R_1およびR_2は既述の受波器であり、いずれもI個の超音波振動子で構成され、一方の受波器R_2は送波兼用としている。3は、トリガパルスを発生するトリガパルス発生器であり、4は、トリガパルス発生器3よりのトリガパルスにより受波器R_2に送信電力を供給する送信増幅器である。5および6は、受波器R_1およびR_2で検出されたそれぞれI個の受波信号を増幅する受信増幅器である。7及び8は受信増幅器5および6よりの出力信号が零点を負から正に横切る時点を検出してパルスを出力するゼロクロス立上り検出器である。9は、クロックパルスを発生するクロックパルス回路であり、10は、カウンタであり、ゼロクロス立上り検出器8よりのパルスがリセット信号として入力されると、クロックパルス回路9よりのクロックパルスを0からカウントする。11は、ラッチ回路であり、ゼロクロス立上り検出器7よりのパルスがセット信号として入力されたとき、カウンタ10におけるカウント値をラッチし、その値は、加算器12とメモリ13とに送出される。

【0018】14は、クロックパルス回路であり、15は、カウンタであり、前記トリガパルス発生器3より出力されるトリガがリセット信号として入力されたときにクロックパルス14よりのクロックパルスを0からカウントする。そのカウント値は、切替器16に供給されると共に、R_{max}値と比較する比較器17に入力され、この比較器17の出力信号は、切替器16の切替信号として送出されるとともにパルス発生器18に入力される。

【0019】21は、CPUであり、ROM27に格納された制御プログラムに従って後で述べるような演算を行う。22は入力装置であり、自船の位置を検出する高精度測位装置23、方位を検出する方位測定装置24およびキーボード25よりの信号が入力されるとともに、前記トリガパルス発生器3よりのトリガパルスおよびパルス発生器18より出力されるメモリ完了パルスが入力される。26は、CPU21での演算に必要となる各種データを随時記憶するRAMである。28は、深度情報記憶手段である等深線ROMであり、各等深線毎の位置を緯度経度で表したものをROM化したものであり、位置をアクセスすることによりその地点の海底深度が得られる。29は出力装置であり、CPU21で求められた－dφの値を前記加算器12に送出する。

【0020】上記構成の制御回路の動作を説明する。図8に示す時点T_0、T_2、T_4は受波器R_2の送信タイミングを示しており、時点T_0にて送信のためにトリガパルス発生器3よりトリガパルスが出力されると、カウンタ15は“0”にリセットされクロックパルス回路14よりのクロックパルスがカウントされると共に、送信増幅器4より送信信号が出力され、受波器R_2より図1に示したような右舷側に扇状に拡がる超音波のビームが送波される。この超音波ビームの送波により、最初に自船直下の海底面よりのエコーが受波器R_2で検出され、次にわずかな時間差をおいて受波器R_1で検出され、受信増幅器6,5より図9に示すような信号が出力される。受信増幅器6の出力信号に対して、ゼロクロス立上り検出器8により零レベルを負から正に横切ったときの時点t_1が検出されてパルスが出力される。このパルスがリセット信号としてカウンタ10に供給されることにより、カウンタ10はクリアされクロックパルス回路9より出力されるクロックパルスがカウントされ、そのカウント値が逐次にラッチ回路11に入力される。

【0021】一方、受信増幅器5の出力信号に対しては、ゼロクロス立上り検出器7により零レベルを負から正に横切ったときの時点t_2が検出されてパルスが出力され、このパルスがセット信号としてラッチ回路11に供給されると、このラッチ回路11は、入力されていたカウント値をラッチする。従ってラッチ回路11は、時点t_1から時点t_2までの間のクロックパルスの数をラッチすることになる。このパルス数は、二つの受波器R_1，R_2の取り付け位置と水平物体の方向に起因する時間差であり、クロックパルス回路9のパルスの周期を、用いた音波の周期の1／360にすれば、この時間差は上記の位相差φ’で表され、この値φ’は加算器12およびメモリ13に入力される。続く時点t_3からt_4間においても同様にして位相差φ’が求められ、このようにして時間が経過するにつれて自船直下より右方に次第に遠ざかる海底面よりのエコーが次々に検出されてそれらの位相差φ’がメモリ13に送出される。

【0022】一方、カウンタ15のカウント値が切替器16を介してメモリ13にアドレスとして送出されており、かつ、この切替器16を介してライト信号が印加されているので、メモリ13に入力される位相差φ’は所定のアドレスに次々に格納される。又、時点T_0以降においてはCPU21にて図10のフローチャートに示した動作が並行して行われる。

【0023】即ち、トリガパルス発生器3よりのトリガパルスが入力装置22を介してCPU21に入力されると、ステップS1からステップS2へと進み、高精度測位装置23および方位測定装置24よりの自船の測位置および航行の方位を読み込み、この値と予めキーボード25により入力されている探査範囲（本実施例では両舷側方向に1000m）をもとにして、図11に示す等深線図において右舷側の探査範囲での等深線との交点A，B，C，D，Eを求める。次のステップS3で前記の各交点までの水平距離hを求め、このhと、このときの深度d（等深線の値）とを（6）式及び（7）式に入力することにより、受波器R_1とR_2の中心から各交点下の海面までの距離rを求め、又、そのときの位相差φ”を（2）式から求める。ステップS4では、カウンタ15のカウント値がR_{max}となり、パルス発生回路18からメモリ完了パルスが出力される時点T_1になるのを待つ。尚、ステップS2およびステップS3の処理時間は短く、メモリ完了パルスが出力される時点T_1で既に終了している。

【0024】さて、時点T_1になり、比較器17から切替器16に対して切替信号が送出され、切替器16の接点が右方に切り替わることにより、CPU21は、ステップS5において、この切替器16を介してメモリ13に、リード信号を送出し、更に距離rにおける測定位相差φ’を読み出すべく、所定のアドレス信号Rをメモリ13に送出することにより、メモリ13に記憶されていた交点AないしEに対する位相差φ’を順次読み出す。ここでr＝R×Δrである。Δrはカウンタ15の入力クロックパルス周期tpとすると、Δr＝c・tp／2となる。以上の説明でわかるように、時点T_0ないしT_1の間がエコー取り込み期間であり、従って、この期間で所望の範囲よりのエコーが検出されるよう、比較器17に対するR_{max}の設定値が決められる。なお、比較器17はカウンタ15のカウント値が0になった時、切替器16を左方へ切り替える。

【0025】図12は、各交点AないしEに対する、実測の位相差φ’（●記号で示す）と等深線図より求めた位相差φ”（記号で示す）とを示したものであり、ステップS6では、これらの各交点で対応する両位相差の引き算、φ’－φ”を行い、それらの平均値を上記の位相差のずれdφとする。このステップS5およびステップS6の処理時間は短く、次にトリガパルスが出力される時点T_2には終了している。

【0026】この位相差のずれ－dφが出力装置29を介して加算器12に送出されることにより、この加算器12において、φ’－dφの演算が行われ、両受波器R_1、R_2の入射時の位相差φが出力される。尚、ここで補正される位相差φ’は前回の送信で得た－dφで補正されることになるが、送信間隔程度の短い時間ではdφの値は変化しないので差し支えない。もし、今回の送信に基づくdφで今回の位相差φ’を補正するには、メモリ13を2個使用して、次回の送信時に片方のメモリに次回の位相差φ’を記憶させると共に今回の位相差φ’をカウンタ15の値に従って読み出し、dφで補正すればよい。

【0027】第2発明になるサイドルッキングソナーの一実施例を図13および図14に示している。図13においては図7と異なる箇所について述べる。31は、後で述べるスキャニングソナーにおける受波ビーム数Mと同値としたM進のHカウンタであり、トリガパルス発生器3より出力されるトリガがリセット信号として入力されたときクロックパルス14よりのクロックパルスを0からカウントする。そのカウント値は、図14の切替器46に供給され、又、図14の切換器43の切換信号として送出され、更にそのカウント値が（M－1）から0になる時の桁上げパルスがRカウンタ15に送出される。Rカウンタ15はN進カウンタであり、トリガパルス発生器3より出力されるトリガがリセット信号として入力されたとき、Hカウンタ31よりの桁上げパルスを0からカウントする。そのカウント値は、切換器16および図14の切換器46に供給されると共に、R_{max}（R_{max}＜N）値と比較する比較器17に入力される。この比較器17の出力は、パルス発生器18と、切換器16および図14の切換器46の各々の切換信号として送出される。入力装置22にはパルス発生器18より出力されるメモリ完了パルスが入力される。

【0028】図14は、図13のサイドルッキングソナ

ーに付加されるスキャニングソナー部の一実施例を示している。R_3およびＴＸは、受波器および送波器であり、図１５の展開図に示されるように、受波器R_3は、航行方向と直角の方向にｊ個の超音波振動子が配列されており、送波器ＴＸは、航行方向にｋ個の超音波振動子が配列されている。右側にあるR_1、R_2は、図１３における受波器であり、左側のR_1'、R_2'は左舷側の受波器である。

【００２９】４０は、送信増幅器であり、４１は、受波器R_3のｊ個の超音波振動子よりの受波信号をそれぞれ増幅する受信増幅器である。４２は、位相合成回路であり、ｊ系統の各受波信号を公知の技法で位相合成することにより、図６で示されるように、側方向に順に走査されるＭ個の受波ビームを形成する。切換器４３は、位相合成回路４２により形成されたＭ個の受波ビームを順に取り出し、Ａ／Ｄ変換器４４にてデジタル化した後にメモリ４５に供給する。

【００３０】上記構成の制御回路の動作を再び図８および図９を用いて説明する。図８に示す時点T_0、T_2、T_4は受波器R_2および送波器ＴＸの送信タイミングを示しており、時点T_0にて送信のためにトリガパルス発生器３よりトリガパルスが出力されると、Ｒカウンタ１５およびＨカウンタ３１は“0”にリセットされると共に、送信増幅器４、４０より予め定められたパワー、パルス幅および周波数の送信信号が出力され、受波器R_2により図５に示したように右舷側に扇状に拡がる送波ビーム１００が形成され、又、送波器ＴＸにより、図６に示したように両舷方向に拡がる送波ビーム１０１が形成される。そして、海底から反射された探知信号は受波器R_1、R_2、R_3で受波され、受信増幅器５、６、４１にて増幅される。

【００３１】図１３のサイドルッキングソナーにおいては、超音波ビームの送波により、最初に自船直下の海底面よりのエコーが受波器R_2で検出され、次にわずかな時間差をおいて受波器R_1で検出され、受信増幅器６，５より図９に示すような信号が出力される。受信増幅器６の出力信号に対して、ゼロクロス立上り検出器８により零レベルを負から正に横切ったときの時点t_1が検出されてパルスが出力される。このパルスがリセット信号としてカウンタ１０に供給されることにより、カウンタ１０はクリアされクロックパルス回路９より出力されるクロックパルスがカウントされ、そのカウント値が逐次にラッチ回路１１に入力される。

【００３２】受信増幅器５の出力信号に対しては、ゼロクロス立上り検出器７により零レベルを負から正に横切ったときの時点t_2が検出されてパルスが出力され、このパルスがセット信号としてラッチ回路１１に供給されると、このラッチ回路１１は、入力されていたカウント値をラッチする。従ってラッチ回路１１は、時点t_1から時点t_2までの間のクロックパルスの数をラッチすることになる。このパルス数は、二つの受波器R_1，R_2の取り付け位置と水平物体の方向に起因する時間差であり、クロックパルス回路９のパルスの周期を、用いた音波の周期の１／３６０にすれば、この時間差は上記の位相差ϕ'で表され、この値ϕ'は加算器１２およびメモリ１３に入力される。続く時点t_3からt_4間においても同様にして位相差ϕ'が求められ、このようにして時間が経過するにつれて自船直下より右方に次第に遠ざかる海底面よりのエコーが次々に検出されてそれらの位相差ϕ'がメモリ１３に送出される。

【００３３】一方、図１４のスキャニングソナー部においては、送波器ＴＸによる送波により、海底面よりのエコーが受波器R_3で受波される。このＪ個の受波信号は、位相合成回路４２により位相合成され、走査角の異なるＭ個の受波ビームが形成される。Ｈカウンタ３１よりの切換信号により切換器４３が制御されることにより、Ｍ個の受波ビームの中からＨカウンタ３１のカウント値が示す方向の受波ビームが選択され、Ａ／Ｄ変換器４４を介してメモリ４５に格納される。

【００３４】ここでスキャニングソナーにおける動作を図１７を用いて更に詳しく述べる。θ_{sm}は、ｍ番目のビームの直下方向ｄよりの角度(右舷側を＋)を示し、$\theta_{sm}=\Delta\theta_s\{(M-1)/2-m\}$、ここでＭは奇数であり、(Ｍ－１)／２番目のビームは直下方向である。R_mは、ｍ番目のビーム内に存在していた海底のメモリ４５におけるＲ方向の位置を示す。r_mは、ｍ番目のビーム内に存在していた海底の自船からの直線距離(単位m)を示し、$r_m=\Delta r\times R_m$である。h_m、d_mは、ｍ番目のビーム内に存在していた海底の自船からの水平距離と進度である。h_mは右舷側を＋、d_mは下方を＋としており、いずれも単位はメートルである。

$h_m=r_m\times\sin\theta_{sm}$、$d_m=r_m\times\cos\theta_{sm}$

の関係がある。又、Δrはメモリ１３およびメモリ４５にデータを取り込むｒ方向(距離方向)の間隔でＨカウンタ３１の出力する桁上げパルスの周期をt_pとすると、$\Delta r=c\cdot t_p/2$となる。

【００３５】図１３、図１４に戻り、メモリ１３およびメモリ４５には、それぞれサイドルッキングソナーの位相差とスキャニングソナーの探知信号がΔr(m)ごとにr_{max}まで１送信分記憶される。r_{max}は、本発明装置が使用される海域において図５におけるビーム端でも海底に到達するのに十分な船からの直線距離である。ここで$r_{max}=R_{max}\times\Delta r$である。ラッチ回路１１およびＡ／Ｄ変換器４４の出力ビット数をβ_1、β_2とすると、メモリ１３、４５の記憶容量は、それぞれ$\beta_1\times R_{max}$、$\beta_2\times R_{max}\times M$となる。

【００３６】Ｒカウンタ１５のカウント値がR_{max}になるまでのT_0ないしT_1間は切換器１６、４６は図示したように左方に切り替わっており、従って、Ｒカウンタ１５のカウント値は切換器１６を介してメモリ１３にアド

レスとして送出され、かつ、この切換器１６を介してライト信号が印加されているので、メモリ１３に入力される位相差φ’は所定のＲアドレスに次々に格納される。

【００３７】一方、Ｈカウンタ３１およびＲカウンタ１５のカウント値が切換器４６を介してメモリ３８に送出されており、かつ、この切換器４６を介してライト信号が印加されているので、メモリ４５に入力される探知信号は所定のＲとＨで決まるアドレスに次々に格納される。

【００３８】さて、時点T_1になり、メモリ１３、４５への信号の書込みが終了すると、比較器１７から切替器１６、４６に対して切替信号が送出され、切替器１６、３４の接点が右方に切り替わると同時に、パルス発生器１８よりのメモリ完了パルスが入力装置２２を介してＣＰＵ２１に入力されると、ＣＰＵ２１は、図１６のステップＳ１１からステップＳ１２へと進み、切換器４６を介してメモリ４５にリード信号を送出し、スキャニングソナーのｍ番目のビームで受信した$r=0$ないしr_{max}までの探知信号を読み出すべく、所定のアドレス信号をメモリ４５に送出する。つまりＨアドレスはｍとし、Ｒアドレスを０から順に$R_{max}-1$とする。

【００３９】次に読み出したR_{max}個の探知信号中、例えば最大の探知信号が存在している位置すなわちＲアドレス値R_mを海底位置とする。そしてR_m、θ_{sm}よりr_m、d_m、h_mを求め、その時の位相差φ”を(2), (4), (6), (7)式から求める。なお、図１７と図３の０点は一致しているものとみなす。

【００４０】次にＣＰＵ２１は、ステップＳ１３において、切替器１６を介してメモリ１３に、リード信号を送出し、R_mのアドレス信号をメモリ１３に送出することにより、メモリ１３に記憶されていたr_mに対する位相差φ’を読み出す。これをスキャニングソナーの右半分のビームに対して、即ち$m=0$から$(M-1)/2$まで繰り返す。

【００４１】以上の説明でわかるように、時点T_0ないしT_1の間がエコー取り込み期間であり、従って、この期間で所望の範囲よりのエコーが検出されるよう、比較器１７に対するR_{max}の設定値が決められる。

【００４２】図１８は、スキャニングソナーによる実測の位相差φ”（●記号で示す）と同じ距離上のサイドルッキングソナーにより求めた位相差φ”(記号で示す)とを示したものであり、ステップＳ４では、これらの各点で両位相差の引き算、$\phi_m' - \phi_m''$を行い、それらの平均値を上記の位相差のずれｄφとする。このステップＳ１１およびステップＳ１４の処理時間は短く、次にトリガパルスが出力される時点T_2には終了している。

【００４３】この位相差のずれ－ｄφが出力装置２９を介して加算器１２に送出されることにより、この加算器１２において、φ’－ｄφの演算が行われ、両受波器R_1、R_2の入射時の位相差φが出力される。尚、ここで補正される位相差φ’は前回の送信で得た－ｄφで補正されることになるが、送信間隔程度の短い時間ではｄφの値は変化しないので差し支えない。もし、今回の送信に基づくｄφで今回の位相差φ’を補正するには、メモリ１３を２個使用して、次回の送信時に片方のメモリに次回の位相差φ’を記憶させると共に今回の位相差φ’をＲカウンタ１５の値に従って読み出し、ｄφで補正すればよい。上記の実施例においては、送波器ＴＸと受波器R_2から送波される超音波パルスの周波数は互いに干渉しないよう異なるものでなければならないが、送波器ＴＸと受波器R_3は同じ周波数のものであり、受波器R_1とR_2とは同じものである。又、受波器R_1、R_2、R_3をすべて同じ周波数のものにして送波器ＴＸを省略することもできる。

【００４４】

【発明の効果】以上説明したように、本第１発明では、予め正確に測定されたある測定点に対し、計算により、２つの受波器の入力点での位相差φ”を求めておき、そして同じ測定点に対して２つの受波器により位相差φ’を測定し、φ’－φ”＝ｄφを２つの受信系間での位相のずれとして、これ以降に実際に測定した位相差をこの位相のずれｄφで補正するようにしたので、２組の受信系間で生じる位相差のずれを除去することができ、よって水中物体の位置を正確に測定できる。第２発明は、上記の予め計測した海底の深度情報に代えて、スキャニングソナーによる正確な深度情報を用いるものであり、この装置によればリアルタイムで正確な水中探知を行える。

【図面の簡単な説明】

【図１】 サイドルッキングソナーで形成されるビームを示す斜視図

【図２】 サイドルッキングソナーにおける送受波器の取付け例を示す図

【図３】 サイドルッキングソナーの動作原理を説明するために用いた図

【図４】 本発明の原理を説明するために用いた図

【図５】 サイドルッキングソナーにおける送受波ビームを示す図

【図６】 スキャニングソナーにおける送受波ビームを示す図

【図７】 本第１発明のサイドルッキングソナーの一実施例を示す制御ブロック図

【図８】 図７の制御ブロック図の動作を示すタイムチャート

【図９】 図７の制御ブロック図の動作を示すタイムチャート

【図１０】 図７の制御ブロック図の動作を示すフローチャート

【図１１】 右舷方向の探査範囲内における等深線図との交点を示す図

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【図１２】　実測により得た位相差と、等深線からのデータに基づき得た位相差とを示すグラフ

【図１３】　本第２発明のサイドルッキングソナーの一実施例を示す制御ブロック図

【図１４】　図１３の装置に付加されるスキャニングソナー部の一実施例を示すブロック図

【図１５】　図１３の装置における送受波器の取り付け例を示した展開図

【図１６】　図１３の装置の動作を示すフローチャート

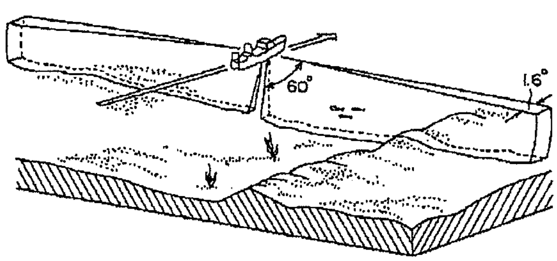
【図１７】　図１３の装置において位相差の計算を説明するために用いた図

【図１８】　スキャニングソナーにおけるビームの走査を示した図

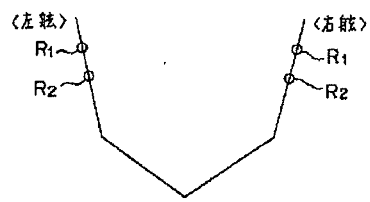
【符号の説明】

R　受波器
3　トリガパルス発生器
4　送信増幅器
5　受信増幅器
6　受信増幅器
7　ゼロクロス立上り検出器
8　ゼロクロス立上り検出器
9　クロックパルス回路
１０　カウンタ
１１　ラッチ回路
１２　加算器
１３　メモリ
１４　クロックパルス回路
１５　カウンタ
１６　切替器
１７　比較器
１８　パルス発生器
２１　ＣＰＵ
２２　入力装置
２３　高精度測位装置
２４　方位測定装置
２５　キーボード
２６　ＲＡＭ
２７　ＲＯＭ
２８　等深線ＲＯＭ
２９　出力装置
３１　カウンタ
ＴＸ　送波器
４０　送信増幅器
４１　受信増幅器
４２　位相合成回路
４３　切換器
４４　Ａ／Ｄ変換器
４５　メモリ
４６　切換器

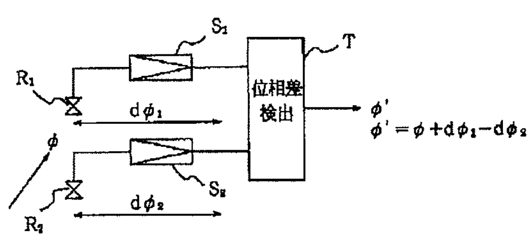
【図1】



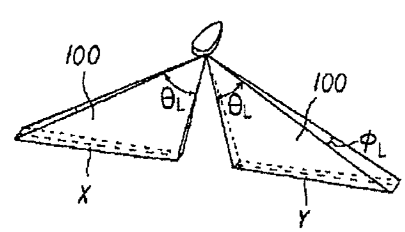
【図2】



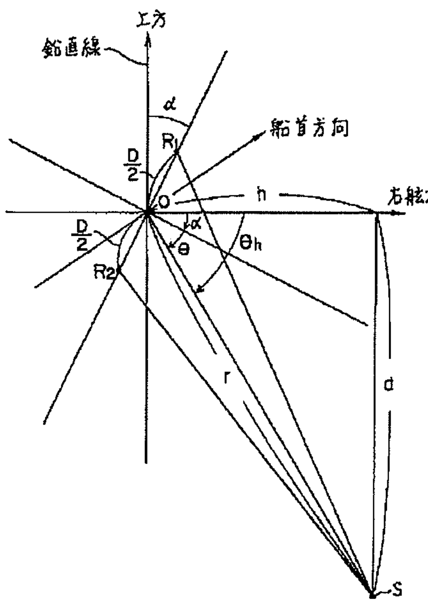
【図4】



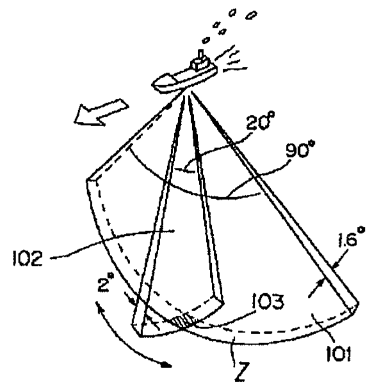
【図5】



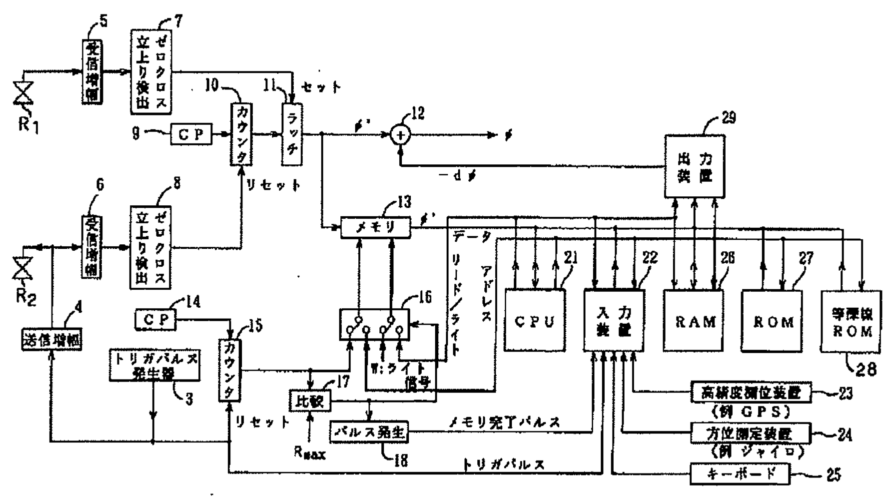
【図3】


上方
鉛直線
船首方向
右舷方向
R1
R2
D/2
O
h
d
r
S
α
θ
θh

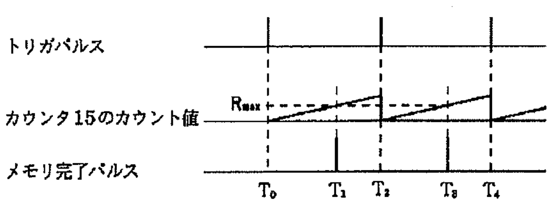
【図6】


20°
90°
1.6°
2°
102
103
101
Z

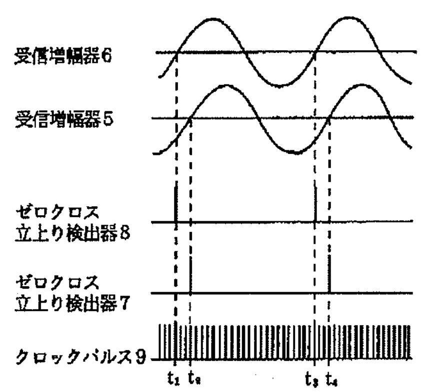
【図7】


受信増幅
ゼロクロス立上り検出
カウンタ
ラッチ
セット
リセット
CP
メモリ
出力装置
データ
リード／ライト
アドレス
CPU
入力装置
RAM
ROM
等深線ROM
送信増幅
トリガパルス発生器
比較
パルス発生
メモリ完了パルス
トリガパルス
高精度測位装置（例 GPS）
方位測定装置（例 ジャイロ）
キーボード
W:ライト信号
-dφ

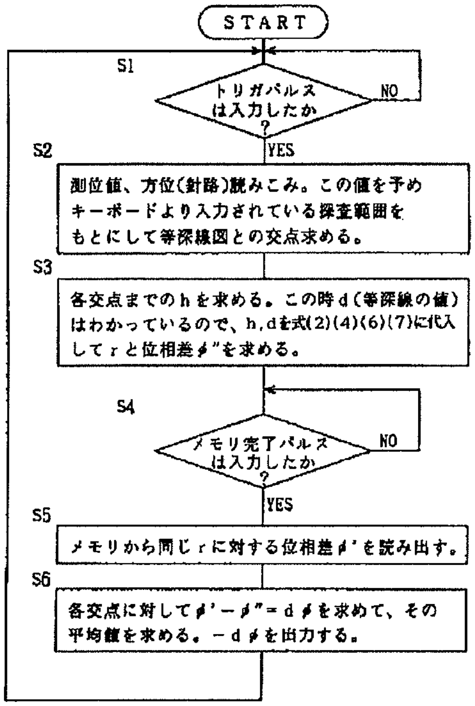
【図8】


トリガパルス
カウンタ15のカウント値
メモリ完了パルス
Rmax
T0
T1
T2
T3
T4

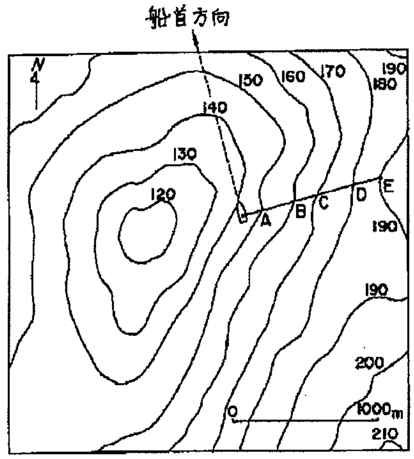
【図9】


受信増幅器6
受信増幅器5
ゼロクロス立上り検出器8
ゼロクロス立上り検出器7
クロックパルス9
t1
t2
t3
t4

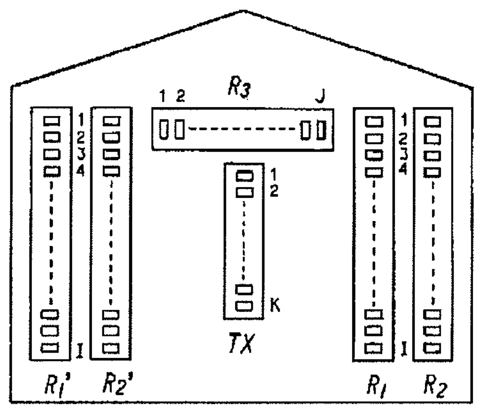
【図10】



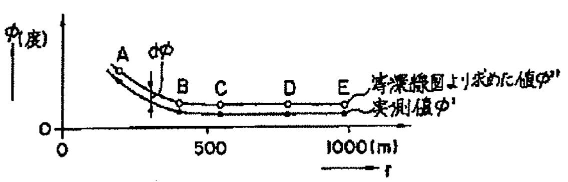
【図11】



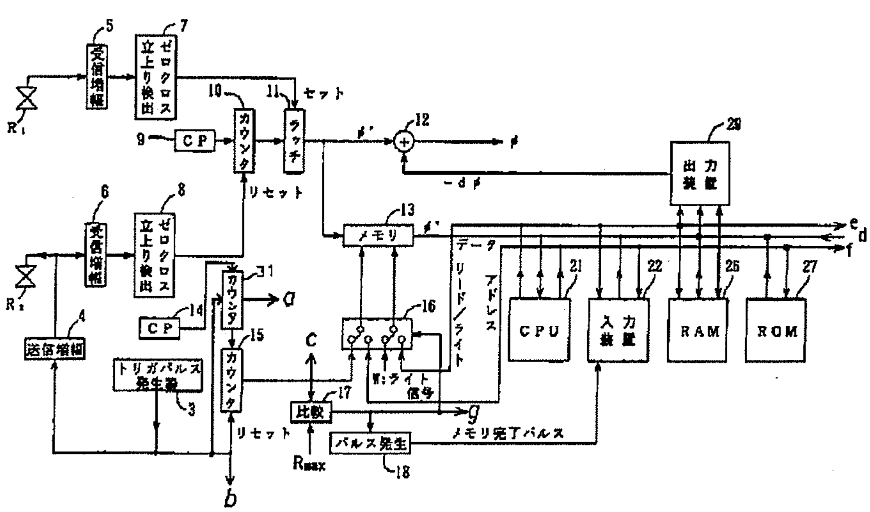
【図15】



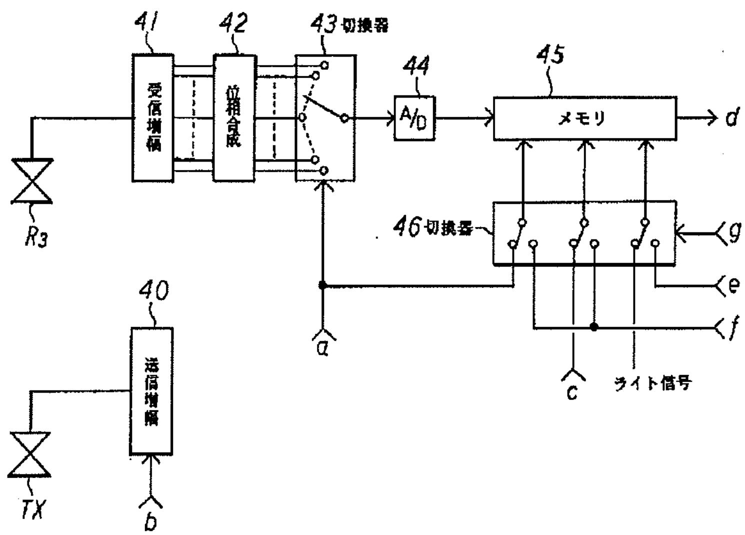
【図12】



【図13】



【図１４】



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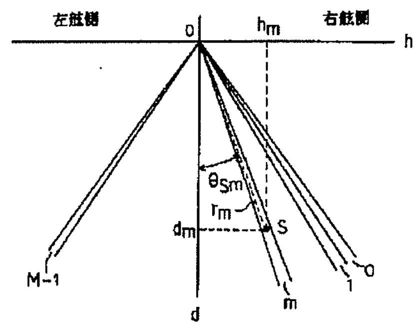

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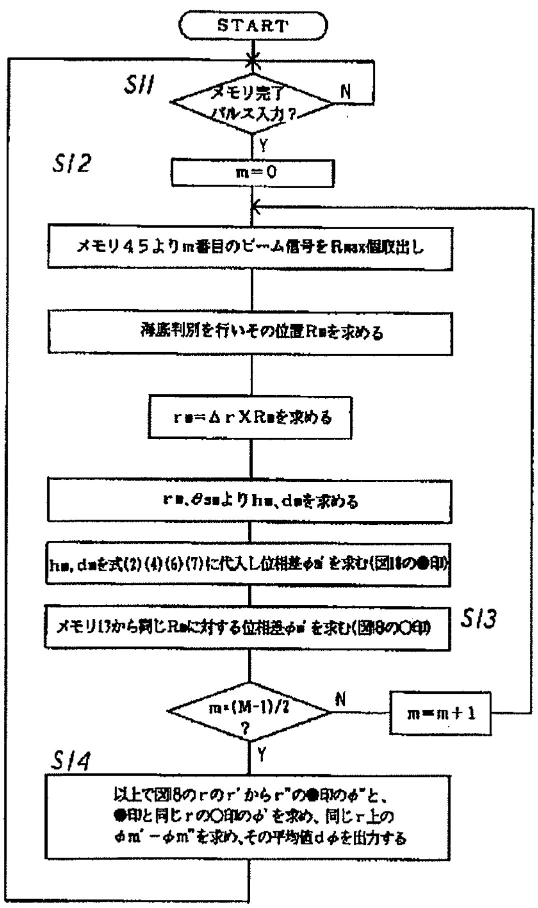

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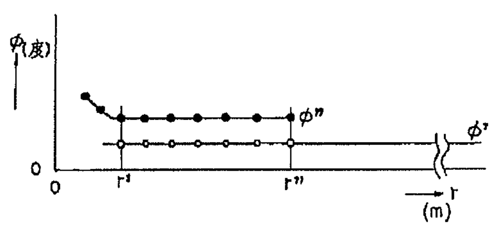

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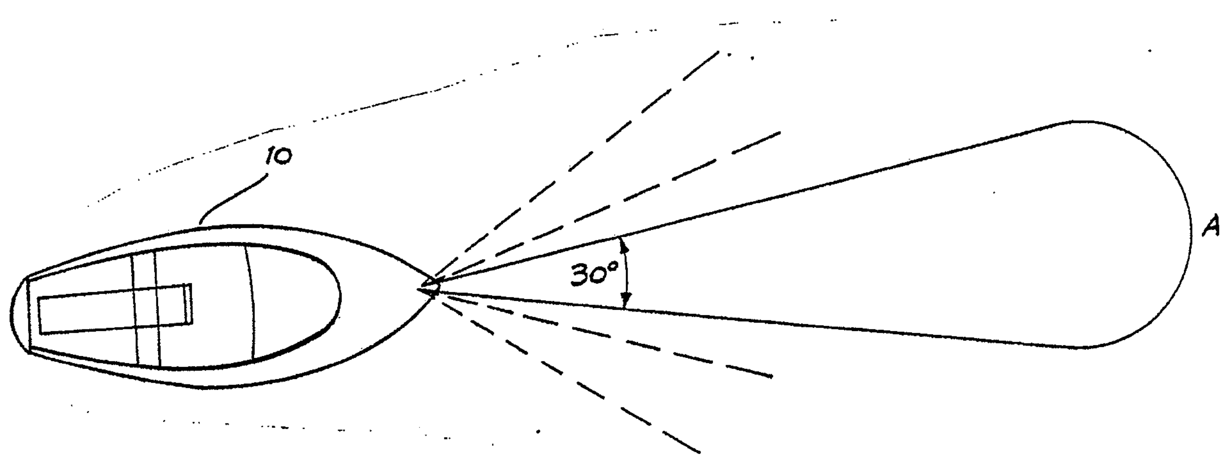

(57) Abstract

A sonar system suitable for small and medium sized boats which scans ahead, to port and to starboard, preferably at a distance related to depth below. The system includes a display (40) using series of LCD segments orientated in directions representative of the directions of scanning so that the displayed information can be instantly interpreted. Signals are displayed continuously until updated. The system also includes a transducer assembly for scanning in a plurality of discrete scanning directions.

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"SONAR SYSTEM"

The present invention relates to a sonar system which is particularly, but not solely, suited for small and medium sized vessels such as private pleasure yachts and small commercial vessels. The invention is particularly useful when cruising near coral reefs and navigating narrow channels through mud and sand banks since the invention not only measures depth, but also scans ahead and to port and starboard.

BACKGROUND ART

Although lateral scanning radar and sonar systems are known, such systems are complex and expensive, and as such, are only suitable for large scale vessels such as navy craft.

In known lateral scanning radars and sonar, rotating cathode ray tube displays are used. In such displays, the old signals fade as new signals on the rotating arm are displayed. Moreover, the cathode ray tube is difficult to read in bright sunlight as it does not provide a high contrast display.

SUMMARY OF THE INVENTION

It is an object of the present invention to overcome, or substantially ameliorate, at least one of the above described disadvantages by providing an economical sonar system suitable for small and medium sized boats which provides forward, port and starboard scanning as well as depth scanning.

According to the present invention, there is provided a sonar system for a boat for scanning ahead, to port and to starboard, said system comprising transducer means for transmitting scanning signals in a plurality of discreet scanning directions including ahead of the boat, to port and to starboard; electronic control means for activating said transducer means to transmit said scanning signals sequentially in said plurality of directions; receiving means for receiving the transmitted signal after reflection from objects; signal processing means connected to the output of said receiving means for determining distances of said objects from the received signals; and display means connected to said signal processing means for displaying the determined distances in their respective directions.

Preferably, the sonar system has a display which utilises liquid crystal display (LCD) segments which display a measured value continuously until superceded by a newly measured signal.

Preferably, the sonar system monitors depth ahead at a distance related to the depth below. The depth ahead range can be set manually, or calculated automatically from the depth below. Typically, depth ahead (as well as depth to port and depth to starboard) are measured at a distance approximately six times the depth below. If desired, the sonar system can incorporate transducer means and associated display means for measuring and displaying depth abeam, or even depth aft.

Since the measured signals representing depth to port, ahead, starboard and below, are displayed continuously until updated, a simultaneous display of all signals is obtained. Moreover, by arranging the LCD segments in a suitable pattern, a quasi-analog display can be obtained.

Preferably, the sonar system incorporates an alarm which is activated when the depth ahead varies more than a selected amount. This amount may be related to the depth below. Typically, the alarm volume increases and/or its pitch increases as the vessel approaches an obstacle such as a reef. In further preferred embodiments, different alarm tones are provided so that the operator is immediately able to distinguish audibly between obstacles to port, starboard and ahead.

Typically, the display means is capable of displaying a number of depth ranges. If the measured signal falls outside the selected range, an alarm is activated to indicate that the range selection requires changing or the gain requires adjustment.

The sonar system incorporates a transducer arrangement for transmitting and receiving signals in the required directions. In one embodiment, a transducer is provided for each scanning direction. Each transducer is connected sequentially for a period of time sufficient to transmit and receive an echo from the maximum range selected. In another embodiment, a single transducer is physically orientated to the required scanning direction. The received echo is quantised to a number of time levels, and stored and displayed until the next echo is received for that particular scanning direction. The number of time levels is related to the number of display segments selected for the display means.

The transducer arrangement is preferably mounted on a single gimballed assembly mounted inside the hull of a glass reinforced plastic vessel, or mounted externally and protected by a glass reinforced plastic or ABS plastic hydrofoil protective cover.

Notwithstanding any other forms of the present invention, preferred embodiments thereof will now be described with reference to the accompanying drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic plan view of a scanning pattern of a sonar system according to one embodiment of the present invention;

Fig. 2 is a side elevational view of the scanning pattern of Fig. 1;

Fig. 3 is a plan view of the scanning pattern of one beam of Fig. 1;

Fig. 4 illustrates one display layout for the sonar system;

Fig. 5 is a schematic block circuit diagram of the sonar system according to another embodiment of the present invention;

Fig. 6 is a schematic block circuit diagram of the signal processing circuit of Fig. 5;

Fig. 7 is a schematic block circuit diagram of part of the circuit of Fig. 6;

Fig. 8 is a schematic block circuit diagram of a clock circuit for use with the embodiment of Fig. 5;

Fig. 9 illustrates timing pulses for the circuit of

Figs. 5 to 8;

Fig. 10 is a cross-sectional plan view of a transducer arrangement of one embodiment;

Fig. 11 is a cross-sectional plan view of a transducer arrangement of another embodiment;

Fig. 12 is a side elevational view of part of the transducer arrangement of Fig. 11; and

Fig. 13 is a cross-sectional side elevational view of the transducer arrangement of Fig. 11.

DESCRIPTION OF PREFERRED EMBODIMENT

As shown in Figs. 1 to 3, the sonar system of one embodiment of the present invention is designed to scan ahead and to port and starboard, as well as measuring depth (not shown). The beams typically have a horizontal beamwidth between 15° and 30°, and a vertical beamwidth of 7 to 10°. The transducer assembly is gimballed so that the beams are tilted almost straight ahead to provide maximum range in shallow water. Although five scanning directions are shown in Fig. 1, any reasonable number of scanning directions can be obtained by suitable design of the transducer means. The design of the transducer means will be described below. For the sake of simplicity, the following description relates to a scanning pattern having three beams: port (P), ahead (A) and starboard (S) as well as depth measurement.

The circuit diagram for the sonar system is shown in Figs. 5 to 8. A first clock 50 generates a pulse train as shown in Fig. 9. The period of the first clock is greater than the maximum time required for a signal to be transmitted and received from the maximum desired range. An output of the clock 50 drives a 1 to 5 and restart decade counter 53 which provides sequential outputs MD, P, A, S and D as shown in Fig. 9. The output of the counter 53 is connected to a transducer multiplexer/driver 55 which sequentially activates the respective transducer for the port, ahead, starboard and depth beams, or orientates a single transducer in either the port, ahead, starboard or depth direction. The latter system will be described in more detail below.

Each pulse from the first clock 50 also passes to a delay circuit 51 where it is delayed, typically by 10ms. A narrow pulse (typically 2ms) is generated for every pulse from the clock pulse 50 as shown in wave form T in Fig. 9. The narrow pulses T activate a transmitter 52 having an oscillator therein, and also reset a counter 61 in a signal processing circuit 60. The 10ms delay is provided in order to allow reed switches which connect the transducers to operate before the transmitter pulse is fired. This prevents sparking across the contacts and radio frequency interference. On receipt of each narrow pulse, the transmitter 52 will transmit a signal through the transducer 54 selected by the transducer multiplexer/driver 55. The signal is of suitable frequency e.g. 160KHz. The signal is transmitted in the direction in which the transducer 54 is orientated, and received by receiver 56 after reflection from obstacles such as reefs, sandbanks, etc. The received signal is amplified in a tuned amplifier stage 57 with manual gain control and/or automatic gain compensation in which the signal level is multiplied by a ramp voltage proportional to the time delay between the transmitted and received pulse. This time varying gain (TVG) compensates for normal attenuation of the signal through the water. An additional gain control stage can be included to reduce the gain for distances between zero and five times the depth below. This gain stage would be controlled by the period of the received echo from the bottom. Such gain controllers can be provided on the front panel of the sonar display 40 (Fig. 4) to enable the operator to adjust the gain of signals close to the vessel, and those further away from the vessel which in turn, permits the operator to choose between the detection of fish nearby or the distant detection of reefs and other obstacles. The amplified received pulse is then envelope detected in detector stage 58 and thereafter passed through a filter stage 59 to remove short radio frequency interference spikes. The signal output from the filter stage 59 is then input to a signal processing stage

60 shown in more detail in Fig. 6.

As shown in Fig. 6, the signal is passed through circuit 62 if it represents a longer, higher level echo or through circuit 63 if it represents a shorter, small echo such as would be caused by fish. A discriminator circuit can be used to distinguish between the two types of echoes. A three position switch 65 allows the operator to choose whether to display long or short echoes, or both. An external control (not shown) can be provided on the front panel of the display so that it is possible to adjust the threshold level of the small echoes. An additional "white line" stage as used in chart recorders can be included to display fish close to the bottom which would not normally be displayed separately from the bottom signal.

Signals which have been recognised by circuit 62 as being long echoes are used to trigger monostable 64 which has sufficient pulse length to trip all levels of the display. If both short and long echoes are chosen by switch 65, the short echoes (e.g. fish echoes) are displayed by the illumination of extra LCD bars above the depth reading.

The signal processing circuit 60 comprises a cyclic counter 61 which provides 21 sequential pulse outputs and then resets. The counter 61 is reset by every narrow pulse derived from the clock 50 and is used to measure the time difference between the transmitted and received pulses. Connected to outputs 5 to 21 of the counter 61 are 16 sub-circuits A1, A2 .... A16. The number of sub-circuits corresponds to the number of LCD segments in each beam display (see Fig. 4); this number can be varied as desired by appropriate modification of the counter 61.

One sub-circuit is illustrated in more detail in Fig. 7. The echo signal selected by switch 65, the (reset) narrow pulses from clock 50 and an output (timing) pulse from the appropriate output of counter 61 are input to an AND gate 71, the output of which is connected to monostable 70. Hence, the monostable which is tripped corresponds to the elapsed time of the received echo. The time period of the monostables 70 is greater than the period of the first clock 50. The output of each monostable 70 is switched by switch/multiplexer 72 to one of four flip-flops (FFP, FFA, FFS, FFD) according to the signal from a corresponding output (P, A, S, D) from counter 53.

The control signals P_R, A_R, S_R, D_R which operate the flip-flops are derived from the output 21 of counter 61 via circuit 69. The outputs of the flip-flops FFP, FFA, FFS, FFD for sub-circuit A(N) are connected to the Nth segments of the port, ahead, starboard, depth displays respectively.

Changing the range of the display can be accomplished by changing the frequency of the "range clock" input of counter 61. The range clock frequency can be set manually to a predetermined fraction of the clock 50 frequency, or it may be set automatically by using an automatic range selection circuit such as that shown in Fig. 8. In the automatic range selection circuit, the full scale range of the port, ahead and starboard channels is made nominally ten times the distance of the depth below.

In the automatic range selection circuit, a second clock 80 drives a decade counter 82 via a divider (20) stage 81. The decade counter 19 is reset by each MD pulse generated by the counter 53. In addition the counter 19 is stopped by the echo signal at the output of monostable 64. The value of the counter (between 1 to 200) at the time when the "stop" signal is received is stored by the counter 82 until the next MD pulse from counter 53. This value represents the depth of water below the boat and is used to set the divider stage 83 so that the output of the divider stage 83 is the frequency of the clock 80 divided by the currently stored count in counter 82.

An additional divider (10) stage 84 is switched in on the P, A, S cycles of counter 53. The stored count of the counter 82 is displayed in a digital display 85 on the display panel 40.

Alarm circuits are provided to warn of any decrease in depth to port, ahead or starboard in advance without travelling directly over that spot. In addition, the alarm circuits perform this function without requiring constant manual adjustment of the minimum depth to be alarmed as in conventional depth founders. The use of an automatic range selection circuit, as illustrated in Fig. 8, allows the alarm circuit to be simplified. As shown in Fig. 7, the output of each flip-flop (FFP, FFA, FFS) on the port, ahead and starboard display outputs is taken to a resistor adder circuit 68 so that the more display levels illuminated, the greater the alarm volume and/or the higher the alarm pitch. In the long echo pulse threshold mode, the closer the boat gets to an obstacle such as a reef, the more flip-flops are switched on and hence, the louder the alarm and/or the higher its pitch.

An additional alarm circuit can be included to warn of minimum depth below. This can be adjustable to select a depth, typically between one and twenty metres. Furthermore, another alarm can be added to the depth below circuit to alarm if the depth exceeds a selected value, thereby acting as an anchor watch alarm.

A typical display panel 40 is illustrated in Fig. 4. Five scanning directions are illustrated on the panel: two to port, two to starboard and one ahead, as well as a digital depth measurement. Each LCD segment of the display forms an arcuate band of the displayed scanning beam. Such an arrangement of the LCD segments creates a quasi-analog display thereby allowing the operator to tell at a glance whether any obstacles lie ahead, to port, or to starboard.

The flip-flops driving the LCD segments are held on or off during each cycle, rather than flashed on and off rapidly as in multiplex display systems which appear constant due to the persistence of vision but which do not provide maximum contrast in bright sunlight. Moreover, the operator is able to tell immediately whether objects detected by the sonar are obstacles such as reefs, sandbanks or merely reflections due to fish.

Other suitable display means such as cathode ray tubes, multi-pen chart recorders or digital printers, can be fitted to the apparatus of the present invention to suit particular applications such as the charting of channels. Such display means operate on each cycle of the first clock 50.

It will be apparent to those skilled in the art that much of the hardware in the abovedescribed circuits can be replaced by a programmed microprocessor. For example, the microprocessor can be programmed to determine the interval between transmission and reception of a signal, and to display the measured interval on the appropriate beam on the display 40.

A transducer assembly is shown in Fig. 10. Separate transducers T_P, T_A, T_S and provided to scan port, ahead and starboard. The transducers are embedded in a casting 101 made from epoxy and granulated cork. A lead balance weight 100 is provided to balance the casting 101 about the shaft 102. When the shaft 102 is mounted on suitable bearings (not shown), the angle of scan of the transducers can be varied quite simply. The casting 101 can also be mounted in a special frame (described below) in order to stabilise the transducer assembly against pitch and roll. Another transducer T_D (not shown) is provided in a downward orientation for depth measurement.

The abovedescribed transducer arrangement can be replaced by a single pivotable transducer as shown in Figs. 11 to 13. In this embodiment, a single transducer T_1 is used to scan port, ahead and starboard. The transducer T_1 is set in a casting 110 made from a mix of epoxy and granulated cork in order to reduce the effect of signals from the back face of the transducer. The casting 110 also contains an iron bar or permanent magnet 118, and lead balance weights 115 which balance the casting 110 about a shaft 111. The casting 110 is pivotable about its shaft 111 on bearings 112 set in a gunmetal housing 116. Electromagnets E_P, E_A, E_S are also mounted on housing 116. Each electromagnet E_P, E_A, E_S corresponds to a respective scanning direction port, ahead, starboard. In order to scan in the different directions, the electromagnets are energised sequentially to cause the casting 110 to rotate until the iron member 118 in the casting 110 is opposite the energised electromagnet. Each electromagnet is energised for a sufficient period of time to allow a signal to be transmitted and received from the maximum range selected. Means are also provided to switch the output of the transducer T_1 to the display beam corresponding to the energised electromagnet. Although only three electromagnets are shown, it will be apparent to those skilled in the art that any suitable number of electromagnets at spaced intervals can be provided in order to scan in a plurality of directions.

The housing 116 is pivoted about spindles 117 in frame 120 so that the housing 116 remains level as the vessel pitches up and down. In addition, the frame 120 is pivoted about bearings 113 so that the frame 120 and casing 116 remain level as the vessel rolls from side to side. The bearings 113 are mounted in a gunmetal casting (not shown) fixed to the bottom of the hull of the vessel.

A second transducer T_2 is provided to measure the depth below. The transducer T_2 is pivoted about an axis 114 on frame 120 and is stabilised against pitch.

Instead of providing a separate transducer T_2 for measuring depth below, the transducer T_1 can be pivoted at point 119 so that it can be tilted to scan downwardly. An additional set of electromagnets 121 are installed along arc 122 and an additional iron bar is set above T_1 in order to implement the downward tilting of T_1. The additional electromagnets 121 become part of casting 110 and T_1 rotates within casting 110. The casting 110 would also need to be re-balanced about shaft 111.

The iron bar 118 in casting 110 can be replaced by a permanent magnet or an electromagnet energised at the same time as E_P, E_A, E_S. In addition, opposing magnetic fields can be generated by reversing the current direction through the electromagnets not being scanned, i.e. E_P and E_S would have opposing fields to the iron bar 118 while E_A and iron bar 118 are energised by attracting fields. On a cruising yacht where only limited electric power is available, the iron member 118 is preferably a permanent magnet. A reverse field applied to each electromagnet E_P, E_A E_S for a short instant when the energising electric field is turned off leaves a weak opposing field on each unenergised electromagnet due to the magnetic hysteresis of its iron core. Thus, only the energised electromagnet would be attracting the iron bar or magnet 118 while the unenergised electromagnets would be repelling the iron bar or magnet 118.

The foregoing describes only some embodiments of the present invention, and modifications which are obvious to those skilled in the art may be made thereto without departing from the scope of the invention as defined in the following claims.

CLAIMS

1. A sonar system for a boat for scanning ahead, to port and to starboard, said system comprising transducer means for transmitting scanning signals in a plurality of discreet scanning directions including ahead of the boat, to port and to starboard; electronic control means for activating said transducer means to transmit said scanning signals sequentially in said plurality of directions; receiving means for receiving the transmitted signal after reflection from objects; signal processing means connected to the output of said receiving means for determining distances of said objects from the received signals; and display means connected to said signal processing means for displaying the determined distances in their respective directions.

2. A sonar system as claimed in claim 1 wherein said display means comprises a plurality of series of liquid crystal display segments, each orientated in a direction representative of a respective one of said scanning directions, the distance of an object detected in a particular direction being indicated by the number of LCD segements illuminated in the corresponding series.

3. A sonar system as claimed in claim 1 or 2, wherein said transducer means comprises a plurality of transducer elements each orientated in a respective one of said scanning directions.

4. A sonar system as claimed in claim 1 or 2, wherein said transducer means comprises a transducer element pivotable for orientation in any one of said scanning directions.

5. A sonar system as claimed in claim 4, wherein said transducer is pivotable in a casing comprising a plurality of electromagnets orientated in directions corresponding to said scanning directions, whereby said transducer element is orientated sequentially in said scanning directions by sequential energisation of said electromagnets.

6. A sonar system as claimed in any preceding claim,

further comprising depth measurement and display means.

7. A sonar system as claimed in claim 6, wherein said transducer means scans at a distance related to depth of water below said boat.

8. A sonar system as claimed in any preceding claim, further comprising alarm means connected to the output of said signal processing means for providing an alarm upon detection of objects within a predetermined distance.

9. A sonar system as claimed in claim 8 wherein said alarm provides an audio signal whose volume is indicative of the distance of a detected object.

10. A sonar system as claimed in claim 8 wherein said alarm provides an audio signal whose tone is indicative of the distance of a detected object.

11. A sonar system as claimed in any preceding claim, wherein said signal processing means comprises a microprocessor.

AMENDED CLAIMS

(received by the International Bureau on 14 February 1984 (14.02.84))

1.(Amended) A sonar system for a boat for scanning ahead, to port and to starboard, said system comprisng transducer means for transmitting scanning signals in a plurality of discreet scanning directions including ahead of the boat, to port and to starboard; electronic control means for activating said transducer means to transmit said scanning signals sequentially in said plurality of directions; receiving means for receiving the transmitted signals after reflection from objects in said directions; signal processing means connected to the output of said receiving means for determining the distances of said objects and their respective directions from the received signals; and solid state electronic display means connected to said signal processing means [for displaying the determined distances in their respective directions], said display means having a display panel comprising a plurality of electro-optical elements arranged in arrays corresponding to the orientation of said scanning directions, both the distance and direction of objects detected by said sonar system being indicated by the operational state of said electro-optical elements.

2. (Amended) A sonar system as claimed in claim 1 wherein said electro-optical elements are [display means comprises a plurality of series of] liquid crystal display segments. [each orientated in a direction representative of a respective one of said scanning directions, the distance of an object detected in a particular direction being indicated by the number of LCD segments illuminated in the corresponding series].

3. A sonar system as claimed in claim 2, wherein the distance and direction of an object detected by said sonar system are displayed by activation of a corresponding LCD segment, and activation of the further LCD segments in that array indicates that object to be the bottom or a bank.

[3] 4. A sonar system as claimed in claim [1 or 2,] 3 wherein said transducer means comprises a plurality of transducer elements each orientated in a respective one of

said scanning directions.

[4] 5. A sonar system as claimed in claim 1 [or 2], wherein said transducer means comprises a transducer element [pivotable for orientation in any one of said scanning directions.

5. A sonar system as claimed in claim 4, wherein said transducer is] pivotable [in] within a casing [comprising] having a plurality of electromagnets orientated in directions corresponding to said scanning directions, whereby said transducer element is orientated sequentially in said scanning directions by sequential energisation of said electromagnets.

6. A sonar system as claimed in claim 4 or 5 wherein said transducer means is located in a housing on the hull of the boat, and gimballed with respect to the hull.

[6.] 7. A sonar system as claimed in [any preceding] claim 4 or 5, further comprising depth measurement and display means.

[7.] 8. A sonar system as claimed in claim [6] 7, wherein said transducer means scans at a distance related to depth of water below said boat.

[8.] 9. A sonar system as claimed in [any preceding] claim 7, further comprising alarm means connected to the output of said signal processing means for providing an alarm upon detection of objects within a predetermined distance.

[9.] 10. A sonar system as claimed in claim [8] 9 wherein said alarm provides an audio signal whose volume and/or tone is indicative of the distance of a detected object.

[10. A sonar system as claimed in claim 8 wherein said alarm provides an audio signal whose tone is indicative of the distance of a detected object.]

11. A sonar system as claimed in any preceding claim, wherein said signal processing means comprises a microprocessor.

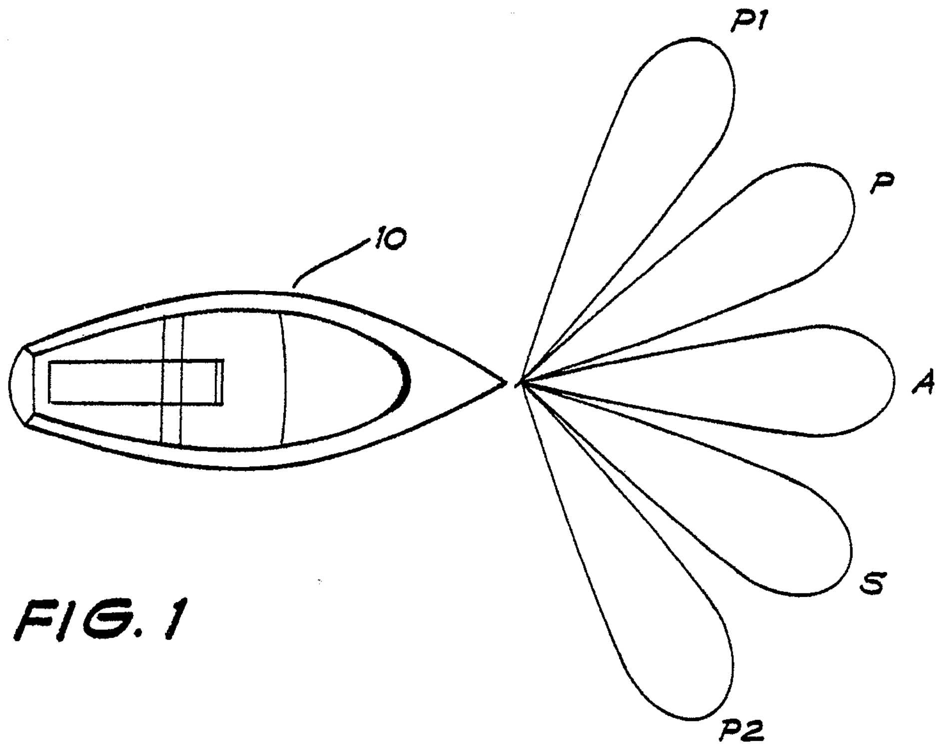
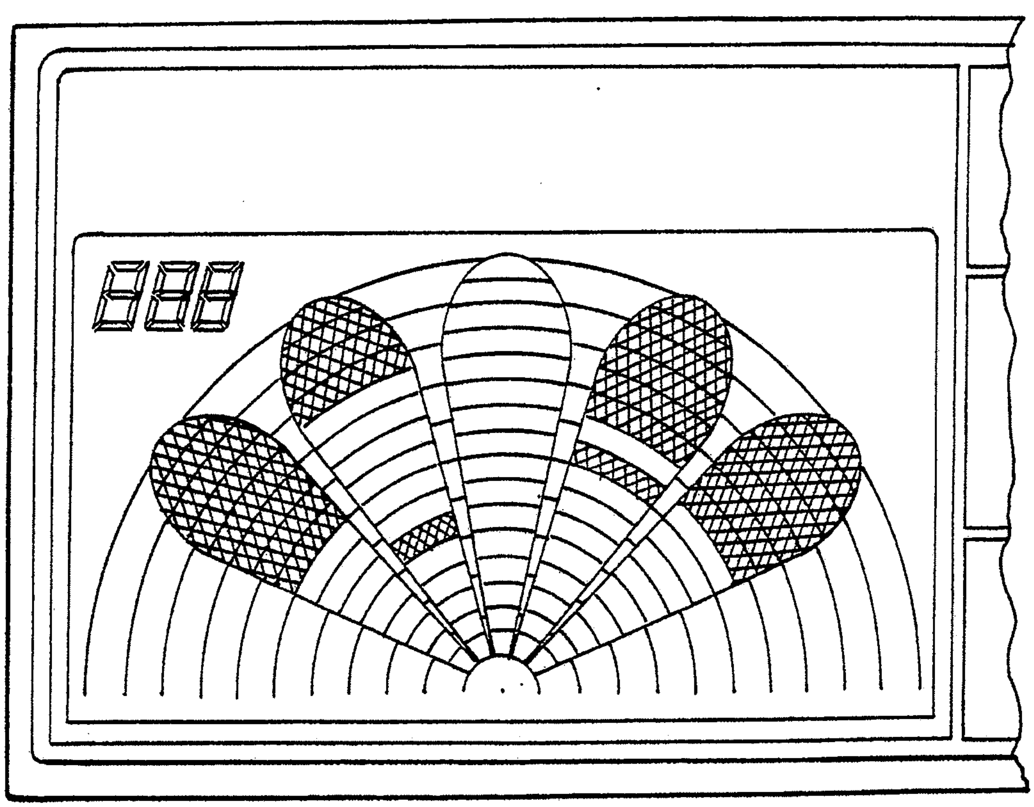


FIG. 1

FIG. 4



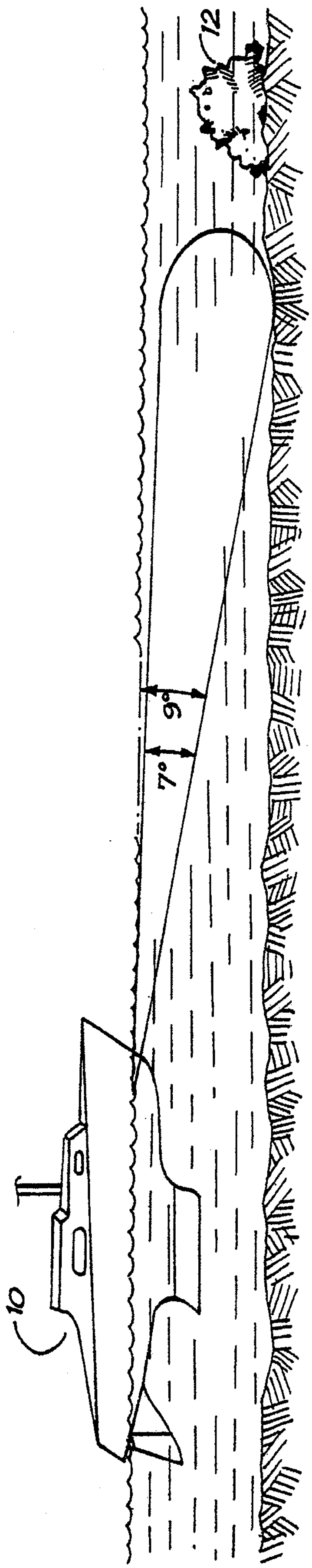


FIG.2

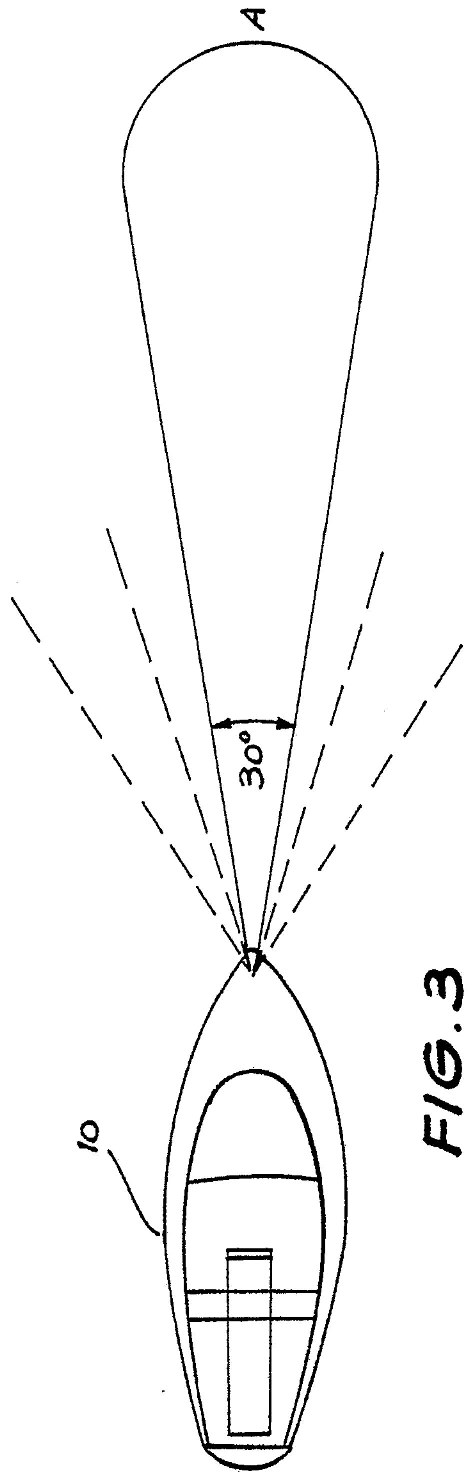
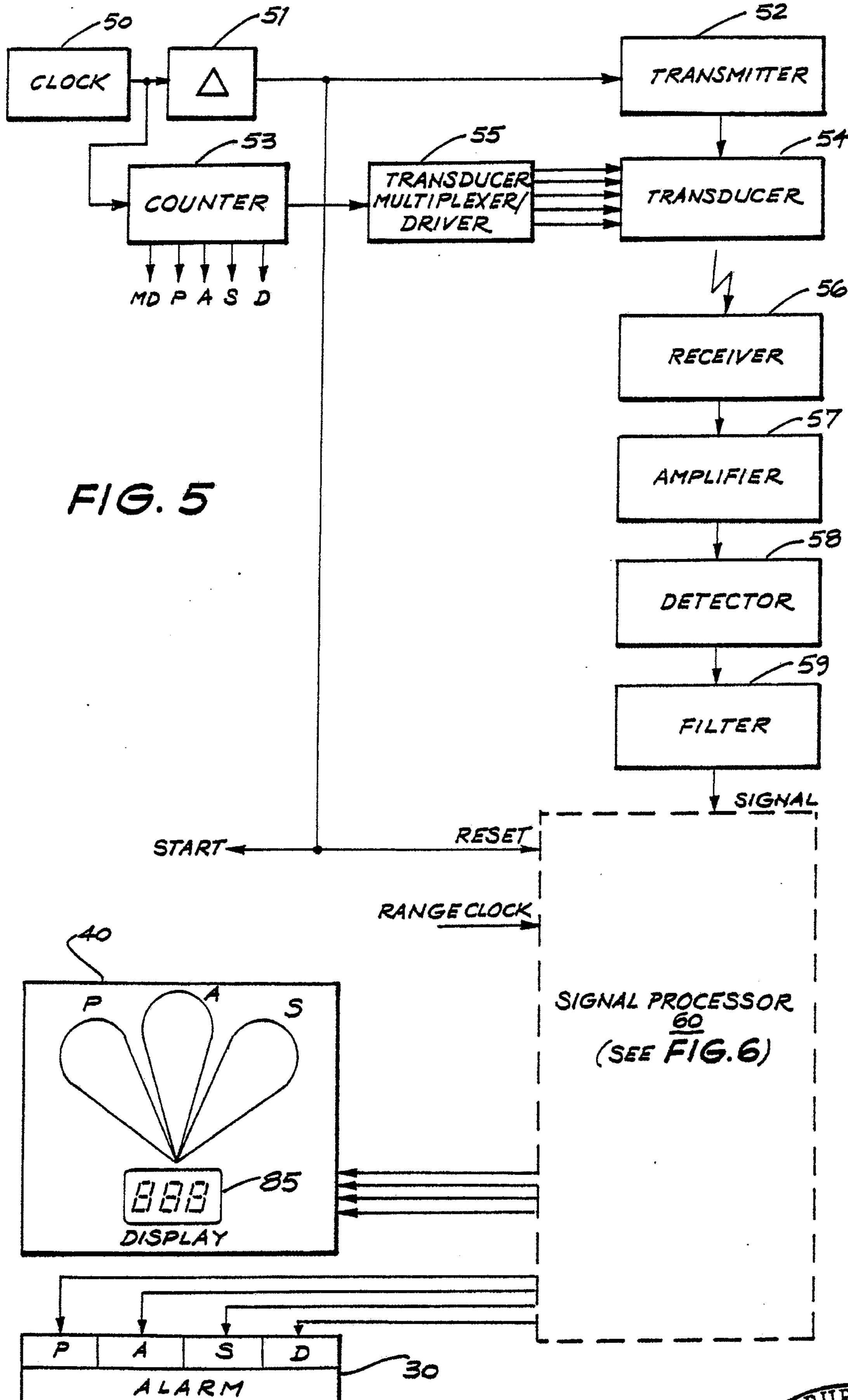
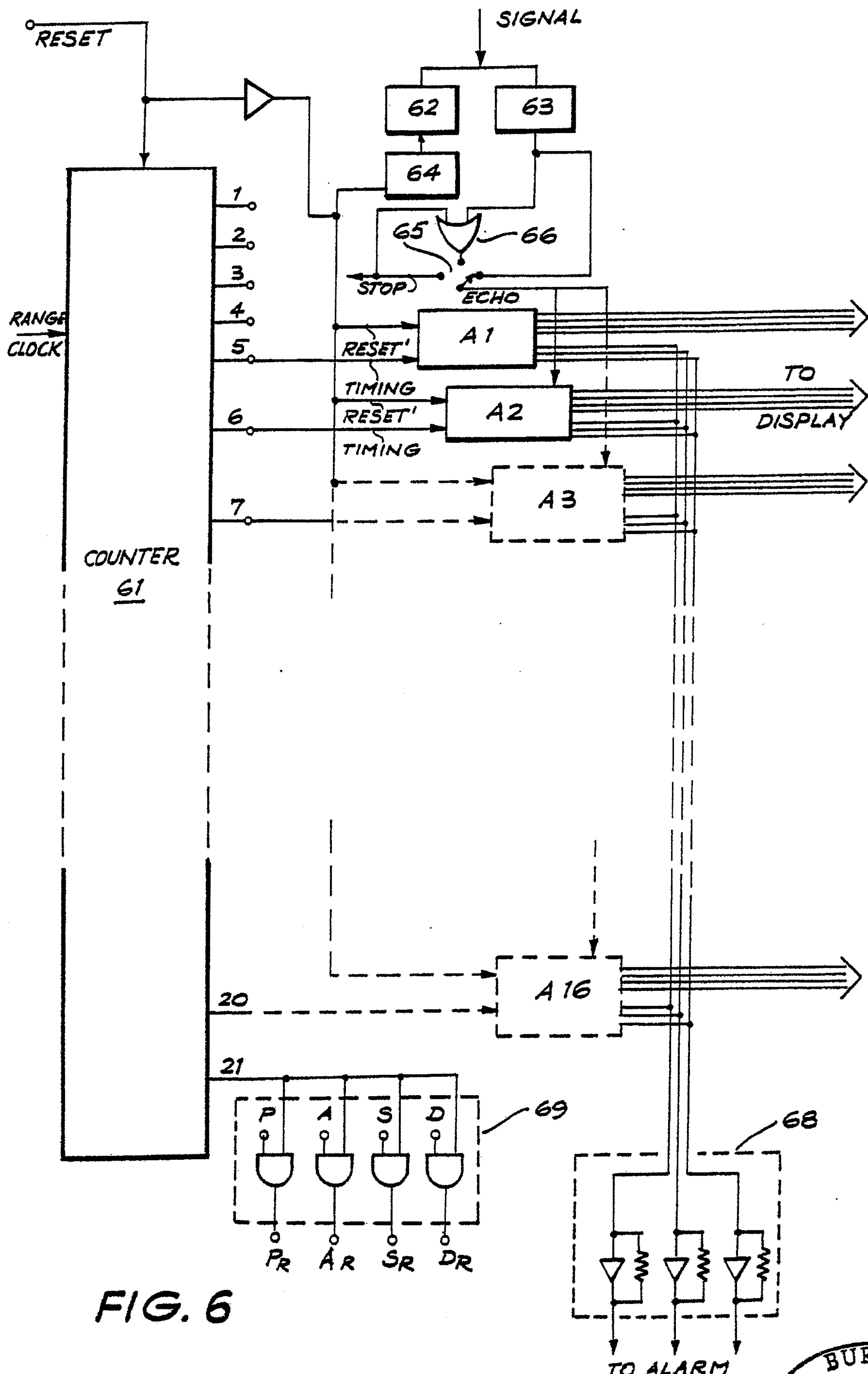


FIG.3



50
CLOCK
51
52
TRANSMITTER
53
COUNTER
55
TRANSDUCER MULTIPLEXER/ DRIVER
54
TRANSDUCER
MD P A S D
56
RECEIVER
57
AMPLIFIER
58
DETECTOR
59
FILTER
SIGNAL
START
RESET
RANGE CLOCK
40
P
A
S
SIGNAL PROCESSOR 60 (SEE FIG.6)
85
DISPLAY
P A S D
ALARM
30

FIG. 5


SIGNAL
RESET
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63
64
65
66
STOP
ECHO
1
2
3
4
5
6
7
20
21
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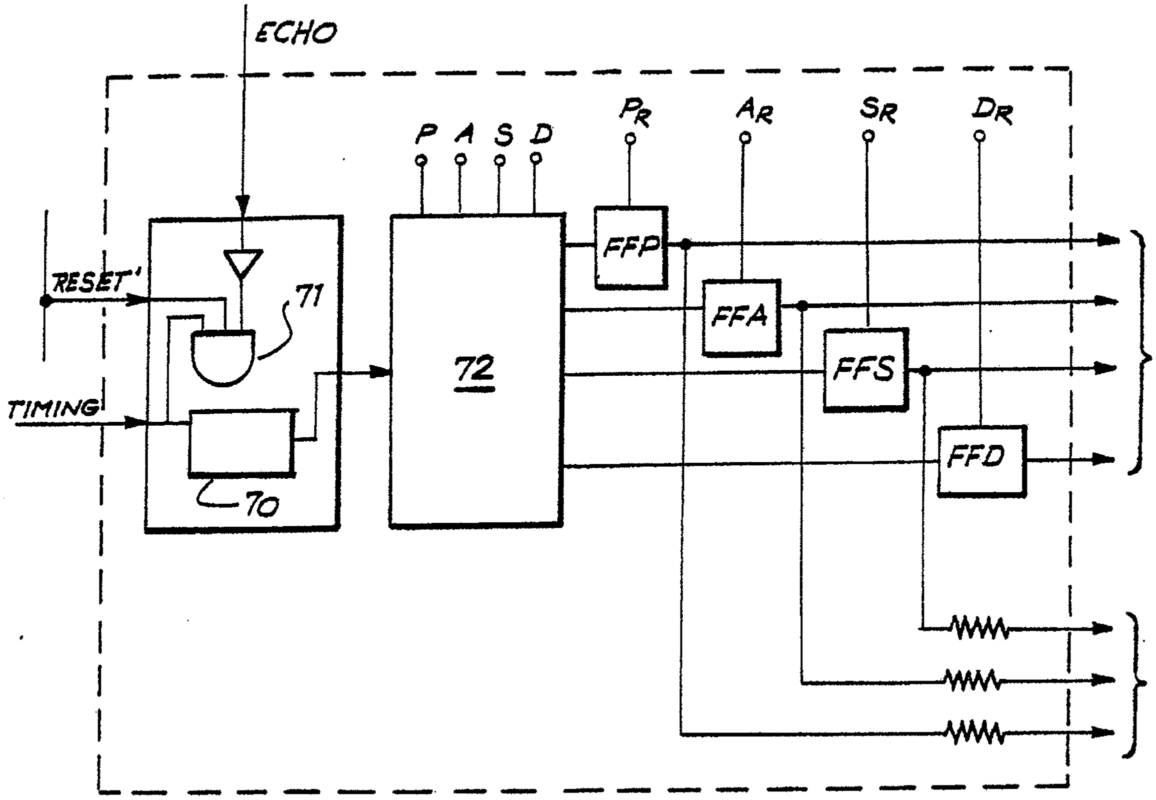
A1
A2
A3
A16
RESET'
TIMING
RESET'
TIMING
TO DISPLAY
COUNTER 61
P
A
S
D
69
68
P_R
A_R
S_R
D_R
TO ALARM

FIG. 6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RESET'
TIMING
71
70
72
P A S D
P_R
A_R
S_R
D_R
FFP
FFA
FFS
FFD

FIG.7

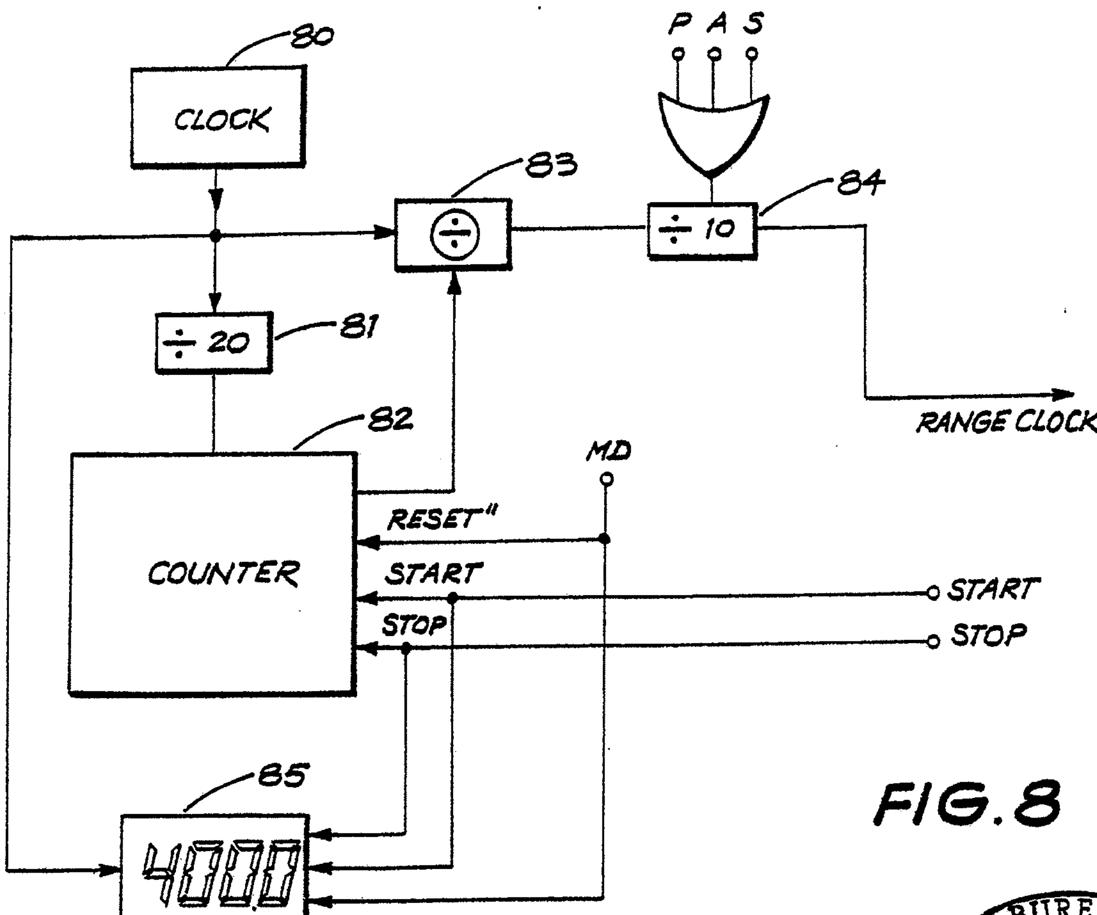

80
CLOCK
83
P A S
84
÷ 10
÷ 20
81
82
RANGE CLOCK
MD
COUNTER
RESET''
START
STOP
START
STOP
85
4000

FIG.8

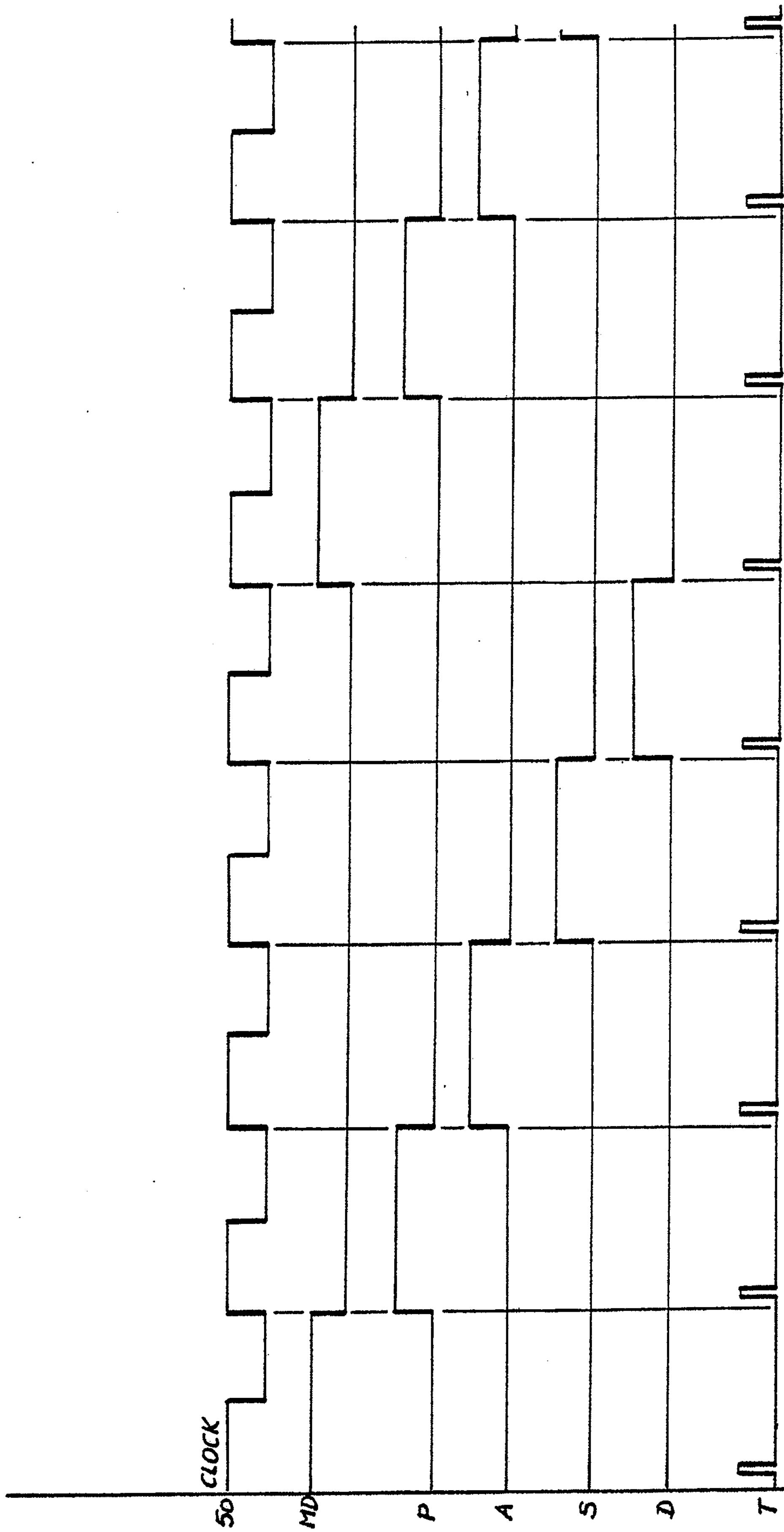


FIG. 9

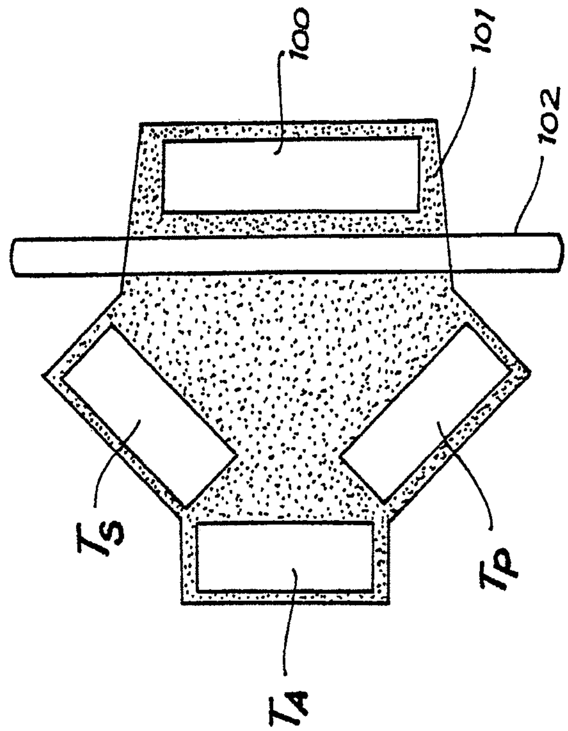

100
101
102
T_S
T_A
T_P

FIG. 10

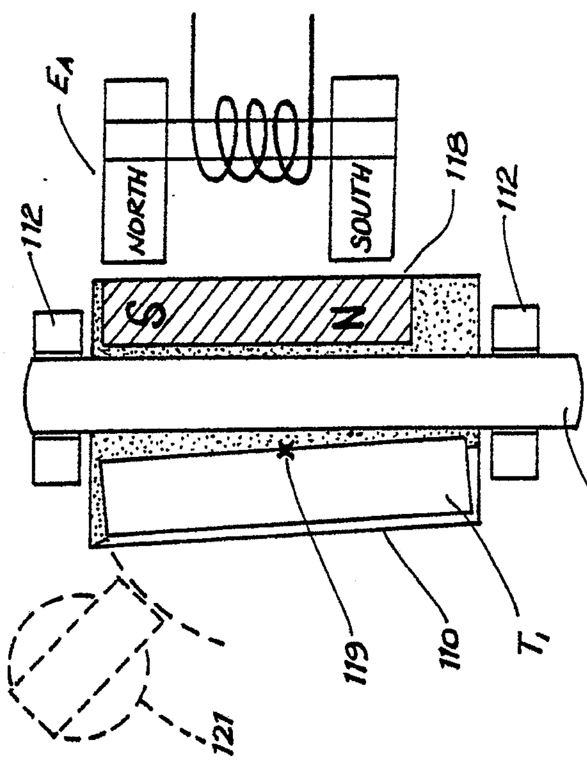
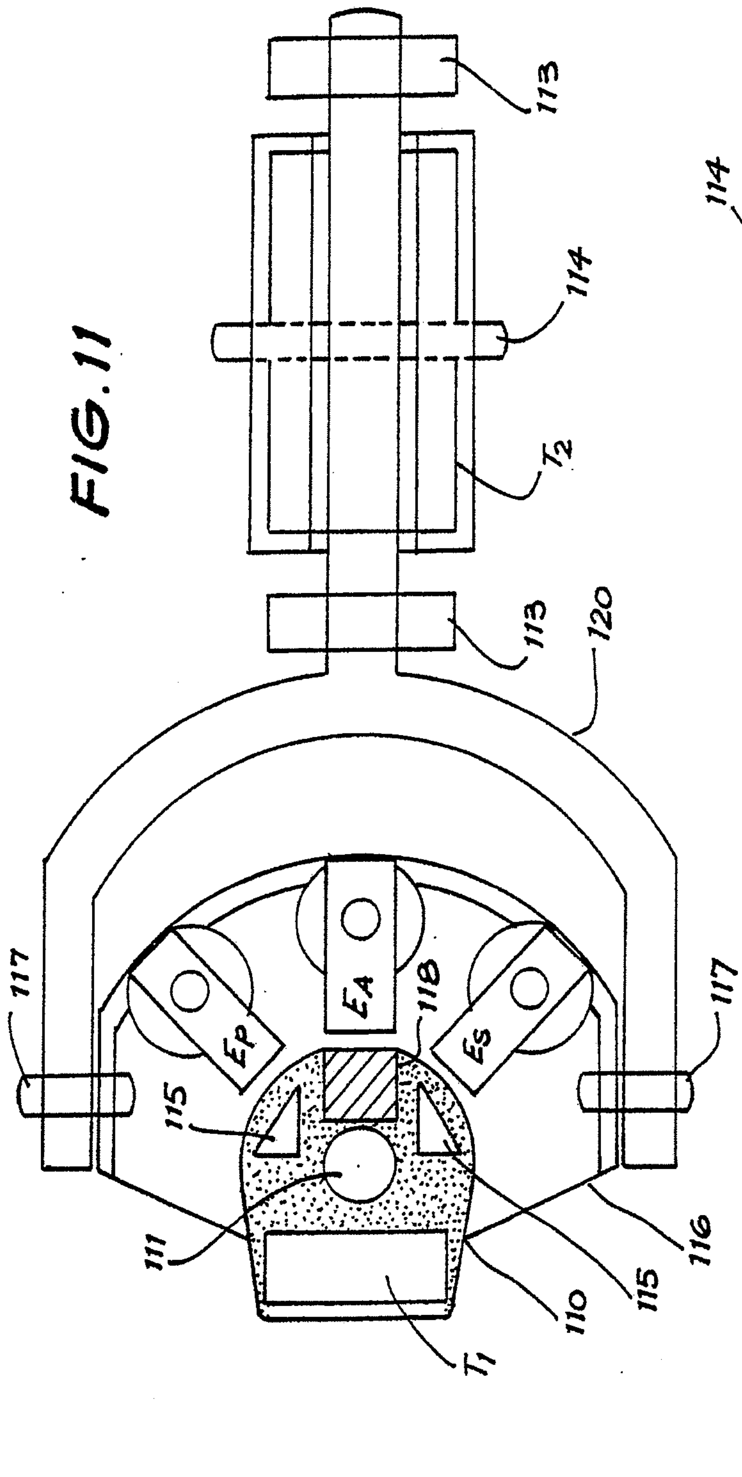

NORTH
SOUTH
S
N
112
118
112
111
T_1
110
119
121

FIG. 13

FIG.11


113
114
T_2
113
120
117
E_P
E_A
E_S
118
117
115
111
110
115
116
T_1

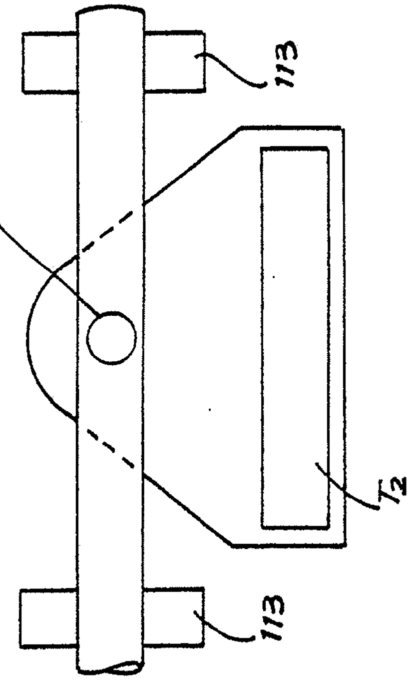

113
114
T_2
113

FIG.12

INTERNATIONAL SEARCH REPORT

International Application No PCT/AU 83/00159

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[3] G01S 7/56, 15/93, 15/96, 15/46

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
IPC US Cl.	G01S 7/56, 7/58, 7/60, 7/62, 7/64, 9/68, 9/70, 15/93 367/909

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

AU: IPC as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X, Y	US, A, 4349823 (TAGAMI et al) 14 September 1982 (14.09.82)	(1-3, 6-10)
X, Y	US, A, 4207620 (MORGERA) 10 June 1980 (10.06.80) See column 3	(1-3, 6-10)
X, Y	US, A, 4202050 (KLEIN) 6 May 1980 (06.05.80) See column 2	(1-3, 6-10)
X, Y	US, A, 3800273 (ROLLE) 26 March 1974 (26.03.74)	(1-3, 6-10)
X, Y	US, A, 3127584 (HATHAWAY) 31 March 1964 (31.03.64)	(1-3, 6-10)
X, Y	GB, A, 696809 (WESTERN ELECTRIC CO.) 9 September 1953 (09.09.53)	(1-3, 6-10)
X, Y	DE, A, 3004492 (PLESSEY HANDEL UND INVESTMENTS AG) 21 August 1980 (21.08.80)	(1-3, 6-10)
X, Y	DE, A, 2248797 (SCHILLING) 11 April 1974 (11.04.74)	(1-3, 6-10)
Y	US, A, 4260980 (BATES) 7 April 1981 (07.04.81)	(1-3, 6-10)
Y	US, A, 4180791 (TIEMANN) 25 December 1979 (25.12.79)	(1-3, 6-10)
Y	US, A, 3987403 (SMITH) 19 October 1976 (19.10.76)	(1-3, 6-10)
Y	US, A, 3835447 (LOWRANCE) 10 September 1974 (10.09.74)	(1-3, 6-10)
	(Continued)	

* Special categories of cited documents: [15]

"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

"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

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
20 December 1983 (20.12.83)	23 December 1983 (23-12-83)
International Searching Authority [1]	**Signature of Authorized Officer [20]**
Australian Patent Office	R.M. DORNING RM Dorning

Form PCT/ISA/210 (second sheet) (October 1981)

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

Y	US, A, 3806861 (OKUMURA & WATANABE) 23 April 1974 (23.04.74)	(1-3, 6-10)
Y	GB, A, 1370424 (SMITHS INDUSTRIES LTD.) 16 October 1974 (16.10.74)	(1-3, 6-10)
Y	WO 83/01515 (KABUSHIKI KAISHA KODEN SEISAKUSHO) 28 April 1983 (28.04.83)	(4)

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [10]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers........, because they relate to subject matter [12] not required to be searched by this Authority, namely:

2. ☐ Claim numbers........, 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 [13], specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [11]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ 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 claim numbers:
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.

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(19) World Intellectual Property Organization
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WO 03/009276 A2

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(30) Priority Data:
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(74) Agents: **HOOVER, Thomas, O.** et al.; Bowditch & Dewey, LLP, 161 Worcester Road, P.O. Box 9320, Framingham, MA 01701-9320 (US).

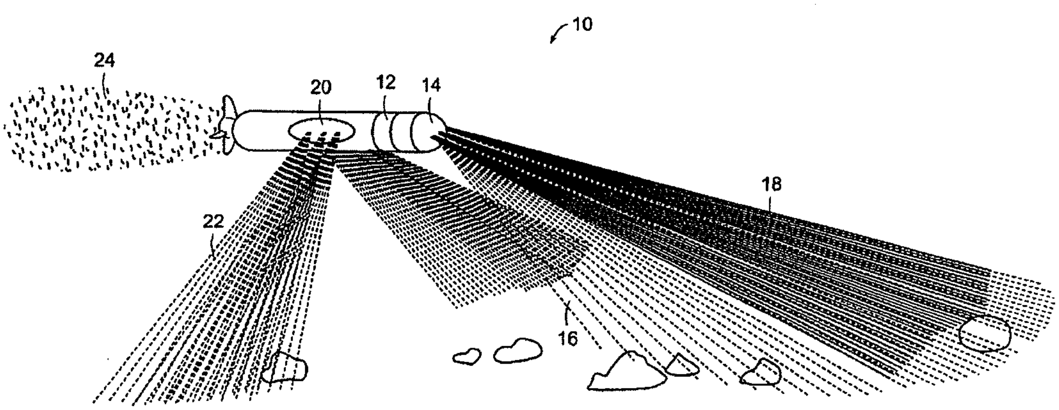
(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that 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: SONAR BEAMFORMING SYSTEM



(57) Abstract: The present invention relates to sonar beamforming systems and methods, using a forward-looking sonar having transmit and receive transducer arrays with a beamforming device and at least one side-looking sonar having dynamically range-focused beams. The forward-looking sonar provides for obstacle avoidance and undersea survey. The systems include one-dimensional transmit and receive transducer arrays with beamforming electronics, a computing controller such as, for example, a personal computer host controller. The arrays and beamforming electronics can be packaged in a hermetically sealed housing unit and mounted in Unmanned Underwater Vehicles (UUV). The side-looking sonar system includes for example, 32-element, one- dimensional arrays that are mounted on either side of the UUVs. Further, a downward looking Bathymetric sonar may be mounted on the underside of the vehicle for high-resolution mapping.

WO 03/009276 A2

CROSS REFERENCES TO RELATED APPLICATIONS

The present application is a continuation-in-part of U.S. Patent Application 09/909,141 filed on July 19, 2001 which is a continuation-in-part of U.S. Patent Application No. 09/828,266 filed on April 6, 2001 which claims priority to U.S. Patent Application No. 60/195,587 filed on April 6, 2000 and U.S. Patent Application No. 09/842,311 filed on April 25, 2001, and a continuation-in-part of U.S. Patent Application No. 08/965,663 filed November 6, 1997 which claims benefit of U.S. Provisional Application No. 60/036,837 filed on February 3, 1997, the contents of these applications being incorporated herein by reference in their entirety.

BACKGROUND OF THE INVENTION

In numerous applications there is a need to perform sonar beamforming operations to acquire spatial information regarding a particular area of interest. Sonar systems make use of sensor arrays to process underwater acoustic signals to determine the location of a noise source. Array processing techniques for isolating received signals are known as beamforming and when the same or analogous principles are applied to focus the transmission of signals, the techniques are referred to as beamsteering. Various systems have been developed to perform such beamforming operations that frequently depend upon the particular applications.

One such application involves undersea search and survey that has various uses such as, but not limited to, terrain mapping and dredging operations. Further, undersea acoustic mine-field reconnaissance and mine hunting applications benefit from high-resolution imaging sonars for clutter rejection, obstacle avoidance, and identification of foreign objects. Currently, the discovery of underwater mines and obstructions is performed by touch in cold, murky water, often at night, under low-light conditions. Navy salvage, explosive ordinance disposal, and other military and civilian applications operate in zero-visibility water where "seeing with sound" using unmanned vehicles would make their jobs significantly more efficient and safer. Commercial applications which include, for example, commercial navigation or aiding search and rescue dive teams would benefit from an improvement in imaging systems.

There is still a need for a light-weight, low-power, low-cost, unmanned self-propelled sonar system for remote undersea imaging or surface imaging.

SUMMARY OF THE INVENTION

The system and method of the present invention is directed to a sonar imaging system. The system and method of the present invention can be used, for example, in a self-propelled vehicle using a compact, light- weight system with an internal power supply such as batteries supplying power to the system for the duration of a particular imaging operation. One application of the sonar beamforming system is for underwater detection and reconnaissance. In waters up to 150 meters deep it is often the most difficult for military and commercial applications, as personnel need to traverse water containing underwater mines and obstructions.

In accordance with a preferred embodiment, the sonar beamforming system and method of the present invention includes, for example, a first beamforming device connected to a first transducer array that transmits and receives signals in a first direction and a second beamforming device connected to a second transducer array that transmits and receives signals in a second direction. This system can be used in a forward-looking sonar for obstacle avoidance and undersea survey. The system can include one-dimensional transmit and receive transducer arrays with beamforming electronics, a computing controller such as, for example, a personal computer host controller. The arrays and beamforming electronics are packaged in an environmentally or hermetically sealed housing unit and mounted in at least the nose of an Unmanned Underwater Vehicle (UUV) for scanning of underwater objects or surfaces. The system and method of the present invention further includes at least one side-looking sonar, and preferably two side-looking sonars. The side-looking sonar system may include 32-element, one-dimensional arrays that are mounted on either side of the UUVs. Further, a downward-looking Bathymetric sonar may be mounted on the underside of the vehicle for high-resolution mapping.

In accordance with a preferred embodiment of the present invention, the sonar imaging systems such as, for example, the forward-looking scan, the side-looking sonar and downward-looking sonar use charge-domain-processing (CDP) such as charge coupled device (CCD/CMOS) integrated circuits that allow electronic lenses to focus reflected energy following detection by a one-dimensional array. The low power attributes of CCD/CMOS technology in beamformers facilitate the use of batteries to provide the life span of missions. Further, beamformers are used to emulate an acoustic lens for the sonar and are made smaller with fewer mechanical parts that are susceptible to failure. Electronic beamformers provide better imaging with minimal or no reflection artifacts.

The foregoing and other features and advantages of the sonar beamforming system and method will be apparent from the following more particular description of preferred embodiments of the system and method as illustrated in the accompanying drawings in which like reference characters refer to the same parts throughout the different views.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the present invention are described with reference to the following drawings, wherein:

Figure 1 is a diagram illustrating a preferred embodiment of a sonar beamforming system in accordance with the present invention;

Figure 2 is a diagram illustrating another preferred embodiment of a sonar beamforming system in accordance with the present invention;

Figure 3 is a block diagram illustrating an electronic focusing sonar imaging system in accordance with a preferred embodiment of the present invention;

Figure 4 is a block diagram illustrating a sonar imaging system in accordance with another preferred embodiment of the present invention;

Figure 5 is a block diagram illustrating a flow chart of the image fusion process of the sonar imaging system in accordance with a preferred embodiment of the present invention;

Figure 6 is a schematic illustration of transmit and receive beam configurations of the sonar imaging system in accordance with a preferred embodiment of the present invention; and

Figure 7 is a graphical illustration of a curvilinear array of a sonar imaging system in accordance with a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Under water research scientists continue to seek small, low power acoustic sensor technology for transition to an Autonomous Unmanned Vehicle (AUV) or an Unmanned Underwater Vehicle (UUV) such as the Semi-Autonomous Hydrographic Reconnaissance Vehicle (SAHRV). High resolution is desired for undersea search and survey and to maximize the vehicle's ability to perform target detection and classification. Existing multi-beam forward-looking sonars (FLS) with nominally half-degree resolution and greater than thirty degree field of view need to be improved to provide adequate imaging performance. The present invention is directed to a system and method for a sonar beamforming systems such as, for example, AUV's with FLS requiring substantially less power and volume than existing systems. This is accomplished by using programmable, low-power, high-throughput charge-domain-processing technology such as charge coupled devices (CCD/CMOS) integrated circuit technologies for electronic beamforming in conjunction with sonar arrays fabricated by, for example, Material Systems Technology (MSI). For example, at a 40 MHz clock rate, the beamformer provides a continuous computation throughput of approximately 10 billion operations per second and a delay update rate of approximately 22 billion bits per second and dissipates less than about 1 Watt of electric power.

The forward-looking sonar provides the vehicle's operational requirement for obstacle avoidance and search of the bottom area beneath the vehicle that is not covered by an additional side-scan sonar or side-looking sonar (gap-filler sonar). A high frequency multi-element curvilinear receive array is used in conjunction with separate acoustic projectors, one aimed straight ahead for obstacle avoidance and a separate projector aimed at a depression angle suitable for the gap-filler application.

In a preferred embodiment, the existing unfocused side-looking sonar (SLS) in underwater vehicles is replaced with a low power focused sonar. In a second preferred embodiment, a downward-looking sonar (DLS) capable of providing real-time Bathymetric surveys suitable for military and commercial ships to negotiate navigable routes into port is additionally provided. Each of the preferred embodiments of the beamforming systems is based on the CCD/CMOS integrated circuit technologies for electronic beamforming. Card assemblies are designed to maximize commonality among the subsystems. Replacing the existing SLS minimizes the power requirements of the suite of sonar sensors and minimizes the impact of the additional sonar sensors on the total vehicle cost.

An example of a low-cost autonomous underwater vehicle (AUV) for coastal monitoring and multiple vehicle survey operations is the Remote Environmental Monitoring UnitS (REMUS). In a preferred embodiment the vehicle is approximately 53 inches long with a body diameter of about 7.5 inches, although the length may be increased to support any reasonable payload. The AUV is neutrally buoyant, preferably weighing, without limitation, only 68 pounds in air, and is powered by sealed lead acid batteries. The vehicle can be operated in fresh or salt water. Because the preferred embodiment of the AUV is so small, it can be easily transported, launched and recovered from a small vessel and special handling equipment is not required.

Although small in size, the AUV vehicle is configured to support a variety of sensor packages. The vehicle has a conductivity/temperature/depth (CTD) sensor system and an optical backscatter sensor on board. Telemetry data provides time of day, depth, heading, and a geographic fix for the data.

Another preferred embodiment of the AUV includes a longer version of REMUS with an acoustic Doppler current profiler and Global Positioning System (GPS). Additional personal computer slots such as, for example, PC-104 slots and RS-232 ports are available for user-designed payloads.

In a preferred embodiment, the AUV has three motors forward of the propeller. The propulsion assembly is optimized to provide 1.5 pounds of thrust at a forward speed of four knots. At this speed a 40-nautical-mile track can be completed in 10 hours. A preferred embodiment of the AUV runs from a 24-volt power supply and draws approximately 32 watts while maneuvering through the ocean, enabling the vehicle to operate at four knots for 14 hours.

In a preferred embodiment the AUV control computer is based on PC-104 technology, a small form factor version of the common IBM-PC hardware. The Central Processing Unit (CPU) is housed in a custom motherboard, and has eight 12-bit analog to digital channels, input/output ports, power supplies, and other interface circuitry. Internally, the AUV runs at least one operating system program such as, for example, a DOS program written in C++ language that executes out of an autoexec.bat file. The vehicle user interface may run on a laptop computer.

A preferred embodiment of the AUV possesses an acoustical system with a digital signal processor. A receiving array of four hydrophones is located in the nose, and on the bottom is a hydrophone sensor that can both transmit and receive. To determine its position, the AUV transmits a coded ping to a transponder and listens for a reply. The range and bearing of the reply allows the AUV to determine its location. The AUV can be programmed to interrogate a plurality of transponders, approaching each transponder by minimizing the range. When the range to a transponder is below a predetermined threshold, the vehicle then listens on a different channel for the next transponder and approaches it using the same technique. By setting the transponders once using GPS, a known track line may be followed on subsequent imaging operations. This system be used to autonomously dock the vehicle.

In a preferred embodiment, the specifications of the AUV are described in Table 1 as follows:

Table 1

Parameter	**Approximate Dimensions**
Length	53 inches (1.3)
Beam	5.5 feet
Diameter	7.5 inches (19.1cm)
Maximum Operating Depth	492 feet (150m)
Gross Weight	68 lbs. in the air, neutrally buoyant in water
Dive Duration	14 hours at 4 knots
Propulsion	Three motors; one direct drive thruster and sprocket driven rudder, two pitch motors, and one stem propeller
Power requirements	24-volt supply, 32 watts while maneuvering at 4 knots
Power Source	Rechargeable lead acid batteries

Figure 1 is a diagram illustrating a preferred embodiment of a sonar beamforming system 10 as implemented in an AUV in accordance with the present invention. The system 10 includes a forward-looking sonar (FLS) 14 having forward-looking sonar transmit beams 16 and forward-looking sonar receive beams 18. The following are exemplary values for the forward-looking sonar:

Table 2

Parameter	**Approximate Dimensions**
Operating frequency	500KHz – 1.2MHz
Beam resolution	< 1 degree
Field of view	> 30 degrees
Number of elements	Minimum of 128, preferably 128 or 192
Aperture	> 14 cm
Element pitch	(0.5 lambda)
Image ranges	3 to 5, 10, 20, 40 or 60 m
Independent beams	64
Range resolution	< 1 cm

The forward-looking sonar has a capability of at least 0.5° azimuth resolution, 30° Field of View (FOV); and reducing volume and power requirements by about one third such as, for example, 700 cubic inches and a range of 25 to100 watts.

In a preferred embodiment, the forward-looking sonar comprises bistatic transducer arrays, preamplification and beamforming electronics and a commercially available computer. Further, an industry-standard personal computer such as PC-104 computer and a high speed serial bus such as, for example, without limitation, Institute of Electrical and Electronics Engineers, Inc. (IEEE) 1394 or Universal Serial Bus (USB) 2.0 peripheral interface provide for data collection and archiving of the data generated by the front-end beamforming electronics. The IEEE 1394 data transport bus supports both asynchronous and isochronous data. In another preferred embodiment, a parallel interface such as a peripheral component interconnect (PCI) may be used.

The system further includes at least one side-looking sonar (SLS) 20, and preferably two side scan or SLS sonars. Exemplary values of the side-looking sonar are as follows:

Table 3

Parameter	Approximate Dimensions
Range	2 m – 50 m
Aperture	> 40 cm
Frequency	500 KHz – 1 MHz
Beam width	< 1 degree
Cross-range resolution	< 0.2 m

In a preferred embodiment, the side-looking scan or sonar consists of two multi-element receive arrays, preamplification and a single beamforming integrated circuit to realize a dynamically range-focused side-looking sonar system. The arrays, in a preferred embodiment, have 32 elements and are sized to have a vertical beamwidth of +/-30 degrees. A common aperture may be used for both the transmitter and receiver.

Another preferred embodiment includes multi-mode arrays such as, for example a first search and detection mode and a second high resolution target recognition mode. The beamformer is integrated with onboard processing which enables automatic obstacle detection and target recognition.

The beamforming system focuses signals received from an image point onto a transducer array. By inserting proper delays in a beamformer to align wavefronts that are propagating in a particular direction, signals arriving from the direction of interest are added coherently, while those from other directions do not add coherently or cancel. However, as the array is scanning through the imaging plane, there are three difficult implementation issues: first, each delay line has to be long enough to compensate for the path differences of a large linear array; second, the delay value has to be adjusted periodically for proper beam steering; and finally, the long round-trip delays when performing long-range imaging must be processed in parallel to provide reasonable display update rates. Ideally, the time-of-flight from the radiation source to the focal point can be calculated at every clock cycle for every channel from multiple directions of arrival in parallel. In a conventional implementation, separate electronic circuitry is necessary for each beam; for a multi-beam system, the resulting electronics rapidly become both bulky and costly as the number of beams increases. A single-chip multiple beamforming processor based on a time-multiplexed delay generation architecture is used in a preferred embodiment of the present invention. The integrated circuit combines programmable delays with a sequentially addressable digital delay selection resulting in a compact, low-power implementation of a multiple beamforming processor.

A delay-and-sum beamformer allows a transducer array to "look" for signals propagating in a particular direction. By adjusting the delays associated with each element of the array, the array's look direction can be electronically steered toward the source of radiation. The multi-beamforming chip consists of N parallel beamforming modules, a summing circuit and a Finite-Impulse-Response (FIR) filter. Within each module, there is a sampling circuit, a programmable delay line, an apodization multiplier and a bank of delay controls that are addressable sequentially. The delay control can be a real-time "time-of-flight" (TOF) computing circuit. Further, the arrays may be built directly on the hulls of the vehicles and then encapsulated as a single unit. This simplifies the fabrication process and minimizes, and preferably eliminates the need for expensive electrical feed through. Preamplifiers may optionally be incorporated in the encapsulation.

Acoustic communication devices 24 which are preferably steerable are also included in the system 10. These arrays may be fabricated by, for example, Material Systems Technology (MSI). Thus, the system 10 includes the integrated arrays – forward-looking sonar (FLS), side-looking sonar (SLS), and acoustic communication devices.

Figure 2 is a diagram illustrating another preferred embodiment of a sonar beamforming system 40 in accordance with the present invention. This system 40 includes a forward-looking sonar 44 having forward-looking sonar transmit beams 48 and forward-looking sonar receive beams 50. In addition, the system 40 has two side scan sonars 46. Further acoustic communication devices 54 which are preferably steerable are also present in this preferred embodiment of the system. At least one identification sonar 60 or a downward-looking Bathymetric Sonar is also mounted on the underside of the vehicle that transmits beam 58 and receives beams 56. This

Bathymetric sonar 60 is a downward-looking sonar (DLS) for high-resolution terrain mapping and object identification. In a preferred embodiment, the sonar 60 can include bistatic or alternatively monostatic transducer arrays.

In a preferred embodiment, the downward-looking sonar 60 is made with a similar construction as the forward-looking sonar and is housed in its own replaceable hull section. This allows the UUV to adapt to imaging operation requirements by adding payload sections as needed. The downward-looking sonar is cylindrically shaped and is conformed to the vehicle hull. As it is preferably, but without limitation, housed in its own section, the surfaces of the arrays are flush with the hull as there is no mechanical interference with the on-board systems. The arrays thus are conformal and are not appendages protruding from the vehicle that can be damaged during deployment, operation or retrieval. The downward-looking sonar array preferably includes, but is not limited to, a single element projector to provide the illumination for a 128-element receiver array 58. The 128 elements may be each spaced a distance of 0.5λ apart to minimize grating lobes.

In a preferred embodiment, the FLS is housed in a replaceable nose cone, the SLS is conformed on a hull section of the vehicle and the DLS is fabricated in its own hull section.

Figure 3 is a block diagram illustrating an electronic focusing sonar imaging system 70 in accordance with a preferred embodiment of the present invention. Signals such as transducer signal 74 and output signals 76 form the input to a low noise preamplifier 72 having time-gain control. The output of the preamplifier 72 forms the input into a sampling subsystem 80. The output of the sampler forms the input to programmable delays 82 associated with beamsteering and focusing functions, the output of which forms an input into a weighting subsystem 84. The outputs of the weighting function are then summed in a summer 86. In a preferred embodiment the sampler 80, the programmable delays 82, the weighting function 84 and summer 86 functions are integrated on a single chip which accomplishes beamforming, preferably using a charge-domain-processing (CDP) structure. A preferred implementation of a beamforming device using CDP technology, including a programmable tapped delay line structure, is described in a co-pending PCT International Application Number PCT/US98/02291, filed on 3 February 1998, by

Jeffrey Gilbert, Alice Chiang, and Steven Broadstone, the entire contents of which is hereby incorporated by reference.

In a CDP circuit, sampled information is represented by analog charge packets. If the information is accurate to 10-bit words, instead of representing it by 10 separate digital bits, each charge packet represents a 10-bit value and these charge packets can be manipulated at a high speed with a high level of accuracy, for example, approximately 10-bit, in a very small chip area. The CCDs of the present invention have a charge sensing method that eliminates clock feed-through. Furthermore, a charge domain multiplier that maintains the output accuracy to more than 8-bits is also included. The CCD signal processors have an output dynamic range of at least 60 dB. The CDP technology used in the systems of the present invention combine high speed, low-power charge-domain units with conventional CMOS digital control and memory circuits.

The output of the summer 86 forms the input to a demodulator 88, whose output is manipulated in a square law function 90. The output of the square law function 90 forms the input of a display 92 such as a monitor. Post processing reformats data to then be displayed on a monitor.

Figure 4 is a block diagram illustrating a sonar imaging system 100 in accordance with another preferred embodiment of the present invention. The imaging system 100 includes a front-end 102 which interfaces with a back-end host computer 104. The front-end electronics including the beamformer is mounted on small-sized printed circuit boards that can be completely housed in the nose of the UUV, for example. The output of the back-end provides the input to a display system 108 or is downloaded via ethernet to a display platform.

The front-end 102 of the system 100 is an integration of many subsystems. A waveform transmit function 112 forms an input to a transmitter 114 which in turn transmits waveforms to a target image 106. An array 116 is received at the front-end 102 from the target image and is then processed in the front-end. The array in a preferred embodiment is a one-dimensional array. The processing signals of the received array begins with preamplification in a low noise preamplifier 118 having time-gain control. The output of the preamplifier 118 forms the input into a beamforming function 124, preferably using CDP. A memory device 122 interfaces with the preamplifier 118 and the beamformer 124. The memory device 122 may be a single memory device or plurality of memory devices. Such a memory device may be, but is not limited to, a random access memory, read-only memory, floppy disk memory, hard drive memory, extended memory, magnetic tape memory, zip drive memory and/or any device that stores digital information. A front-end host interface processing module or controller 120 interfaces with the memory 122. The controller 120 may be a single processing device or a plurality of processing devices. Such a processing device may be a microprocessor, microcomputer, digital signal processor, central processing unit of a computer or work station, digital circuitry, state machine, and/or any device that manipulates signals, for example, analog and/or digital, based on operational instructions. It should be noted that when the processing module implements one or more functions, via a state machine or logic circuitry, the memory storing the corresponding operational instructions is embedded within the circuitry comprising the state machine or logic circuitry. A standard interface such as, for example, a high-speed serial bus IEEE 1394/Firewire chip set 126 interfaces with both the host interface controller 120 and the memory 122.

Thus, in a preferred embodiment, the forward-looking sonar is comprised of bistatic transducer arrays, preamplification and beamforming electronics and a commercially available computer. An industry-standard personal computer such as PC-104 computer and a high-speed serial bus such as IEEE 1394 peripheral interface provide for data collection and archiving of the data generated by the front-end beamforming electronics. The PC-104 computer and its disc driver, memories, input/output, the high-speed serial bus (IEEE 1394) interface are integrated into a hermetically sealed portion of the AUV or UUV. Data is retrieved by connecting through a standard Ethernet interface mounted on the body of the vehicle.

The back-end 104 includes a microprocessor 130 that sends inputs to an Interface chip (IEEE 1394) 134 and then to a buffer 128 and a post signal processor 132. The Firewire (IEEE 1394) chip set 126 in the front-end 102 interfaces with the interface chip set 134 in the back-end through an interface 110. The back-end preferably includes a receiving parallel data bus interface, for example, PCI or a serial bus interface, for example, a Firewire chip set 134. The buffer 128 interfaces with the post signal processor 132. Further details regarding interface structure can be found in U.S. Application No. 09/791,491 filed on February 22, 2001, the entire contents of which is incorporated herein by reference.

The output of the back-end 104 forms the input into a display 108 such as at least, without limitation, a monitor, a video recorder and/or a digitizer. The system of the present invention permits real-time analysis of data to assess the images as well as permits data analysis via post collection.

Figure 5 is a block diagram illustrating a flow chart of the image fusion process 150 of the sonar imaging system in accordance with a preferred embodiment of the present invention. Data from at least one side scan 152 are meshed with forward scan data 156 derived from a forward-looking scan such as described with respect to Figures 1 and 2. This data from the side scan and the forward scan are first normalized or scaled in a normalizing process 158. The process of normalization addresses spatial resolution. This normalization process is preferably performed, without limitation, on a standard personal computer platform. The fan shaped data is then meshed in an image fusion process 160. The data fusion process enables multi-sensor target classification and identification. The data fusion process may be accomplished, without limitation, using commercial products which provide three-dimensional rendering of data that is stacked such as, for example, 3D EchoTech that is provided commercially by EchoTech.

Figure 6 is a schematic illustration of transmit and receive beam configurations of the sonar imaging system in accordance with a preferred embodiment of the present invention. The forward-looking sonar scan 172 includes at least one transmit beam 174, and preferably multiple receive beams. The receive beams are discrete beams such as, for example, beam 176.

Figure 7 is a graphical illustration 190 of a curvilinear array of a sonar imaging system in accordance with a preferred embodiment of the present invention. The FLS curvilinear receive array has a center frequency between 500 Hz to 1 MHz with 192 elements.

The performance of the FLS is a function of the array's design frequency and aperture. The aperture is limited by the diameter of the vehicle, which may be 7.5 inches. In a preferred embodiment, a curvilinear array with approximately a 3.125-inch radius is recommended. This radius allows the array to be encapsulated in a protective cover to protect against damage if the vehicle impacts an obstacle during an imaging operation. For this radius of curvature, the 3dB beam width, or azimuth resolution in degrees, is determined by the arrays center frequency (Fo) and number of elements spaced at one-half wavelength spacing ($\lambda/2$).

In another preferred embodiment of the system of the present invention, the FLS curve linear receive array has a center frequency of 750 KHz with 128 elements, and a 3 inch radius of curvature. The transmit projector consists of a single element looking ahead for obstacle avoidance and a three element transmit array looking forward and downward for gap filling and navigation. The three-element projector array may be three discrete wide beam elements or a three element curved array.

The arrays consist of full-scale receiver and projector arrays mounted on a pressure plate and encapsulated in ρ-c polyurethane. A simple hemispherical shape is used in a preferred embodiment for the outer shape of the array. In yet preferred another embodiment of the present invention, the sonars are mounted on a pivotable mechanism to provide a sonar that provides for forward scan and side scans.

The system of the present invention is contemplated to have at least two modes of operation– an identification mode which provides a zoom capability and a detection mode which allows for a survey with a large range for scanning. The detection mode operates at a lower frequency as compared with the identification mode such as, for example, but not limited to, 500 KHz. This provides a longer range for scanning in the detection mode. The frequency is at least doubled for the identification mode and allows a zoom function. Thus a frequency shift allows for the two modes or operation.

The following table details an exemplary power estimate (Wattage/size) in accordance with a preferred embodiment of the system of the present invention:

Table 5

PC HOST CONTROLLER SUBSYSTEM **Processor: P133 with up to 128MB Memory and Mass Storage Power requirements: 10W (effective), estimated size: 3.5 x 2 x 6 inch**
BEAMFORMING ELECTRONICS SUBSYSTEM FLS power requirements (192 channels): 11 W (effective), estimated size: 9 x 6 x 1 inch SLS power requirement (32 channels): 4 W (effective), estimated size: 3 x 6 x 1 inch
TRANSMITTER SUBSYSTEM **FLS power requirements: 2.5 W (effective)** SLS power requirements: ~5 W (effective)

A preferred embodiment of the system includes the following design criteria:

SLS gap = +/- 6m

Typical mission duration 8 to 10 hours

Frame rate = 1 image/second (AUV speed = 2m/second)

For range resolution = 5.25 in. (match SLS); 64 x 256 class image covers 10m. – 44m. (16 Kbyte file); Azimuth resolution = 0.7° range/64; 9hr mission raw data file = 531 Mbytes.

Further preferred embodiments of the present invention provide mean and long range forward-looking sonar performance, short range focusing of the forward-looking sonar for high resolution classification, three-dimensional imaging with the forward-looking sonar, side-looking sonar with emphasis on short range focusing to minimize gap width, downward-looking sonar to define resolution and corridor width limitations for bathymetric surveys and downward-looking sonar three-dimensional imaging capabilities to evaluate image skew, and near field focusing update rate requirements.

It should be understood that the programs, processes, methods and systems described herein are not related or limited to any particular type of computer or network system (hardware or software), unless indicated otherwise. Various types of general purpose or specialized computer systems may be used with or perform operations in accordance with the teachings described herein.

In view of the wide variety of embodiments to which the principles of the present invention can be applied, it should be understood that the illustrated embodiments are exemplary only, and should not be taken as limiting the scope of the present invention. For example, the steps of the flow diagrams may be taken in sequences other than those described, and more or fewer elements may be used in the block diagrams. While various elements of the preferred embodiments have been described as being implemented in software, other embodiments in hardware or firmware implementations may alternatively be used, and vice-versa.

It will be apparent to those of ordinary skill in the art that methods involved in the sonar beamforming system and method may be embodied in a computer program product that includes a computer usable medium. For example, such a computer usable medium can include a readable memory device, such as, a hard drive device, a CD-ROM, a DVD-ROM, or a computer diskette, having computer readable program code segments stored thereon. The computer readable medium can also include a communications or transmission medium, such as, a bus or a communications link, either optical, wired, or wireless having program code segments carried thereon as digital or analog data signals.

The claims should not be read as limited to the described order or elements unless stated to that effect. Therefore, all embodiments that come within the scope and spirit of the following claims and equivalents thereto are claimed as the invention.

CLAIMS

What is claimed:

1. A sonar beamforming system, comprising in combination:

   a first sonar directed in a first direction, the first sonar having transmit and receive transducer arrays and a first beamforming device; and

   at least one sonar directed in a second direction, the at least one sonar having multi-element arrays and a second beamforming device.

2. The system of claim 1, wherein the first sonar is a forward-looking sonar which scans in a direction forward of a vehicle.

3. The system of claim 1, wherein the at least one sonar is a side-looking sonar which scans in a direction that is orthogonal to the first sonar.

4. The system of claim 1, further comprising a third sonar which is a downward-looking sonar for high-resolution terrain mapping and object identification, the third sonar scans in a direction orthogonal to both the first and the at least one sonar.

5. The system of claim 1, wherein at least one of the first sonar and at least one sonar are mounted on a pivotable motorized array.

6. The system of claim 1, wherein at least one of the first sonar and the at least one sonar include multi-mode arrays for at least a detection mode and an identification mode.

7. The system of claim 1, wherein the system further comprises multi-element acoustic communication receive arrays.

8. The system of claim 1, further comprising at least one processor in communication with the first and second beamforming device.

9. The system of claim 1, wherein the first sonar comprises a plurality of bistatic transducer arrays.

10. The system of claim 1, wherein the first and the second beamforming device comprises a plurality of charge coupled device delay lines.

11. The system of claim 1, further comprising a memory circuit connected to the first and the second beamforming device.

12. The system of claim 1, further comprising a Firewire interface connected to an interface controller and the processor.

13. The system of claim 12, wherein the interface controller is in communication with a memory circuit.

14. A water craft, comprising in combination at least one of:

a first sonar directed in a first direction that is forward-looking, the first sonar having a transmit and receive transducer array and a beamforming device; and

a second sonar directed in a second direction that is orthogonal to the first sonar, the second sonar having multi-element arrays and a beamforming device.

15. The water craft of claim 14, further comprising a third sonar scanning in a third direction that is downward-looking for high resolution terrain mapping and object identification, the third sonar having a transmit and receive transducer array and a beamforming device.

16. The water craft of claim 14, wherein at least one of the first sonar and at least one second sonar are mounted on a pivotable motorized array.

17. The water craft of claim 14, wherein at least one of the first sonar and the second sonar include multi-mode arrays for at least a detection mode and an identification mode.

18. The water craft of claim 14, wherein the system further comprises multi-element acoustic communication receive arrays.

19. The water craft of claim 14, further comprising at least one processor in communication with the beamforming device.

20. The water craft of claim 14, wherein the second sonar is a side-looking sonar.

21. The water craft of claim 14, wherein the first sonar comprises a plurality of bistatic transducer arrays.

22. The water craft of claim 14, wherein the beamforming device comprises a plurality of charge coupled device delay lines.

23. The water craft of claim 14, further comprising a memory circuit connected to the beamforming device.

24. The water craft of claim 14, further comprising a Firewire interface connected to an interface controller and the processor.

25. The water craft of claim 24, wherein the interface controller is in communication with a memory circuit.

26. A sonar scanning in a first direction comprising in combination:

a bistatic transducer array having a first transmit transducer array and a second receive transducer array;

a beamforming device; and

a processing unit.

27. The sonar of claim 26, wherein the beamforming device comprises a plurality of charge coupled device delay lines.

28. The sonar of claim 26, wherein the beamforming device comprises a sampling circuit connected to a programmable delay circuit, a weighting circuit and a summing circuit.

29. The sonar of claim 26, further comprising a memory circuit connected to the beamforming device.

30. The sonar of claim 29, further comprising an interface controller connected to the memory circuit.

31. The sonar of claim 30, further comprising a Firewire interface connected to the interface controller and the memory circuit, the Firewire interface communicating with the processing unit.

32. The sonar of claim 26, wherein the sonar scans in one of three orthogonal directions such as in a direction forward of a device.

33. A method for forming an integrated image comprising the steps of:

obtaining array signals from a first sonar directed in a first direction that is forward-looking;

obtaining array signals from at least one second sonar scanning in a second direction orthogonal to the first sonar;

normalizing the array signals from the first sonar and the at least one second sonar to generate normalized data; and

fusing the normalized data to generate an image.

34. An underwater unmanned vehicle system comprising in combination:

a first sonar scanning in a first direction, the first sonar having a transmit and receive transducer array and a beamforming device; and

at least one sonar having a second transducer array and a beamforming device, the at least one sonar scanning in a second direction.

35. The system of claim 34, further comprising a third sonar for high-resolution terrain and object identification, the third sonar scanning in a third direction orthogonal to the first direction and the second direction.

36. The system of claim 34, wherein at least one of the first sonar and the at least one sonar are mounted on a pivotable motorized array.

37. The system of claim 34, wherein at least one of the first sonar and the sonar include multi-mode arrays for at least a detection mode and an identification mode.

38. The system of claim 34, wherein the system further comprises multi-element acoustic communication receive arrays.

39. The system of claim 34, wherein the beamforming device further comprises a plurality of charge domain delay lines.

40. The system of claim 34, wherein the beamforming device comprises a sampling circuit connected to a programmable delay circuit, a weighting circuit, and a summing circuit.

41. The system of claim 34, further comprising a memory circuit connected to the beamforming device.

42. The system of claim 41, further comprising an interface controller connected to the memory circuit.

43. The system of claim 42, further comprising a Firewire interface connected to the interface controller and the memory circuit, the Firewire interface communicating with a central processor.

44. The system of claim 34, wherein the beamforming device comprises a charge domain delay line.

45. The system of claim 44, further comprising a plurality of charge coupled device delay lines, each delay line having a programmable tap selection circuit.

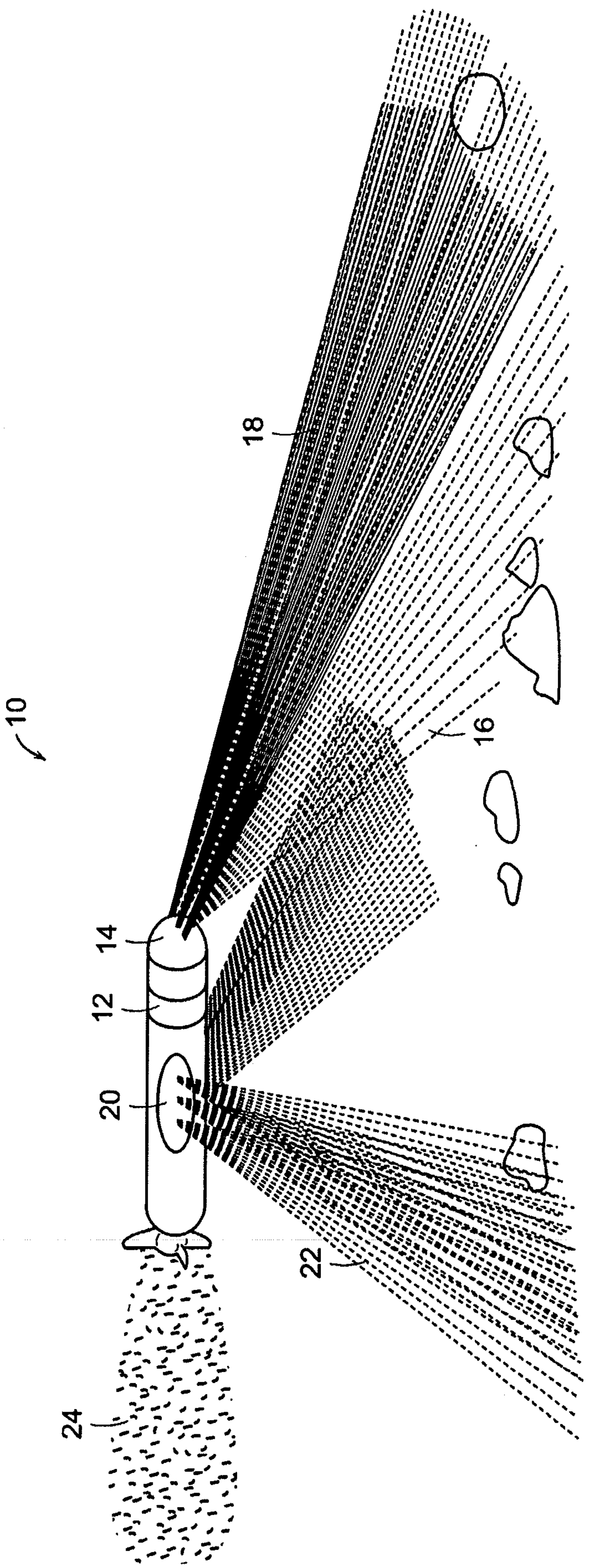


FIG. 1

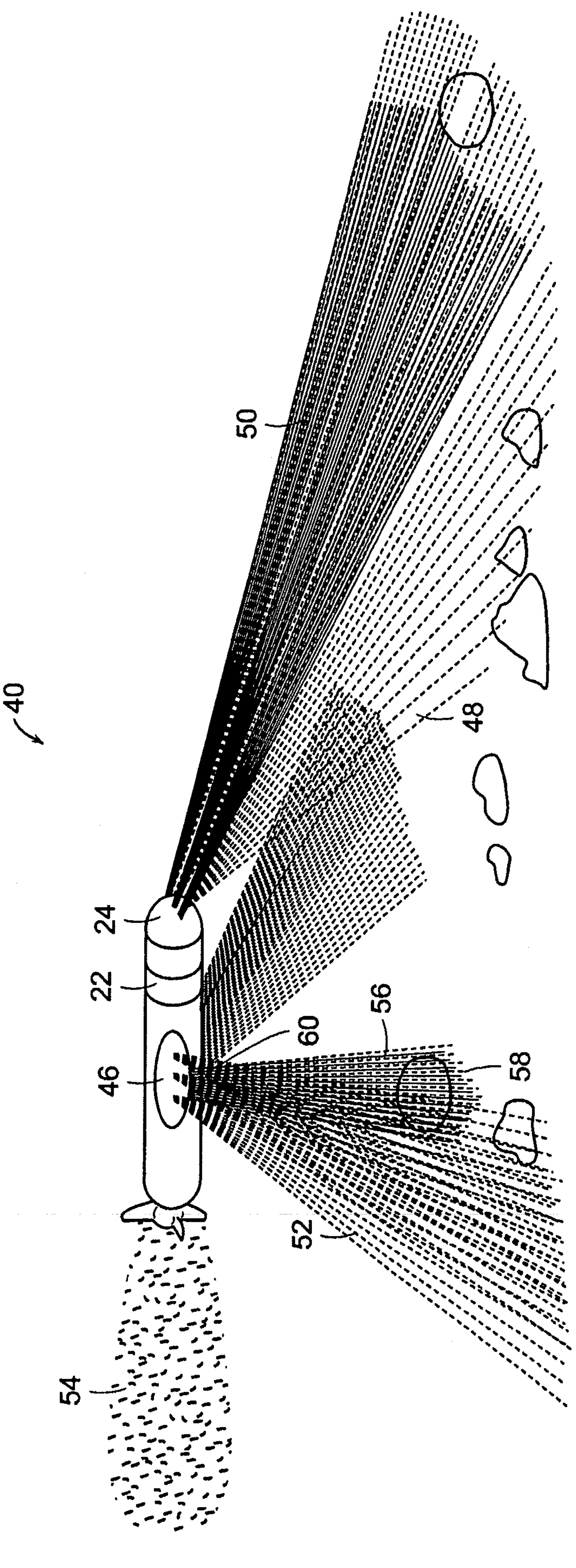


FIG. 2

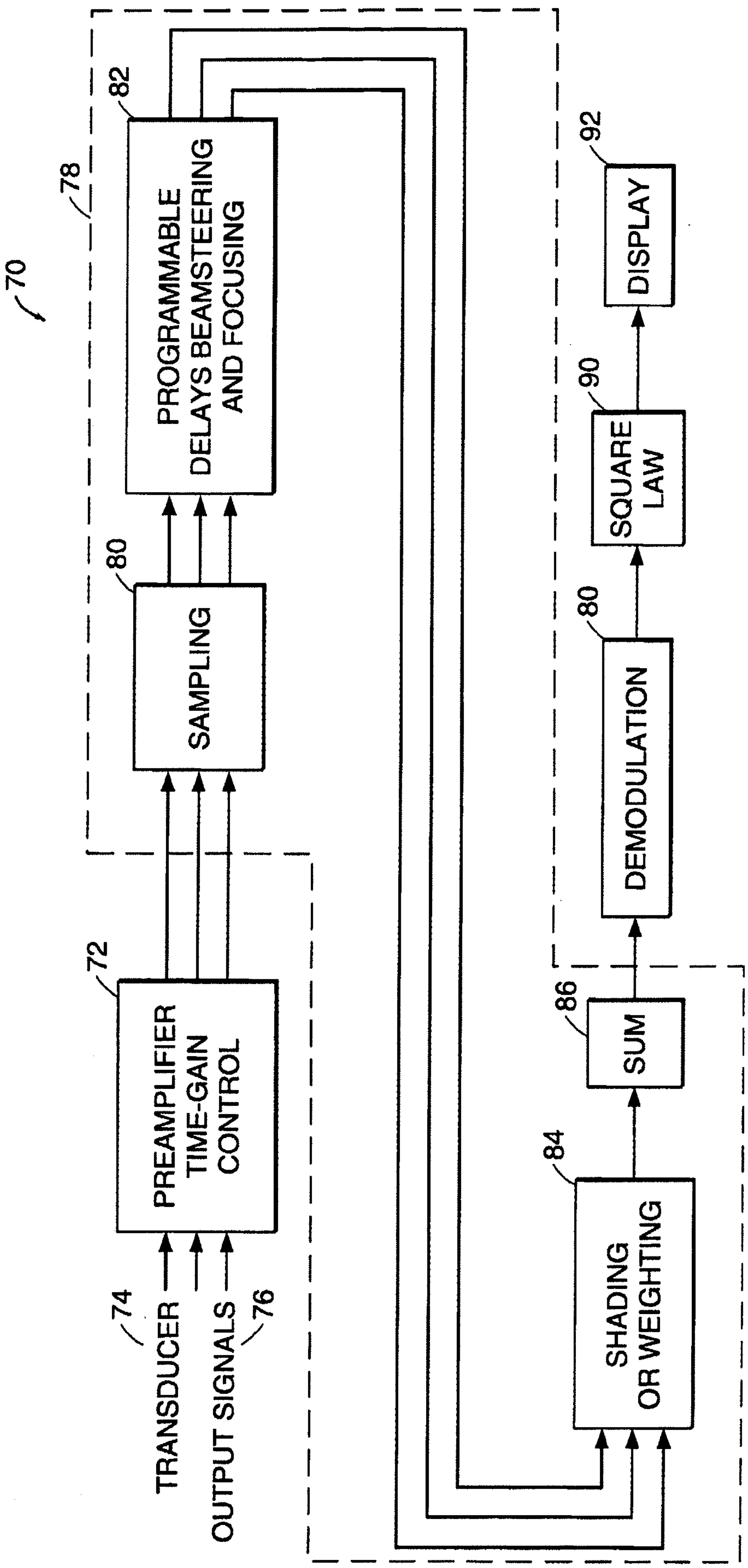

70
78
82
PROGRAMMABLE DELAYS BEAMSTEERING AND FOCUSING
80
SAMPLING
72
PREAMPLIFIER TIME-GAIN CONTROL
TRANSDUCER OUTPUT SIGNALS
74
76
84
SHADING OR WEIGHTING
86
SUM
80
DEMODULATION
90
SQUARE LAW
92
DISPLAY

FIG. 3

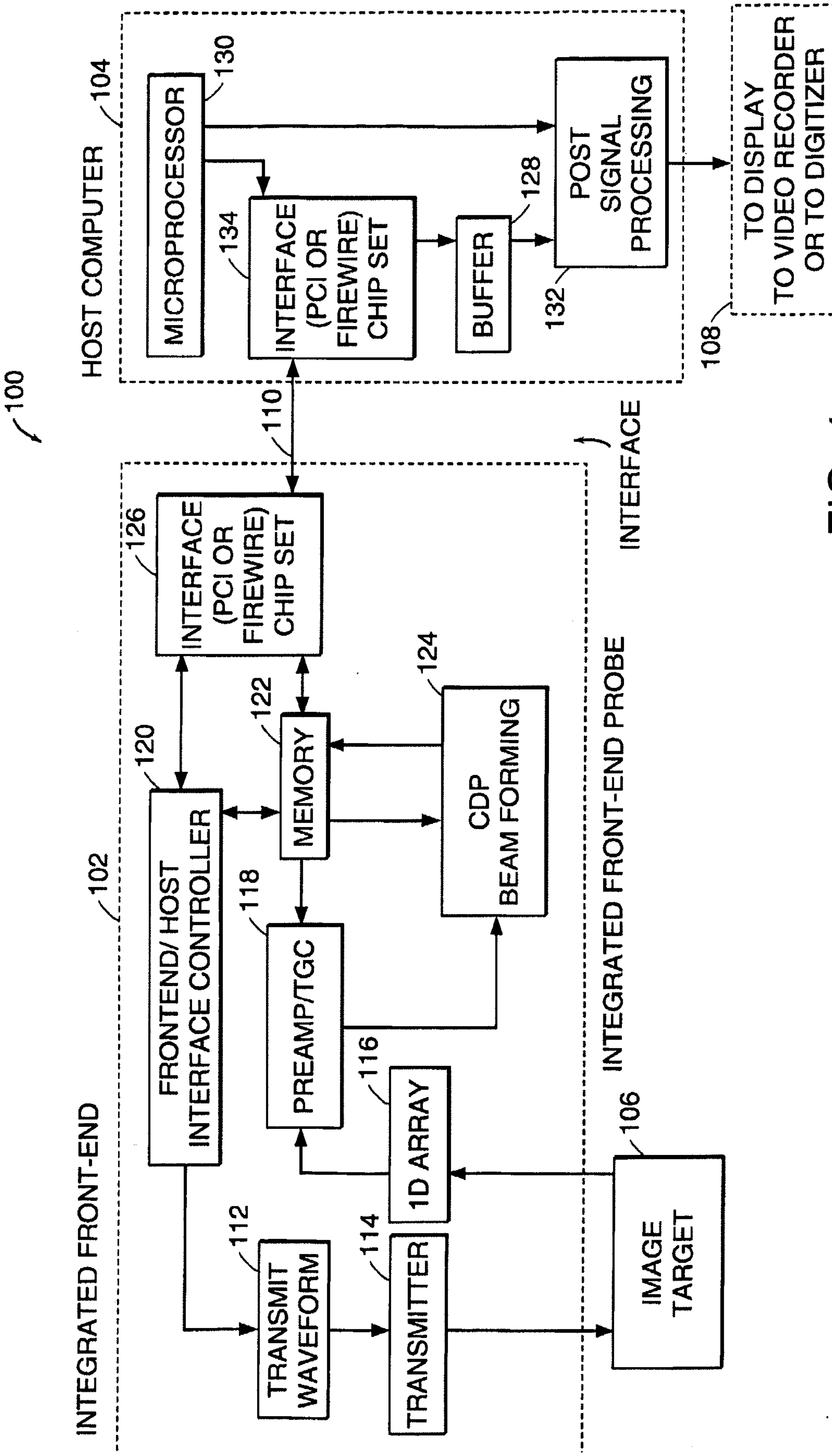

100
HOST COMPUTER
104
MICROPROCESSOR
130
INTERFACE (PCI OR FIREWIRE) CHIP SET
134
BUFFER
128
POST SIGNAL PROCESSING
132
TO DISPLAY TO VIDEO RECORDER OR TO DIGITIZER
108
110
INTERFACE
INTEGRATED FRONT-END
102
INTERFACE (PCI OR FIREWIRE) CHIP SET
126
FRONTEND/ HOST INTERFACE CONTROLLER
120
MEMORY
122
CDP BEAM FORMING
124
PREAMP/TGC
118
1D ARRAY
116
TRANSMIT WAVEFORM
112
TRANSMITTER
114
IMAGE TARGET
106
INTEGRATED FRONT-END PROBE

FIG. 4

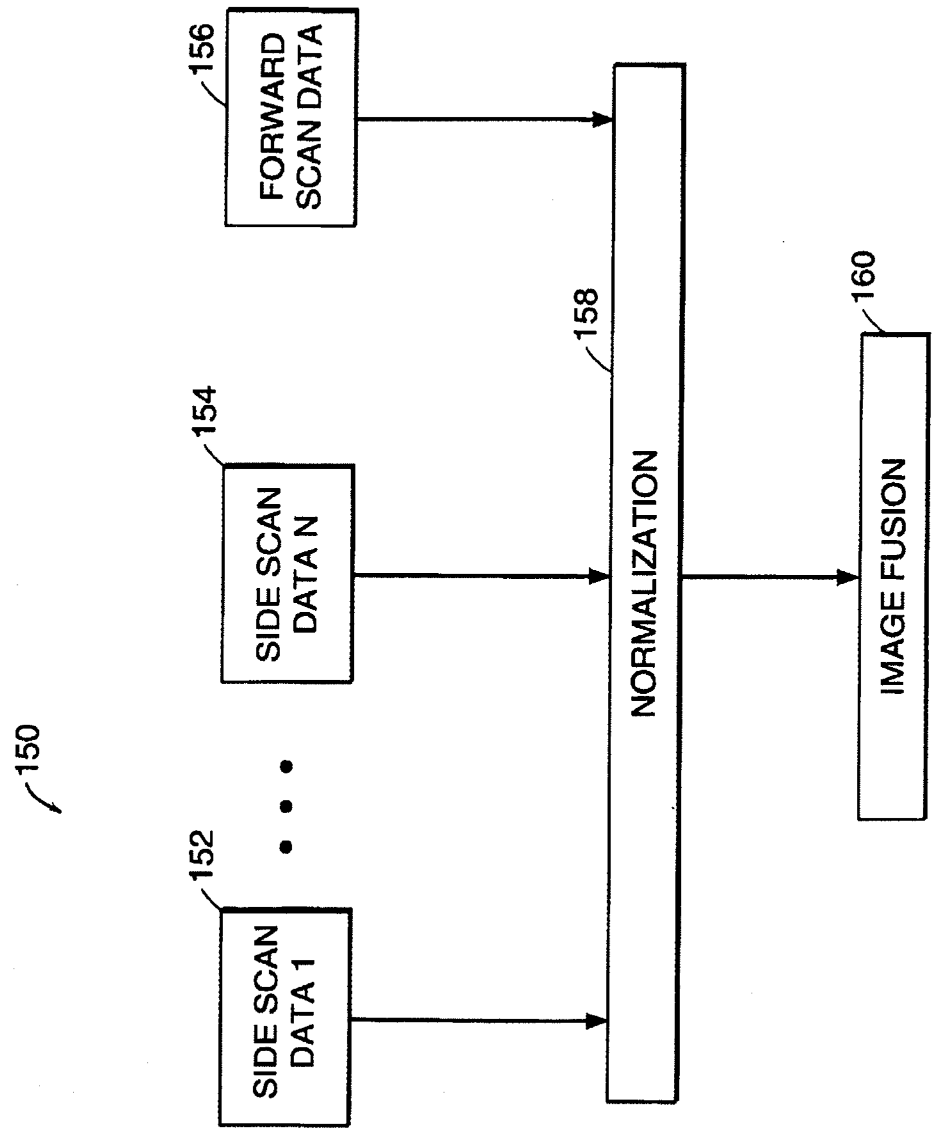

150
152
SIDE SCAN DATA 1
154
SIDE SCAN DATA N
156
FORWARD SCAN DATA
158
NORMALIZATION
160
IMAGE FUSION

FIG. 5

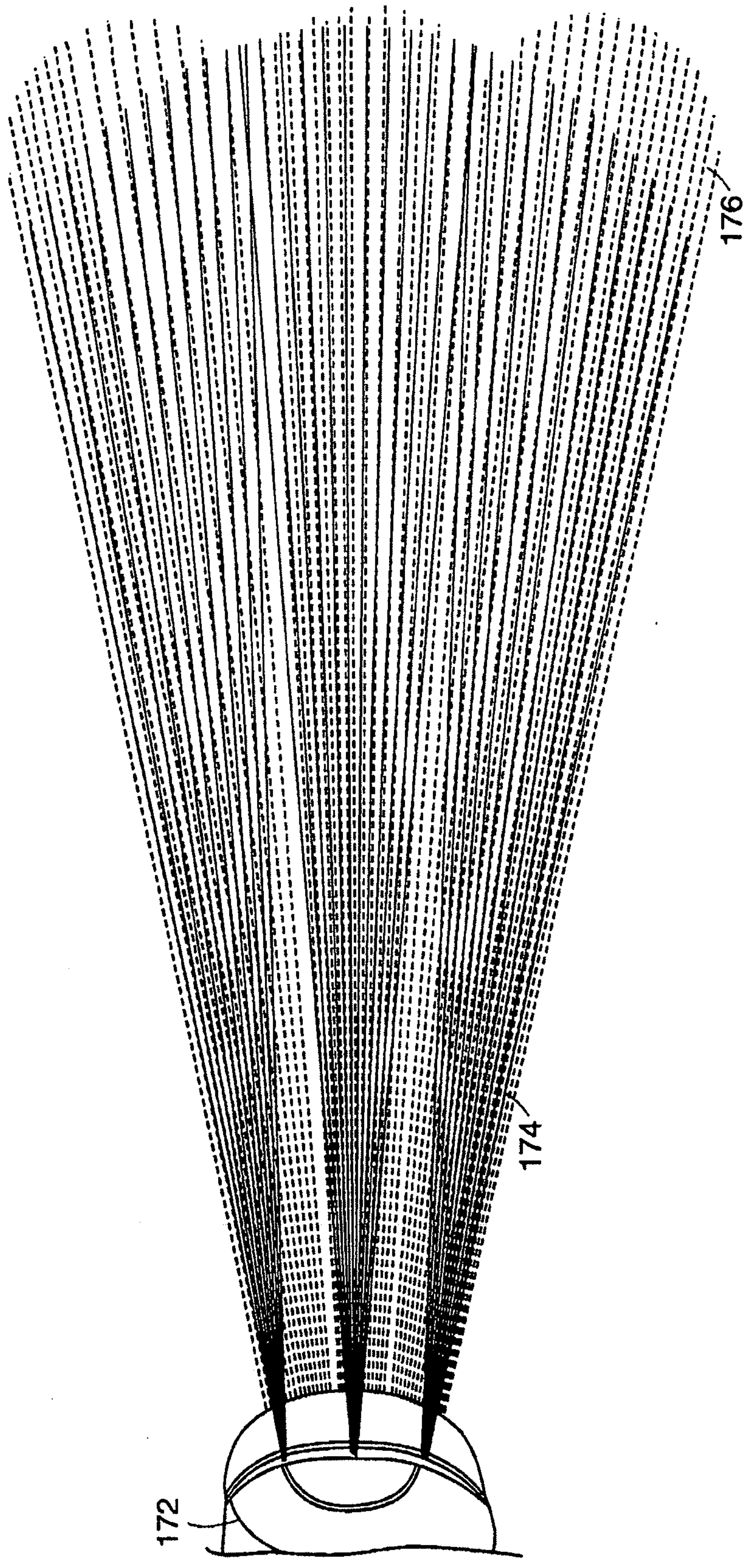


FIG. 6

190

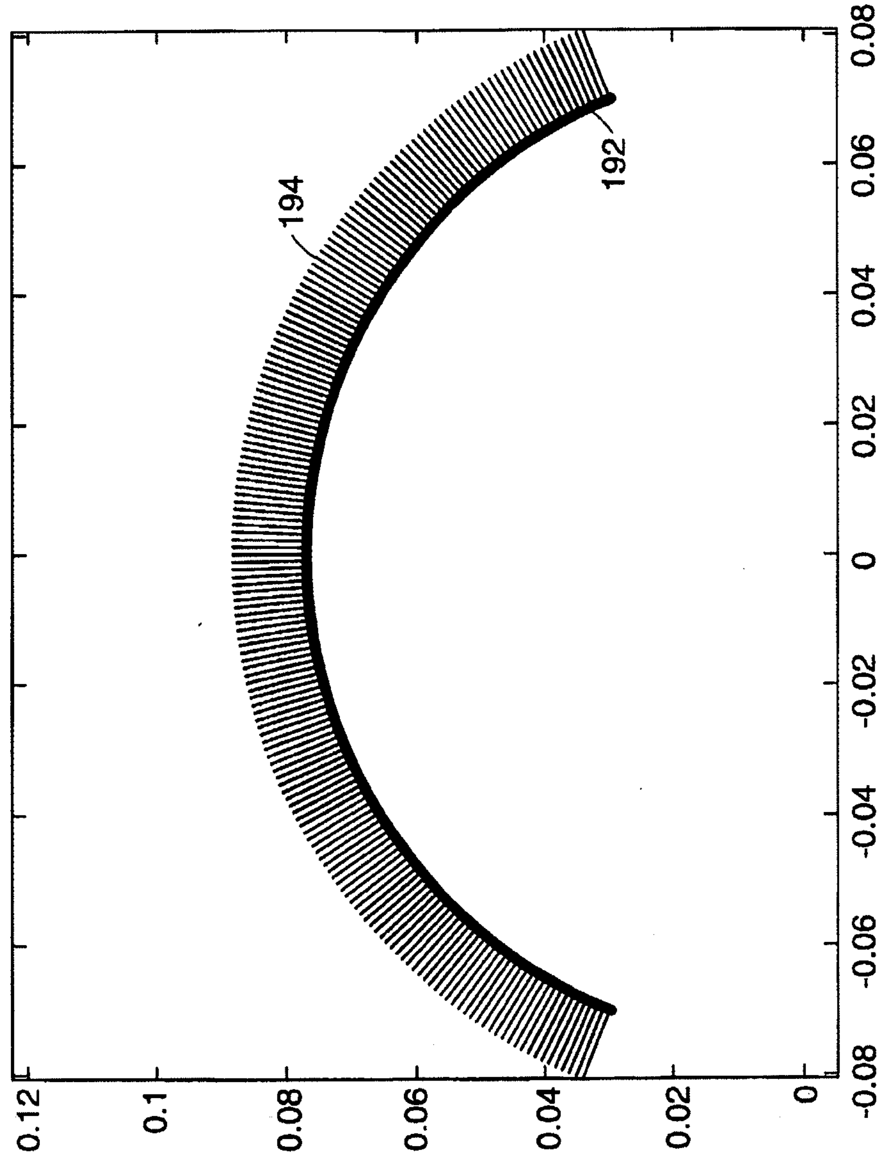


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US05/27436

A. CLASSIFICATION OF SUBJECT MATTER
IPC: **G01S 15/89**(2006.01)
G01S 15/00(2006.01)

USPC: 367/88
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)
U.S. : 367/88, 92, 188

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 practicable, search terms used)
PLUS search, East text search

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,390,152 A (BOUCHER et al) 14 February 1995 (14.02.1995), see Fig. 2	1-24
Y	US 4,216,537 A (DELIGNIERES) 05 August 1980 (05.08.1980), see Figs. 1 and 2	1-24
Y	US 4,879,697 A (LOWRANCE et al) 07 November 1989 (07.11.1989), see Figs. 1-4	1-24
Y	US 4,970,700 A (GILMOUR et al) 13 November 1990 (13.11.1990), see Figs. 9-11	1-24
Y	US 4,075,599 A (KOSALOS et al) 21 February 1978 (21.02.1978), see Figs. 2-4	1-24
Y	US 4,207,620 A (MORGERA) 10 June 1980 (10.06.1980), see entire document	1-24

☐ Further documents are listed in the continuation of Box C. ☐ 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 application or patent 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
07 November 2007 (07.11.2007)	20 NOV 2007
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	Authorized officer Ian J. Lobo Telephone No. (571) 272-6974

Form PCT/ISA/210 (second sheet) (April 2005)

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44*bis*)

Applicant's or agent's file reference J285.13-3	**FOR FURTHER ACTION**	See item 4 below
International application No. PCT/US2005/027436	International filing date *(day/month/year)* 02 August 2005 (02.08.2005)	Priority date *(day/month/year)* 02 August 2004 (02.08.2004)
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237		
Applicant JOHNSON OUTDOORS INC.		

1. This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 *bis*.1(a).

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.

3. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☒	Box No. VIII	Certain observations on the international application

4. The International Bureau will communicate this report to designated Offices in accordance with Rules 44*bis*.3(c) and 93*bis*.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44*bis* .2).

	Date of issuance of this report 06 December 2007 (06.12.2007)
The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 82 70	Authorized officer Nora Lindner e-mail: pt02.pct@wipo.int

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:
DAVID R. FAIRBAIRN
KINNEY & LANGE, P.A.
KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing (*day/month/year*)	20 NOV 2007	
Applicant's or agent's file reference J285.13-3	FOR FURTHER ACTION See paragraph 2 below	
International application No. PCT/US05/27436	International filing date (*day/month/year*) 02 August 2005 (02.08.2005)	Priority date (*day/month/year*) 02 August 2004 (02.08.2004)
International Patent Classification (IPC) or both national classification and IPC IPC: **G01S 15/89**(2006.01) G01S 15/00(2006.01) USPC: 367/88		
Applicant JOHNSON OUTDOORS, INC.		

1. This opinion contains indications relating to the following items:

- [x] Box No. I — Basis of the opinion
- [ ] Box No. II — Priority
- [ ] Box No. III — Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV — Lack of unity of invention
- [x] Box No. V — Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI — Certain documents cited
- [ ] Box No. VII — Certain defects in the international application
- [x] Box No. VIII — Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis(b)* that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/ US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	07 November 2007 (07.11.2007)	Ian J. Lobo Telephone No. (571) 272-6974

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US05/27436

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:
   - ☒ the international application in the language in which it was filed
   - ☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material
   - ☐ a sequence listing
   - ☐ table(s) related to the sequence listing

   b. format of material
   - ☐ on paper
   - ☐ in electronic form

   c. time of filing/furnishing
   - ☐ contained in the international application as filed.
   - ☐ filed together with the international application in electronic form.
   - ☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table(s) relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US05/27436

Box No. V Reasoned statement under Rule 43 *bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 1-24	YES
	Claims NONE	NO
Inventive step (IS)	Claims NONE	YES
	Claims 1-24	NO
Industrial applicability (IA)	Claims 1-24	YES
	Claims NONE	NO

2. Citations and explanations:

Claims 1-24 lack an inventive step under PCT Article 33(3) as being obvious over Boucher et al ('152) in view of any one of Gilmour et al ('700), Kosalos et al, ('599) Delignieres, ('537) or Lowrance et al ('697) and Morgera ('620).

The patent to Boucher et al discloses a transducer assembly that includes a housing (34) having mounting members (30), a forward scan acoustic element (15) and a down scan acoustic element (14) and an electronically controlled head (see Fig. 2).

The difference between claims 1,21 and 25 and Boucher et al is the claims specifies "at least one side scan acoustic element" or "a pair of side scan acoustic elements.", respectively. As aforementioned, Boucher et al discloses a "forward scan acoustic element".

Morgera teaches that it is advantageous to utilize side looking or side scanning sonar imaging to provide greater coverage along the sides of a ship or vessel to thereby minimize the number of passes that the ship must make for complete mapping.

Side scan acoustic elements in sonar imaging systems are well known as evidenced by figures 9-11 of Gilmour et al, figures 2-4 of Kosalos et al, figures 1 and 2 of Deligneres and figures 1-4 of Lowrance et al.

Therefore, in view of Mogera, to modify Boucher et al to include at least one or a pair of side scan acoustic elements, as evidenced by the well-known examples shown in Gilmour et al, Kosalos etal, Deligneres or Lowrance et al, so as to increase the coverage of the mapping at a minimum of passes would not include an inventive step. Claims 1, 21 and 25 are so rejected.

Dependent claims 2-20 and 22-24 are further provided by the above noted combination of prior art.

Claims 1-24 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US05/27436

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the questions whether the claims are fully supported by the description, are made:

Claims 23-24 are objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because claims 23 is indefinite for the following reason(s): There are two claims numbered 23.

Electronic Acknowledgement Receipt

EFS ID:	13387214
Application Number:	12460139
International Application Number:	
Confirmation Number:	9769
Title of Invention:	DOWNSCAN IMAGING SONAR
First Named Inventor/Applicant Name:	Brian T. Maguire
Customer Number:	826
Filer:	Donald Merton Hill/Joyce Smith
Filer Authorized By:	Donald Merton Hill
Attorney Docket Number:	038495/369324
Receipt Date:	31-JUL-2012
Filing Date:	14-JUL-2009
Time Stamp:	18:27:53
Application Type:	Utility under 35 USC 111(a)

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		IDS369324.PDF	397553 6fd7ce8b8847cf35f701251a0690f206e1981cc2	yes	6

Multipart Description/PDF files in .zip description

Document Description	Start	End
Transmittal Letter	1	2
Information Disclosure Statement (IDS) Form (SB08)	3	6

Warnings:

Information:

2		1ART038495.PDF	5960985 80ac7d8307fec0d48866bdb94879e87a46fdfffa	yes	104

Multipart Description/PDF files in .zip description

Document Description	Start	End
Foreign Reference	1	13
Foreign Reference	14	40
Foreign Reference	41	70
Non Patent Literature	71	71
Non Patent Literature	72	76
Non Patent Literature	77	80
Non Patent Literature	81	92
Non Patent Literature	93	101
Non Patent Literature	102	104

Warnings:

Information:

3	Non Patent Literature	Blondel.pdf	18656393 733513546a19969469ebb6312d9a894f16ddbbb7	no	108

Warnings:

Information:

4	Non Patent Literature	2Blondel.pdf	18282209 9958a79b8c2865459c1030b0c31c9fcf5db6b4b3	no	70

Warnings:

Information:

5	Non Patent Literature	3Blondel.pdf	15861586 a0e0234312b3e55ec81218c1c9154b88c3a a95df	no	53
Warnings:					
Information:					
6	Non Patent Literature	4Blondel.pdf	23584038 cc3fde31dd596fc7f3c111e2ad162c86d111 9bfc	no	117
Warnings:					
Information:					
7	Non Patent Literature	Calcutt.pdf	25376754 a3984aa6b3218ac08e31c1b2886838aa244 e4320	no	122
Warnings:					
Information:					
		Total Files Size (in bytes):	108119518		

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

Attorney Docket No. 038495/369324

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re:	Maguire	Confirmation No.:	9769
Appl. No.:	12/460,139	Group Art Unit:	3645
Filed:	July 14, 2009	Examiner:	J. R. Hulka
For:	DOWNSCAN IMAGING SONAR		

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT UNDER 37 C.F.R. § 1.97(d)

This Information Disclosure Statement is being filed after a Notice of Allowance under 37 C.F.R. § 1.311, but before payment of the Issue Fee. The Notice of Allowance was mailed on July 23, 2012.

Attached is a list of documents on form PTO-1449 along with any cited foreign patent documents and non-patent literature documents in accordance with 37 CFR 1.98(a)(2). Also enclosed is a translation or a concise explanation of each non-English language document.

By identifying the listed documents, Applicant in no way makes any admission as to the prior art status of the listed documents, but is instead identifying the listed documents for the sake of full disclosure.

In accordance with the requirements of 37 C.F.R. § 1.97(d)(2), the following statement as specified in 37 C.F.R. § 1.97(e) is made:

No item of information contained in this statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge the person signing this document after making reasonable inquiry, no item of information contained in this statement was known to any individual designated in 37 C.F.R. § 1.56(c) more than three (3) months prior to the filing of this statement.

The $180.00 fee specified in 37 C.F.R. § 1.17(p) is being paid at the time of e-filing. The Commissioner is authorized to charge any additional fee, or credit any refund, to our Deposit Account No. 16-0605.

Respectfully submitted,

Patrick L. Kartes
Registration No. 64,678

CUSTOMER NO. 00826
ALSTON & BIRD LLP
Bank of America Plaza
101 South Tryon Street, Suite 4000
Charlotte, NC 28280-4000
Tel Charlotte Office (704) 444-1000
Fax Charlotte Office (704) 444-1111

ELECTRONICALLY FILED USING THE EFS-WEB ELECTRONIC FILING SYSTEM OF THE UNITED STATES PATENT & TRADEMARK OFFICE ON July 31, 2012.
#33544993v1

Electronic Patent Application Fee Transmittal

Application Number:	12460139
Filing Date:	14-Jul-2009
Title of Invention:	DOWNSCAN IMAGING SONAR
First Named Inventor/Applicant Name:	Brian T. Maguire
Filer:	Donald Merton Hill/Joyce Smith
Attorney Docket Number:	038495/369324

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
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($)
Miscellaneous:				
Submission- Information Disclosure Stmt	1806	1	180	180
		Total in USD ($)		**180**

Electronic Acknowledgement Receipt

EFS ID:	13387261
Application Number:	12460139
International Application Number:	
Confirmation Number:	9769
Title of Invention:	DOWNSCAN IMAGING SONAR
First Named Inventor/Applicant Name:	Brian T. Maguire
Customer Number:	826
Filer:	Donald Merton Hill/Joyce Smith
Filer Authorized By:	Donald Merton Hill
Attorney Docket Number:	038495/369324
Receipt Date:	31-JUL-2012
Filing Date:	14-JUL-2009
Time Stamp:	18:32:14
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$180
RAM confirmation Number	7685
Deposit Account	160605
Authorized User	

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		2ART038495.PDF	11009849 8addd69b23bfd02d74415541f42759591a39642e	yes	128

Multipart Description/PDF files in .zip description

Document Description	Start	End
Non Patent Literature	1	34
Non Patent Literature	35	37
Non Patent Literature	38	61
Non Patent Literature	62	65
Non Patent Literature	66	67
Non Patent Literature	68	76
Non Patent Literature	77	92
Non Patent Literature	93	102
Non Patent Literature	103	106
Non Patent Literature	107	114
Non Patent Literature	115	128

Warnings:

Information:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
2	Non Patent Literature	KvitekFinalReport.pdf	18957903 807b8311ac8a6a30438506f1a8e679f20e87c988	no	92

Warnings:

Information:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
3		3ART038495.PDF	12355023 6368d061120a47f3a6cf5942b56acd258dc2702e	yes	77

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Non Patent Literature	1	5
	Non Patent Literature	6	11
	Non Patent Literature	12	29
	Non Patent Literature	30	31
	Non Patent Literature	32	35
	Non Patent Literature	36	37
	Non Patent Literature	38	59
	Non Patent Literature	60	61
	Non Patent Literature	62	71
	Non Patent Literature	72	73
	Non Patent Literature	74	77

Warnings:

Information:

4	Fee Worksheet (SB06)	fee-info.pdf	30357 86ba84e4374ef9196740d1f5a8c474d32c4a2b43	no	2

Warnings:

Information:

Total Files Size (in bytes):	42353132

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.

Electronic Acknowledgement Receipt

EFS ID:	13387312
Application Number:	12460139
International Application Number:	
Confirmation Number:	9769
Title of Invention:	DOWNSCAN IMAGING SONAR
First Named Inventor/Applicant Name:	Brian T. Maguire
Customer Number:	826
Filer:	Donald Merton Hill/Joyce Smith
Filer Authorized By:	Donald Merton Hill
Attorney Docket Number:	038495/369324
Receipt Date:	31-JUL-2012
Filing Date:	14-JUL-2009
Time Stamp:	18:36:41
Application Type:	Utility under 35 USC 111(a)

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	Non Patent Literature	Raymarine.pdf	1146169 0546da9adb63f5e63bc426887431d08f438731c1	no	93

Warnings:

Information:

2		4ART038495.PDF	20962400 9f5373348e0b0c9d9f3debaefd9e583634d7de3d	yes	78

Multipart Description/PDF files in .zip description

Document Description	Start	End
Non Patent Literature	1	2
Non Patent Literature	3	6
Non Patent Literature	7	8
Non Patent Literature	9	9
Non Patent Literature	10	11
Non Patent Literature	12	12
Non Patent Literature	13	16
Non Patent Literature	17	26
Non Patent Literature	27	50
Non Patent Literature	51	70
Non Patent Literature	71	72
Non Patent Literature	73	74
Non Patent Literature	75	78

Warnings:

Information:

3	Non Patent Literature	RussellCargill.pdf	24890715 69f2390c36b7af4a628c471ce5e930ca046978e1	no	142

Warnings:

Information:

4	Non Patent Literature	Trabant.pdf	16815143 5c325a4e6e7c001c70388b75aab110e6bcbc07f3	no	92

Warnings:

Information:

5	Non Patent Literature	2Trabant.pdf	21721740 63eb08393edfcdcac44690b476246f150324550a	no	98
Warnings:					
Information:					
6	Non Patent Literature	3Trabant.pdf	13988256 ec75852d378ef49dd7cc3edfa3a401146950efdd	no	86
Warnings:					
Information:					
			Total Files Size (in bytes):	99524423	

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
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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

NOTICE OF ALLOWANCE AND FEE(S) DUE

826 7590 07/23/2012

ALSTON & BIRD LLP
BANK OF AMERICA PLAZA
101 SOUTH TRYON STREET, SUITE 4000
CHARLOTTE, NC 28280-4000

EXAMINER	
HULKA, JAMES R	
ART UNIT	PAPER NUMBER
3645	

DATE MAILED: 07/23/2012

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/460,139	07/14/2009	Brian T. Maguire	038495/369324	9769

TITLE OF INVENTION: DOWNSCAN IMAGING SONAR

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1740	$300	$0	$2040	10/23/2012

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: **Mail** **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

826 7590 07/23/2012

ALSTON & BIRD LLP
BANK OF AMERICA PLAZA
101 SOUTH TRYON STREET, SUITE 4000
CHARLOTTE, NC 28280-4000

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/460,139	07/14/2009	Brian T. Maguire	038495/369324	9769

TITLE OF INVENTION: DOWNSCAN IMAGING SONAR

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1740	$300	$0	$2040	10/23/2012

EXAMINER	ART UNIT	CLASS-SUBCLASS
HULKA, JAMES R	3645	367-088000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
   - ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
   - ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
   (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
   (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
   1____________________
   2____________________
   3____________________

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies ____________

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number ________ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
- ❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature ____________________ Date ____________________

Typed or printed name ____________________ Registration No. ____________________

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.
12/460,139	07/14/2009	Brian T. Maguire	038495/369324	9769

826 7590 07/23/2012

ALSTON & BIRD LLP
BANK OF AMERICA PLAZA
101 SOUTH TRYON STREET, SUITE 4000
CHARLOTTE, NC 28280-4000

EXAMINER	
HULKA, JAMES R	
ART UNIT	PAPER NUMBER
3645	

DATE MAILED: 07/23/2012

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)

(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 299 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 299 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Privacy Act Statement

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.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
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.

Notice of Allowability	Application No. 12/460,139	Applicant(s) MAGUIRE, BRIAN T.	
	Examiner JAMES HULKA	Art Unit 3645	

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

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 22 June 2012.
2. ☐ 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.
3. ☒ The allowed claim(s) is/are *57-84,86,88-125,127-131 and 134*.
4. ☐ 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 the:
   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)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
   1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 20120622
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

/J. H./ Examiner, Art Unit 3645	/ISAM ALSOMIRI/ Supervisory Patent Examiner, Art Unit 3645

Issue Classification

Application/Control No.	Applicant(s)/Patent Under Reexamination
12460139	MAGUIRE, BRIAN T.
Examiner	**Art Unit**
JAMES HULKA	3645

ORIGINAL		INTERNATIONAL CLASSIFICATION					
CLASS	SUBCLASS	CLAIMED					NON-CLAIMED
367	88	G	0	1	S	15 / 00 (2006.0)	

CROSS REFERENCE(S)

CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	57	17	73	34	89	47	105	61	121		137				
2	58	18	74	35	90	48	106	62	122						
3	59	19	75	36	91	49	107	63	123						
4	60	23	76	37	92	50	108	66	124						
5	61	24	77	38	93	51	109	67	125						
6	62	25	78	39	94	52	110		126						
7	63	26	79	42	95	64	111	68	127						
8	64	27	80	40	96	65	112	69	128						
9	65	28	81	41	97	53	113	70	129						
10	66	29	82	43	98	54	114	71	130						
11	67	30	83	44	99	55	115	72	131						
12	68	31	84	20	100	56	116		132						
13	69		85	45	101	57	117		133						
14	70	32	86	21	102	58	118	73	134						
15	71		87	22	103	59	119		135						
16	72	33	88	46	104	60	120		136						

/J.H./ Examiner.Art Unit 3645 (Assistant Examiner)	06/25/2012 (Date)	**Total Claims Allowed:** 73
/ISAM ALSOMIRI/ Supervisory Patent Examiner.Art Unit 3645 (Primary Examiner)	07/14/2012 (Date)	O.G. Print Claim(s): 76 / O.G. Print Figure: 5

Substitute for form 1449/PTO
(Revised 07/2007)

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet	1	of	1

Complete if Known	
Application Number	12/460,139
Filing Date	July 14, 2009
First Named Inventor	Brian T. Maguire
Art Unit	3645
Examiner Name	HULKA, James R.
Attorney Docket Number	038495/369324

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.	Document Number Number - Kind Code (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages of Relevant Figures Appear
	278	US-4,935,906	06-19-1990	Baker, et al.	
	279	US 2001/0026499 A1	10-04-2001	Inouchi	
	280	US 2012/0106300 A1	05-03-2012	Maguire	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.	Foreign Patent Document Country Code - Number Kind Code (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	English Language Translation Attached
	281	JP 50-109389 (U)	09-06-1975			
	282	JP 54-054365 (U)	04-14-1979	Furuno Denki, Co. Ltd.		YES
	283	JP 62-099877 (U)	06-25-1987			YES
	284	JP 62-190480 (A)	08-20-1987	Japan Tech Rex & Dev Inst, et al.		Abstract
	285	JP 62-134084 (U)	08-24-1987			
	286	JP 63-261181 (A)	10-27-1988	NEC Corp		Abstract
	287	JP 7-031042 (A)	01-31-1995	Fujikura Ltd		YES
	288	JP 10-186030 (A)	07-14-1998	Koden Electronics Co Ltd		Abstract
	289	JP 2001-074840 (A)	03-23-2001	Achilles Corp		Abstract
	290	JP 2004-020276 (A)	01-22-2004	Honda Electronic		Abstract

OTHER 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, page(s) , volume-issue number(s), publisher, city and/or country where published.	English Language Translation Attached
	291	MARINE ACOUSTICS SOCIETY OF JAPAN (Editor); "Basics and Application of Marine Acoustics"; April 28, 2004; pp. 152-172	

Examiner Signature	/James Hulka/	Date Considered	06/25/2012

*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.H./

SUBMITTED: JUNE 22, 2012

Index of Claims

Application/Control No.	Applicant(s)/Patent Under Reexamination
12460139	MAGUIRE, BRIAN T.
Examiner	**Art Unit**
JAMES HULKA	3645

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/26/2011	09/13/2011	12/08/2011	03/07/2012					
	1	÷	N	-	-					
	2	÷	N	-	-					
	3	÷	N	-	-					
	4	÷	N	-	-					
	5	÷	N	-	-					
	6	÷	N	-	-					
	7	÷	N	-	-					
	8	÷	N	-	-					
	9	÷	N	-	-					
	10	÷	N	-	-					
	11	÷	N	-	-					
	12	÷	N	-	-					
	13	÷	N	-	-					
	14	÷	N	-	-					
	15	÷	N	-	-					
	16	÷	N	-	-					
	17	÷	N	-	-					
	18	÷	N	-	-					
	19	÷	N	-	-					
	20	÷	N	-	-					
	21	÷	N	-	-					
	22	÷	N	-	-					
	23	÷	N	-	-					
	24	÷	N	-	-					
	25	÷	N	-	-					
	26	÷	N	-	-					
	27	÷	N	-	-					
	28	÷	N	-	-					
	29	÷	N	-	-					
	30	÷	N	-	-					
	31	÷	N	-	-					
	32	÷	N	-	-					
	33	÷	N	-	-					
	34	÷	N	-	-					
	35	÷	N	-	-					
	36	÷	N	-	-					

Index of Claims	Application/Control No. 12460139	Applicant(s)/Patent Under Reexamination MAGUIRE, BRIAN T.
	Examiner JAMES HULKA	Art Unit 3645

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/26/2011	09/13/2011	12/08/2011	03/07/2012					
	37	÷	N	-	-					
	38	÷	N	-	-					
	39	÷	N	-	-					
	40	÷	N	-	-					
	41	÷	N	-	-					
	42	÷	N	-	-					
	43	÷	N	-	-					
	44	÷	N	-	-					
	45	÷	N	-	-					
	46	÷	N	-	-					
	47	÷	N	-	-					
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	49	÷	N	-	-					
	50	÷	N	-	-					
	51	÷	N	-	-					
	52	÷	N	-	-					
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	54	÷	N	-	-					
	55	÷	N	-	-					
	56	÷	N	-	-					
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3	59	÷	✓	✓	=					
4	60	÷	✓	✓	=					
5	61	÷	✓	✓	=					
6	62	÷	✓	✓	=					
7	63	÷	✓	✓	=					
8	64	÷	✓	✓	=					
9	65	÷	✓	✓	=					
10	66	÷	✓	✓	=					
11	67	÷	✓	✓	=					
12	68	÷	✓	✓	=					
13	69	÷	✓	✓	=					
14	70	÷	✓	✓	=					
15	71	÷	✓	✓	=					
16	72	÷	✓	✓	=					

Index of Claims	Application/Control No. 12460139	Applicant(s)/Patent Under Reexamination MAGUIRE, BRIAN T.
	Examiner JAMES HULKA	Art Unit 3645

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/26/2011	09/13/2011	12/08/2011	03/07/2012					
17	73	÷	✓	✓	=					
18	74	÷	✓	✓	=					
19	75	÷	✓	✓	=					
23	76	÷	✓	✓	=					
24	77	÷	✓	✓	=					
25	78	÷	✓	✓	=					
26	79	÷	✓	✓	=					
27	80	÷	✓	✓	=					
28	81	÷	✓	✓	=					
29	82	÷	✓	✓	=					
30	83	÷	✓	✓	=					
31	84	÷	✓	✓	=					
	85	÷	✓	-	-					
32	86	÷	✓	✓	=					
	87	÷	✓	-	-					
33	88	÷	✓	✓	=					
34	89	÷	✓	✓	=					
35	90	÷	✓	✓	=					
36	91	÷	✓	✓	=					
37	92	÷	✓	✓	=					
38	93	÷	✓	✓	=					
39	94	÷	✓	✓	=					
42	95	÷	✓	✓	=					
40	96	÷	✓	✓	=					
41	97	÷	✓	✓	=					
43	98	÷	✓	✓	=					
44	99	÷	✓	✓	=					
20	100			✓	=					
45	101			✓	=					
21	102			✓	=					
22	103			✓	=					
46	104			✓	=					
47	105			✓	=					
48	106			✓	=					
49	107			✓	=					
50	108			✓	=					

Index of Claims	Application/Control No. 12460139	Applicant(s)/Patent Under Reexamination MAGUIRE, BRIAN T.
	Examiner JAMES HULKA	Art Unit 3645

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/26/2011	09/13/2011	12/08/2011	03/07/2012					
51	109			✓	=					
52	110			✓	=					
64	111			✓	=					
65	112			✓	=					
53	113			✓	=					
54	114			✓	=					
55	115			✓	=					
56	116			✓	=					
57	117			✓	=					
58	118			✓	=					
59	119			✓	=					
60	120			✓	=					
61	121			✓	=					
62	122			✓	=					
63	123			✓	=					
66	124			✓	=					
67	125			✓	=					
	126			-	-					
68	127			✓	=					
69	128			✓	=					
70	129			✓	=					
71	130			✓	=					
72	131			✓	=					
	132			-	-					
	133			-	-					
73	134			✓	=					
	135			-	-					
	136			-	-					
	137			-	-					

Search Notes	Application/Control No. 12460139	Applicant(s)/Patent Under Reexamination MAGUIRE, BRIAN T.
	Examiner JAMES HULKA	Art Unit 3645

SEARCHED

Class	Subclass	Date	Examiner
367	88	9/13/2011	JH

SEARCH NOTES

Search Notes	Date	Examiner
EAST (Keyword and Class Limited)	6/25/2012	JH
PALM (Inventor Name)	9/13/2011	JH
Google (Keyword)	9/13/2011	JH
Consulted Primary Examiner (D. Pihulic)	4/2/2012	JH

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner
367	Searched Claim Language	3/7/2012	JH

/J.H./
Examiner.Art Unit 3645

REQUEST For CONTINUED EXAMINATION (RCE) TRANSMITTAL Address to: **MAIL STOP RCE COMMISSIONER FOR PATENTS P.O. BOX 1450 ALEXANDRIA, VA 22313-1450** (Revised 04/2005)	Application Number: 12/460,139 Filing Date July 14, 2009 First Named Inventor: Brian T. Maguire Art Unit: 3645 Examiner Name: HULKA, James R. Confirmation No.: 9769 Attorney Docket No. 038495/369324

This is a request for Continued Examination (RCE) under 37 C.F.R. § 1.114 of the above-identified application. Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application.

1. Submission required under 37 C.F.R. § 1.114 Note: if the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

a. ☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

i. ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on

ii. ☐ Other

b. ☒ **Enclosed**

i. ☐ Amendment/Reply

ii. ☐ Affidavits(s)/Declarations(s)

iii. ☒ Information Disclosure Statement (IDS); fourteen (14) cites listed on PTO Form 1449

iv. ☐ Other

2. Miscellaneous

a. ☐ Suspension of action on the above-identified application is requested under 37 C.F.R. §1.103(c) for a period of __ months. (Period of suspension shall not exceed 3 months; Fee under 37 C.F.R. § 1.17(g) required)

b. ☐ Other

3. **Fees** The RCE fee under 37 C.F.R. § 1.17(e) is **required** by 37 C.F.R. § 1.114 when the RCE is filed.
   a. The Director is hereby authorized to charge any fee deficiencies, or credit any overpayments to Deposit Account No. 16-0605.
      i. ☒ **RCE fee required under 37 C.F.R. § 1.17(e)** **($930.00 large entity**; $465.00 small entity)
      ii. ☐ Extension of Time Fee (37 C.F. R. §§ 1.136 and 1.17)
      iii. ☐ Other
   b. ☐ Check in the amount of $___enclosed

Respectfully submitted,

Patrick L. Kartes
Registration No. 64,678

Customer No. 00826
ALSTON & BIRD LLP
Bank of America Plaza
101 South Tryon Street, Suite 4000
Charlotte, NC 28280-4000
Tel Charlotte Office (704) 444-1000
Fax Charlotte Office (704) 444-1111

ELECTRONICALLY FILED USING THE EFS-WEB ELECTRONIC FILING SYSTEM OF THE UNITED STATES PATENT & TRADEMARK OFFICE ON JUNE 22, 2012.

Attorney's Docket No. 038495/369324 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re:	Brian T. Maguire	Confirmation No.:	9769
Appl. No.:	12/460,139	Art Unit:	3645
Filed:	July 14, 2009	Examiner:	HULKA, James R.
For:	DOWNSCAN IMAGING SONAR		

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT
CITATION UNDER 37 C.F.R. § 1.97

Attached is a list of documents on form PTO-1449 along with a copy of any cited foreign patent documents and non-patent literature documents in accordance with 37 CFR 1.98(a)(2).

It is requested that the Examiner consider these documents and officially make them of record in accordance with the provisions of 37 C.F.R. § 1.97 and Section 609 of the MPEP. By identifying the listed documents, Applicant in no way makes any admission as to the prior art status of the listed documents, but is instead identifying the listed documents for the sake of full disclosure.

Respectfully submitted,

Patrick L. Kartes
Registration No. 64,678

Customer No. 00826
ALSTON & BIRD LLP
Bank of America Plaza
101 South Tryon Street, Suite 4000
Charlotte, NC 28280-4000
Tel Charlotte Office (704) 444-1000
Fax Charlotte Office (704) 444-1111

ELECTRONICALLY FILED USING THE EFS-WEB ELECTRONIC FILING SYSTEM OF THE UNITED STATES PATENT & TRADEMARK OFFICE ON JUNE 22, 2012.

Substitute for form 1449/PTO (Revised 07/2007)	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(Use as many sheets as necessary)*	Application Number	12/460,139
	Filing Date	July 14, 2009
	First Named Inventor	Brian T. Maguire
	Art Unit	3645
	Examiner Name	HULKA, James R.
Sheet 1 of 1	Attorney Docket Number	038495/369324

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.	Document Number Number - Kind Code (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages of Relevant Figures Appear
	278	US-4,935,906	06-19-1990	Baker, et al.	
	279	US 2001/0026499 A1	10-04-2001	Inouchi	
	280	US 2012/0106300 A1	05-03-2012	Maguire	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.	Foreign Patent Document Country Code - Number Kind Code (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	English Language Translation Attached
	281	JP 50-109389 (U)	09-06-1975			
	282	JP 54-054365 (U)	04-14-1979	Furuno Denki, Co. Ltd.		YES
	283	JP 62-099877 (U)	06-25-1987			YES
	284	JP 62-190480 (A)	08-20-1987	Japan Tech Rex & Dev Inst, et al.		Abstract
	285	JP 62-134084 (U)	08-24-1987			
	286	JP 63-261181 (A)	10-27-1988	NEC Corp		Abstract
	287	JP 7-031042 (A)	01-31-1995	Fujikura Ltd		YES
	288	JP 10-186030 (A)	07-14-1998	Koden Electronics Co Ltd		Abstract
	289	JP 2001-074840 (A)	03-23-2001	Achilles Corp		Abstract
	290	JP 2004-020276 (A)	01-22-2004	Honda Electronic		Abstract

OTHER 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, page(s), volume-issue number(s), publisher, city and/or country where published.	English Language Translation Attached
	291	MARINE ACOUSTICS SOCIETY OF JAPAN (Editor); "Basics and Application of Marine Acoustics"; April 28, 2004; pp. 152-172	

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.

SUBMITTED: JUNE 22, 2012

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Bibliographic data: JP50109389 (U) — 1975-09-06

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Inventor(s):		
Applicant(s):		
Classification:	**- international:**	***E04H6/18; E04H6/28;*** (IPC1-7): E04H6/28
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Application number:	JP19740018291U 19740215	
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特許願(C)

(2000円)

昭和49.2.12日

特許庁長官 殿

1. 発明の名称 水中用超音波送受波装置（スイチユウヨウチヨウオンパソウジユハソウチ）

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⑲ 日本国特許庁

公開特許公報

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54 B H11

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54 B K0

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G05D 3/04

G01S 9/66

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明細書

1.発明の名称

水中用超音波送受波装置

2.特許請求の範囲

水中用超音波送受波器と、本水中用超音波送受波器の俯角を設定する修正俯角信号を発生する手段と、海水を取り入れて前記修正俯角信号に応じた流量の海水を噴出する電気－海水流量変換器と、本電気－海水流量変換器の海水噴流を受けて複数の出力ポートから海水を流出させ、かつある出力ポートからの噴出流量と他の出力ポートの噴出流量との比を、前記電気－海水流量変換器の噴出流量に対応して変化させる流体制御素子と、本流体制御素子と前記水中用超音波送受波器とを一体として回動自在に船底で保持する手段とを備え、前記出力ポートもしくは出力ポートに取り付けられた噴出ノズルから海中へ海水を噴出させることによつて水中用超音波送受波器の俯角を制御することを特徴とした水中用超音波送受波装置。

3.発明の詳細な説明

この発明は、水中用超音波送受波装置に関し、特に船舶の動揺に対して、船底部に装着した超音波送受波器指向方向を安定化させるための俯角の制御に関するものである。

従来この種の装置は船舶の動揺を検出し、その信号により電動機、油圧等を駆動源とした機械的方法により行なつていた。しかし従来のものの欠点として複雑な機構を必要とし装置規模が大きくなり、経済的に又保守上の問題があつた。

この発明は、そのような欠点を取り除くため、流体制御素子を使用して超音波送受波器を船舶の動揺に対して安定に保つようにしたものである。以下この発明を図について説明する。

なお超音波送受波器は超音波送波器、超音波受波器、または超音波送波兼受波器を意味し以下単に送受波器という。

以下本発明の一実施例として、船のピッチ方向の動揺に対して船底に装置した超音波送受

器を水平位置に保持するシステムについて説明する。第1図は本実施例の超音波送受波器及び純流体素子部等が入つている船底機器部の装着状態を示している。第1図の1は船底、2は船底機器部で支点3で保持されピッチ方向に最大＋80°乃至－80°回転できる構造になつている。なお第1図において3aは軸、3bは軸3aと一体となつた支持腕であり、軸3aおよび支持腕3bは中空になつている。第2図は本実施例のブロックダイヤグラムを示している。

第2図において、4は送受波器の希望俯角を設定する俯角設定器、5は振り子型の動揺検出器、6は加算器、7と8は制御増幅器、9は電磁弁で流体管路の断面積を変化させ、入力として与えられた信号εに応じて噴出流量を変化させる電気－海水流量変換器、10は一定圧従つて一定流量の海水を取り入れて供給する海水供給装置、14は分流器であり、これら4～10，14は船体内に設置される。同じく第2図において、11は、純流体素子部であり、第3図に示す如く分流器11a、制御流Q_cが与えられる。制御ポート11bと一定の制御流Q_sが与えられる制御ポート11cと一定の主流が与えられる。主流ポート11dと2個の出力ポート11e，11fを有する比例増幅型純流体素子11gおよび2個の噴出ノズル11h，11iを備え、制御流Q_cの流量に応じて2個の出力ポート11d，11e従つて噴出ノズル11h，11iから噴出する流量の比を変化させるものである。

同じく第2図において、12は、軸3aをロータとしかつステータを船底機器部2に固定したシンクロ発電機型の傾度検出器であり、船底1に対する船底機器部2すなわち送受波器13の傾きを検出するものである。

第2図において流体制御素子部11、傾斜検出器12、および送受波器13は船底機器部2に収容され、また信号伝送線12a、流体移送管9a，9bは軸3aおよび支持腕3bの中を通つて船底機器部2に導入される。

なお伝送線12aや管9a，9bはフレキシブルチユーブや管を用いることによつて船底機器部壁から導入することもできる。

動作について述べる。先ず送受波器4により俯角θ_iが与えられる。動揺検出器5から船の動揺に応じてその時のピッチ角θ_pが得られる。一方傾度検出器12から制御増幅器8を経て船底機器部2の船底1に対するピッチ方向の傾度θ_0が得られる。従つてθ_i，θ_p及びθ_0の3信号が加算器6に加えられ、修正角度信号$\varepsilon=(\theta_i-\theta_p)-\theta_0$を演算し出力する。この信号$\varepsilon$は制御増幅器7により増幅し、電磁弁9に加える。電磁弁9には海水供給装置10及び分流器14により一定圧の海水が加えられており、制御増幅器7の出力信号に比例した制御流量信号Q_cをつくつている。即ちこの信号εの大きさと方向により或る範囲の大きさでQ_cの流量が変化するものである。

比例増幅型純流体素子の制御ポートの一方には前述のQ_cを加え、他方の制御ポートには分流器14からの海水を分岐して一定流量の海水Q_sを加えておく、主噴流は分流器14から分岐して一定流量の海水を供給する。例えば$Q_c=Q_s$の時、純流体素子部11の二つの噴出ノズルから等流量の海水が噴流し船底機器部2は船底1に対して傾度0°に保持される。又$Q_c>Q_s$の場合、Q_c-Q_sの差のモーメンタムに比例して主噴流が偏向し、その結果純流体素子部11の二つの噴出ノズルから噴出する流量は変化する。即ち一方は従来より流量が増大し、他方は減少する。その結果二つの噴流によるスラストも同様に変化し船底機器部2を修正角度信号に見合つた角度だけ上向の傾度位置に保持することになる。

従つてシステム全体として、超音波送受波器の俯角値が設定されると船のピッチ方向の動揺に対して自動的に修正動作を行なわせその結果超音波送受波器を基準水平面に対して規定の俯角値に保持させることができる。更に俯角値を変更する場合は、電気信号で入力すればよいので複雑な機構を必要としない利点がある。

なお第2図における傾斜検出器としては、抵抗摺動型その他のタイプを使用することができ、また船底機器部2外に設置しておくこともできる。

また、船底機器部2が受ける流体抵抗に抗して軸3aを支点として船底機器部2を可動させるために必要なスラストを得るために複数個の比例増幅型純流体素子を用いることもあるし、噴出ノズルも必要数だけ装着することもあり、又特殊な比例増幅型純流体素子により出力ポートがそのまま噴出ノズルとなるように製作することも可能である。

また流体制御素子部11は制御ポートから噴出する流体の運動流を変えることにより、入力ポートから噴出する流体の方向を変えるものであるから第4図Aに示すように一つの制御ポートと二つの出力ポートを有するもの第4図Bに示すように二つの制御ポートと三つの出力ポートを有するものその他の流体素子を用いることもできる。

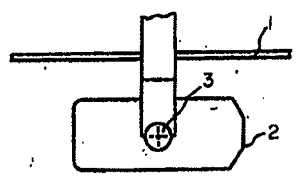
以上説明したように、この発明は純流体制御素子を使用した単純な機構により構成されており、可動部分がないことによる耐久性、長寿命及び耐環境特性を有する利点がある。又以上の利点から主として小型船舶に容易に装備することが可能になつた。

4.図面の簡単な説明

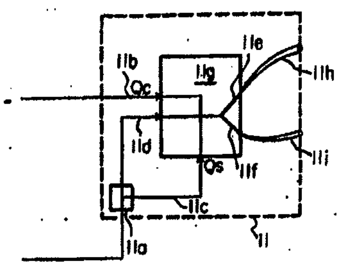
第1図は本発明に係る一実施例の断面図で、船底に超音波送受波器部が装置している状況を示す図、第2図は、本発明による一実施例のブロツクダイヤグラムを示す図、第3図と第4図は本発明に用いる流体制御素子部の具体例を示す図である。

1…船底、2…船底機器部、3…支点、3a…軸、3b…支持腕、4…俯角設定器、5…動揺検出器、6…加算器、7，8…制御増幅器、9…電磁弁、10…海水供給装置、11…純流体素子部、12…傾度検出器、13…送受波器、14…分流器。

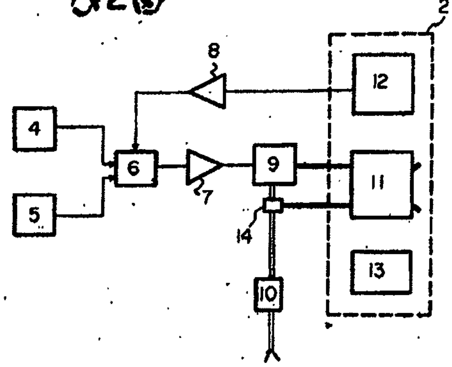
第1図



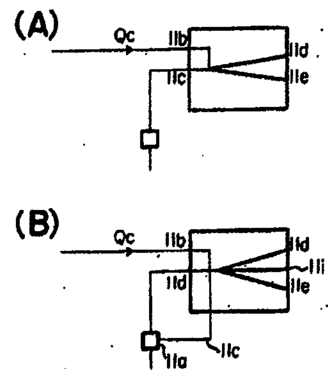
第3図



第2図



第4図



5. 添付書類の目録

(1) 明 細 書　　1 通
(2) 図　　面　　1 通
(3) 委 任 状　　1 通
(4) 願書副本　　1 通

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Espacenet

Bibliographic data: JP54054365 (U) — 1979-04-14

No title available

Inventor(s):		
Applicant(s):		
Classification:	**- international:**	***B63B49/00; B63B5/00; G01S7/52; G01S7/521;*** (IPC1-7): B63B5/00; G01S7/52
	- European:	
Application number:	JP19770128135U 19770922	
Priority number (s):	JP19770128135U 19770922	

Abstract not available for JP54054365 (U)

[Revenue Stamps 3,000 Yen]

JAPANESE UTILITY MODEL REGISTRATION APPLICATION

Date: September 22, 1977

Attn: Director General of the Patent Office

1. Title of the Idea
MOUNTING DEVICE OF UNDERWATER SEARCH ECHO SOUNDER TRANSDUCER TO NONMETAL VESSEL HULL

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4. List of Attached Documents
(1) Specification 1
(2) Figures 1
(3) Copy of Application 1

[Stamp: Patent Office
September 24, 1977
Sec. 2 Applications
Tsunoda]

54-54365
52 128135

Japanese Unexamined Utility Model Registration No. 54-54365

Specification

1. Title of the Idea

MOUNTING DEVICE OF ECHO SOUNDER TRANSDUCER FOR HYDROSPACE SENSOR TO NON-METALLIC SHIP

2. Scope of Registered Utility Model

A mounting device of an echo sounder transducer for a hydrospace sensor to a non-metallic ship configured with an echo sounder transducer case that is held so that a radiation surface of the ultrasonic transducer appears on the lower end surface with a flange in the periphery of the upper end surface, a frame in the form of rectangular parallelepiped shape having a hitch part that is embedded in advance in the bottom of the ship and formed so as to be held after at least two mutually opposing flanges of the echo sounder transducer case are slid and engaged, and a latch provided on the remaining side of the frame to latch the flanges.

3. Detailed Description of the Idea

The present idea relates to an echo sounder transducer mounting device to mount in the bottom of a ship in which an echo sounder transducer for the hydrospace sensor is projected a specified length below the bottom of the ship, and particularly relates to an echo sounder transducer mounting device in which an echo sounder transducer can be mounted extremely easily on the bottom of a non-metallic ship.

A hydrospace sensor that detects a school of fish, the bottom of the ocean, or the like to observe an underwater condition sends an ultrasonic pulse signal of a specified frequency at a constant cycle from an echo sounder transducer mounted on the undersurface of the bottom of a ship, receives a reflected wave from a school of fish or the like, and displays the received signals on a recorder to provide precise hydrospace information to a user. Because the reflected signals that come back to the echo sounder receiver are extremely weak by being faded considerably due to undersea factors, and when these are amplified in a high degree, various noises are also amplified likewise, so a clear display image is difficult to obtain. Accordingly, it is desirable to minimize to the utmost the fading of the ultrasonic reflected signal that occurs until reaching the echo sounder receiver.

Originally, the ultrasound signal has a characteristic to fade considerably due to an air bubbling layer or an eddy layer, and particularly an air bubbling layer generated when waves crash against the bow as the ship travels the water, and an eddy or the like due to a projection structure of the bottom of the ship covering the surface of the echo sounder transducer, the reception performance of the hydrospace sensor is considerably deteriorated. In order to avoid the air bubbling layer that rushes through the bottom of the ship, conventionally the echo sounder transducer have been held by projecting anywhere from 20 to 40 [cm] from the bottom surface of the ship. More specifically, The upper surface of an steel made echo sounder transducer case has been cut in conformity to an inclination of the bottom of the ship part and the cut surface was weld to the board of the bottom of the ship. This method has been a suitable installation method for a steel ship that was the mainstream in the past; however, this could not be applied to a FRP (fiberglass reinforced plastics) ship that has been popularized rapidly in recent years.

This idea is to provide a suitable echo sounder transducer mounting device to install the echo sounder transducer into FRP ships.

Descriptions of embodiments of the present idea will be given hereinafter with reference to drawings.

FIG. 1 is a conventional device in which an echo sounder transducer is mounted in the bottom of the ship of a steel ship.

In FIG. 1, ultrasonic transducers 3 and 4 are mounted on a plate 2 that configures an echo sounder transducer case 1, and the plate 2 is fixed by a bolt 5. The upper surface of the echo sounder transducer case 1 is welded and fixed continuously on the bottom sheathing 6.

On the other hand, in the case of an FRP ship in which the body is formed by a laminating material of FRP resin, a welding method cannot be used so a fastening method that uses a bolt or the like is considered.

FIG. 2 is a conventional device where an echo sounder transducer is mounted to a wooden ship. This was widely performed in the previous stage transitioning to the steel ship.

In FIG. 2, flange 7 where an appropriate number of mounting holes are provided in the periphery is welded on the upper surface of an iron echo sounder transducer case 1, and the echo sounder transducer case 1 is fixed to the top and bottom of the bottom sheathing 8 by using a bolt 12 and a nut 13 that penetrate filler pieces 10 and 11 to compensate the inclination of the bottom part of the ship.

Although the same mounting method as the mounting method to the wood ship in FIG. 2 may be considered for use, a partial deterioration of strength is likely to occur because the mounting holes are drilled into the bottom sheathing, and this leads to deficiency requiring a preventive treatment for water leakage.

FIG. 3 illustrates an embodiment of the present idea. FIG. 4 illustrates an explanatory drawing for a mounting process of the embodiment. FIG. 5 illustrates the essential part of the embodiment. FIG. 6 is a cross-sectional view of the embodiment described above. FIG. 7 and FIG. 8 are cross-sectional views of another embodiment.

In FIG. 3, ultrasonic transducers 3 and 4 are held on the bottom surface of the echo sounder transducer case 15 so that those radiation surfaces appear from the case, and a flange 16 is provided integrally on the upper surface of the echo sounder transducer case.

A U-shaped or L-shaped hitch part 17 is provided on three sides as illustrated in FIG. 5 and a frame shape having notch 18 is formed on the remaining side in the bottom of an RFP ship. Frame 19 is embedded in advance when forming the ship body with FRP resin. The hitch part 17 may be integrally formed with the frame 19, or may be configured by welding a U-shaped or I-shaped metal fitting to the frame, and when embedding in the bottom of the ship in advance, the hitch part 17 is outside the bottom of the ship. Screw hole 20 is cut in the notch part 18 of the frame.

The echo sounder transducer case 15 is held in the bottom of the ship 14 by engaging the flange 16 into the hitch part 17 and pressure welding with an L-shaped pressure welding plate 21. Through holes for a bolt to be through are provided in the pressure welding plate 21, and the pressure welding plate 21 is fastened to the frame 19 by the bolt so these through holes are arranged opposing each other to the screw hole of the frame 19. Arrow A indicates a traveling direction of the ship.

In FIG. 4, an echo sounder transducer case 15 having ultrasonic transducers 3 and 4 and flange 16 are engaged so as to slide within a U-shaped hitch part 17 in the arrow B direction, and subsequently, L-shaped pressure welding plate 21 is pressed against one side of the flange and secured with a bolt to be fixed on the bottom of the ship.

In FIG. 6, an echo sounder transducer case 15 is held by being engaged into a hitch part 17 of a frame 19 where the flange 16 is embedded in the bottom of the ship in advance. A section 22 where the frame of the bottom of the ship 14 is embedded is formed in a convex shape in order to prevent the deterioration of strength or is formed in a streamlined shape or the like in order to reduce traveling resistance. As illustrated in FIG. 7, when the flange is doubly provided so as to be on either side of the hitch part 17, the echo sounder transducer case 15 can be held securely, and also wave receiving noise can be reduced because a lash can be suppressed.

When compensating for the inclination of the bottom of the ship 14, the height may be adjusted when molding the ship bottom convex part 22 as illustrated in FIG. 8(A), or the upper part of the echo sounder transducer case 15 may be formed to conform to an inclination of the bottom of the ship as illustrated in FIG. 8(B).

According to the idea described above, the ultrasonic echo sounder transducer can be mounted extremely easily to the bottom of the ship with no occurrence of deterioration in the strength of the bottom of the ship, and the only object penetrating the bottom of the ship is an echo sounder transducer cable, so a well commonly used marine watertight cable gland can be used without needing special preventive treatment for water leakage or the like, and thereby, an excellent effect can be achieved.

In addition, holding strength is given by using the pressure welding plate 21 after the echo sounder transducer case is engaged and held into the hitch part 17 as well as prevented from the echo sounder transducer case to be slipped out in the above embodiments; however, this should not be limited to this method, and for example the through holes may be provided in the flange itself to lock the echo sounder transducer case by utilizing these.

4. Brief Description of Drawings

FIG. 1 and FIG. 2 illustrate a conventional device;

FIG. 3 illustrates an embodiment of the present idea;

FIG. 4 is an explanatory drawing of installing process of an embodiment of the present idea;

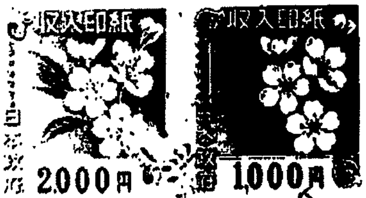
FIG. 5 is an essential part of an embodiment;

FIG. 6 is a cross-sectional view of the embodiment described above; and

FIG. 7 and FIG. 8 are cross-sectional views of another embodiment.

Numerical reference number 1 is an echo sounder transducer case, 3 and 4 are ultrasonic transducers, 6 is the bottom of the steel ship, 7 is a flange, 8 is the bottom of a wooden ship, 10 and 11 are penetrate filler pieces, 14 is the bottom of a FRP ship, 15 is an echo sounder transducer case, 16 is a flange, 17 is a hitch part, 19 is a frame, 21 is a pressure welding plate, and 22 is a convex part of the bottom of a ship.

Applicant of the JP Utility Model Registration: Furuno Electric Co., Ltd.



(3.000円)

実用新案登録願

昭和52年9月22日

特許庁長官　　　　殿

1. 考案の名称　水中探知用送受波器の非金属製船体への取付装置
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   古野電気株式会社
4. 添付書類の目録
   (1) 明　細　書　　1通
   (2) 図　　面　　1通
   (3) 願書副本　　1通

特許庁
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明　　細　　書

1. 考案の名称

水中探知用送受波器の非金属製船体への取付装置

2. 実用新案登録請求の範囲

その下端面において超音波振動子の輻射面が現出するように保持されその上端面の周囲にフランジを有する送受波器ケースと、船底に予め埋設され少くともその相対する二辺に上記送受波器ケースのフランジが摺動して嵌入された後保持され得るよう成形される引掛部を有する直方体状の枠体と、上記フランジを係止するために上記枠体の残りの辺に設けられる係止具とで構成される水中探知用送受波器の非金属製船体への取付装置。

3. 考案の詳細な説明

この考案は、水中探知用送受波器を船底下に特定長さ突出させて船底に取付ける送受波器取付装置に関し、特に送受波器を非金属製船の船底に極めて容易に取付けることができる送受波器取付装置に関する。

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魚群や海底等を探知し水中状況を観測する水中探知装置は、船底下面に取付けた送受波器から特定周波数の超音波パルス信号を一定周期にて送出して魚群等からの反射波を受信しこの受信々号を記録器に表示せしめることにより利用者に的確な水中探知情報を提供する。受波器に帰来する反射信号は海中の諸因子により著しく減衰されて極めて微弱なものであり、これを高度に増幅すると諸雑音も同様に増幅されるので明瞭な表示像が得られにくい。従つて、受波器に到達するまでに生じる超音波反射信号の減衰を極力少なくすることが望まれる。

元来、超音波信号は気泡層や渦流層で著しく減衰する性質をもち、特に船の走行により波が船首で破砕される際に生じる気泡層や船底の突出構造物による渦流などが送受波器面を覆うときは著しく水中探知装置の受信性能が低下する。旧来より船底を流過する気泡層を避けるために、送受波器を船底面から20～40〔cm〕突出させて保持することが行なわれていた。具体的には、鉄製の送受波

器ケースの上面を船底部の傾斜に合せて切断し切断面の周囲を船底板に溶接することにより行つていた。この方法は従来主流を占めていた鉄鋼船に適した装備法であつたが、近年急速に普及してきたFRP (Fiberglass Reinforced Plastics,強化プラスチック) 船には採用できなかつた。

この考案は、FRP船に送受波器を装備するのに好適な送受波器取付装置を提供するものである。

以下、図面を併せ用いてこの考案の実施例を説明する。

第1図は、送受波器が鉄鋼船の船底に取付けられる従来装置を示す。

第1図において、送受波器ケース1を構成する平板2には超音波振動子3及び4が取付けられており、平板2はボルト5により固着されている。送受波器ケース1は船底板6にその上面が連続的に溶接され固定される。

一方、船体をFRP樹脂の積層材料で成形したFRP船の場合には溶接法を採用できず、ボルト等を用いた締結法が考えられる。

第2図は、送受波器を木造船に取付けた従来装置を示す。これは鉄鋼船に移行する前の段階で広く行なわれていた。

第2図において、鉄製の送受波器ケース1の上面にその周囲に適当数の取付穴を設けたフランジ7が溶接され、船底板8の上下に船底部の傾斜を補正する間座10,11が当てられ貫通されるボルト12及びナット13を用いて送受波器ケース1が固定される。

FRP船の場合にも第2図の木造船への取付方法と同じ取付法を採用できるとも考えられるが、船底板を貫通して取付穴を穿つたために部分的な強度低下を生じやすく、漏水の防止処置が必要となるという不具合が生じる。

第3図は、この考案の実施例を示す。第4図は実施例の装備過程説明図を示す。第5図は、実施例の主要部を示す。第6図上記実施例の断面図を、第7及び第8図は他の実施例の断面図を示す。

第3図において、送受波器ケース15の下面には超音波振動子3,4がそれら輻射面をケースから現

出する如く保持されており、送受波器ケースの上面にはフランジ16が一体的に設けられている。

FRP船の船底14には、第5図に示すようにその三辺にコ型又はL型の引掛部17が設けられ残りの一辺に切欠き部18を有する枠型状に形成されている枠体19がFRP樹脂で船体を成形する時に予め埋設される。引掛部17は、枠体19と一体的に形成しあるいは枠体にコ型又はI型の金具を溶接して構成することができ、予め船底に埋設する際には引掛部17は船底外にあるようになされる。枠体の切欠き部18にはネジ穴20が切られている。

送受波器ケース15は、そのフランジ16が引掛部17に嵌入されそしてL字型の圧接板21で圧接されることにより船底14に保持される。圧接板21にはボルトを通す貫通穴が設けられており、圧接板21はこれらの貫通穴が上記枠体19のねじ穴に相対するように配置されボルトにより上記枠体19に締結される。矢印Aは船の進行方向を示す。

第4図において、超音波振動子3，4及びフランジ16を有する送受波器ケース15は、矢印B方向に

フランジ16がコ字型の引掛部17内を摺動するように嵌入された後、L字型の圧接板21がフランジの一辺に押し当てられボルトを用いて固着することにより、船底に固定される。

第6図において、送受波器ケース15は、そのフランジ16が予め船底に埋設される枠体19の引掛部17に嵌入されることにより保持される。船底14の枠体が埋設される部分22は強度低下を防ぐために凸状に且つ走行抵抗の軽減をはかるために流線形等に成形される。第7図に示すように、引掛部17を挟むようにフランジを2段設ければ送受波器ケース15の保持を確実にすることができしかも遊隙を抑えることができるので受波ノイズも減少させることができる。

船底14の傾斜を補正する場合には、第8図(A)に示すように船底凸部22成型時にその高さを調節するか、あるいは同図(B)に示すように送受波器ケース15の上部を船底の傾斜に合わせて成形すればよい。

上述のようにこの考案によれば、船底の強度低

下を生ずることなく極めて容易に超音波送受波器を船底に取付けることができ、しかも船底の貫通物は送受波器のケーブルのみとなるので通常よく用いられる船用電線貫通金物を用いることができ特別な漏水防止策を施こす必要を生じない等の優れた効果を奏する。

なお、上記実施例においては、送受波器ケースを引掛部17へ嵌入して保持した後圧接板21を用いて保持力を与え且つ送受波器ケースが抜け出るのを防止しているが、この方法に限定されることなく例えばフランジ自身に貫通穴を設けこれらを利用して送受波器ケースを係止することも可能である。

4.図面の簡単な説明

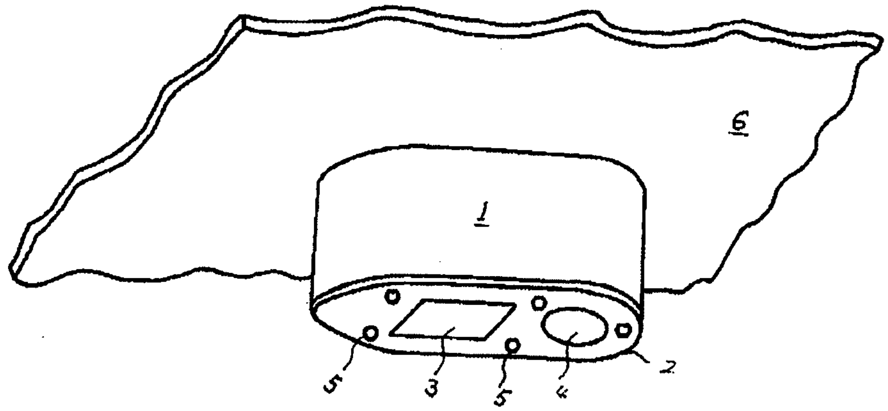
第1及び第2図は、従来装置を示す。第3図は、この考案の実施例を、第4図はこの考案の実施例の装備過程説明図、第5図は実施例の主要部を、第6図は上記実施例の断面図を示す。第7及び第8図は他の実施例の断面図を示す。

1は送受波器ケース、3及び4は超音波振動子

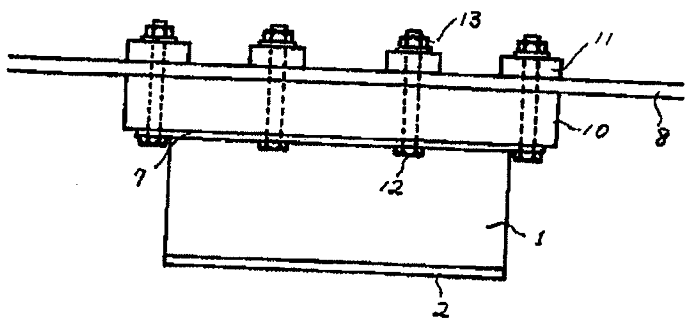
6は鉄鋼船の船底、7はフランジ、8は木造船の船底、10及び11は間座、14はFRP船の船底、15は送受波器ケース、16はフランジ、17は引掛部、19は枠体、21は圧接板、22は船底の凸部を示す。

実用新案登録出願人　古野電気株式会社

第1図



第2図



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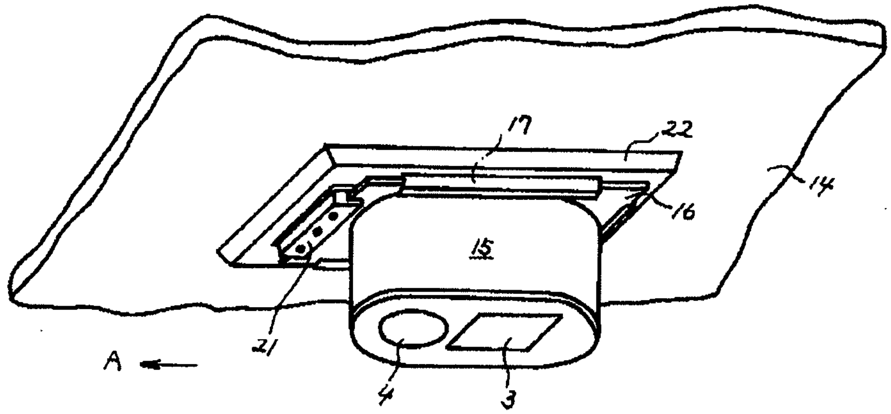
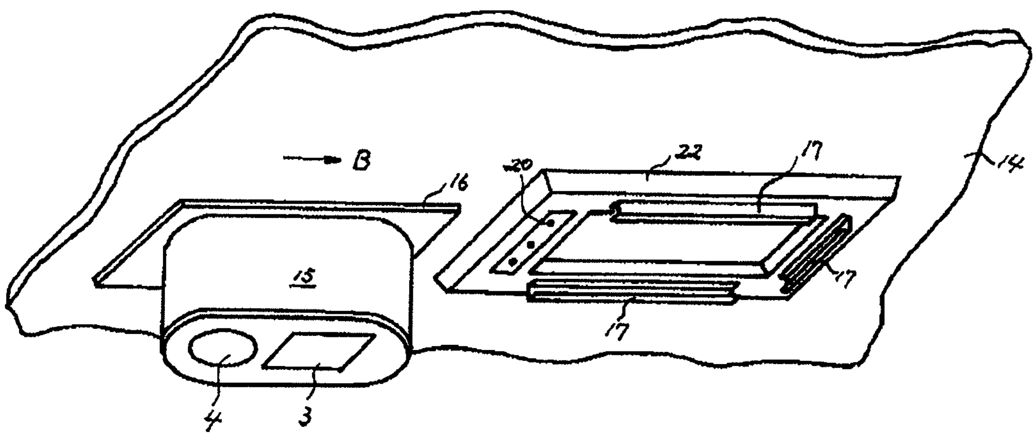
出願人　古野電気株式会社

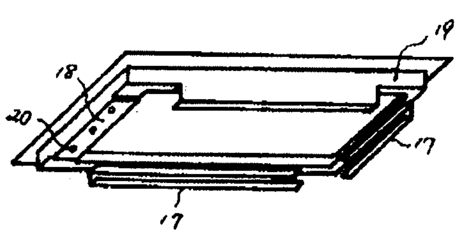
第3図



第4図



第5図



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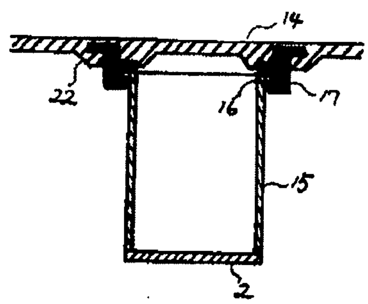
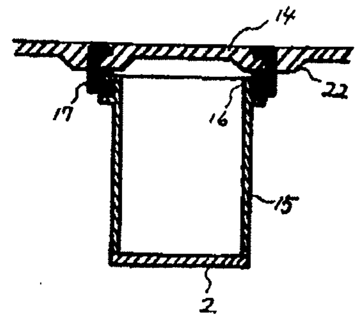
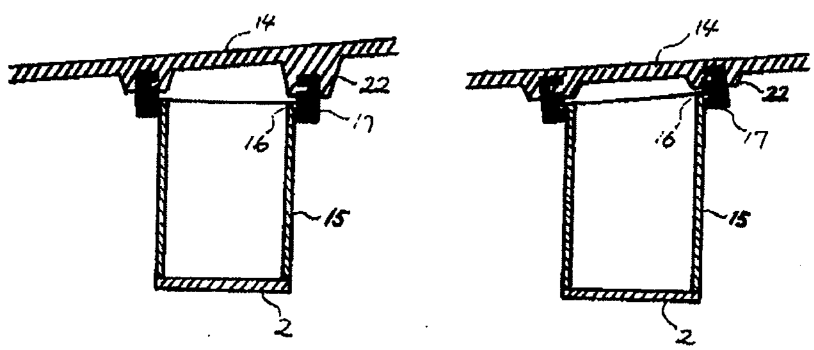
第6図



第7図



第8図



(A) (B)

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Espacenet

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(54) Title of the Idea

HOUSING CASE OF HYDROACOUSTIC EQUIPMENT

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SPECIFICATION

1. Name of Idea

Housing Case of Acoustic Equipment

2. Scope of Utility Model Registered Claims

A housing case of hydroacoustic equipment mounted outside a vessel, comprising water conducting holes that connect inside and outside of a case body and which are mounted on the top and bottom surfaces of a hollow case body in which the bottom surface is flat and the top surface is made to have a streamlined expansion along the front to back direction of the vessel.

3. Detailed Description of the Idea

[Field of Industrial Application]

The present idea relates to a housing case of hydroacoustic equipment mounted outside a vessel.

[Related Art]

Devices are available in which hydroacoustic equipment such as an acoustic current meter, echo sounding machine, fish finder, or the like, are provided in a vessel body such as an oceanographic investigation vessel, fishing vessel, or the like, and those that mount the hydroacoustic equipment outside the vessel are also available.

FIGS. 8 and 9 illustrate a mounting method of hydroacoustic equipment mounted outside a vessel, and hydroacoustic equipment A is housed within a case B so as not to receive direct water current pressure that accompanies the operation of the vessel 1. FIG. 8 illustrates the case B attached and mounted to the bottom end of a support pipe 3 vertically lowered from a boom 2 that is extended laterally of the vessel 1. FIG. 9 illustrates the case B attached and mounted to the outer surface of the side of the vessel 1.

Conventionally, a box shape having flat top and bottom surfaces has been used as a housing case of hydroacoustic equipment mounted outside a vessel, and the acoustic equipment is equipped on the bottom panel within the case with the acoustic wave transmitter and receiver facing downward.

[Problems to be Solved by the Idea]

However, the housing case of the hydroacoustic equipment generates bubbles due to the cavitation of the flow on the corner parts of the case when moving in the water in conjunction with the operation of the vessel while being supported outside the vessel as described above, and these bubbles surround the case as they travel to the rear of the case. Because these bubbles also pass by the bottom surface of the case, there is the problem that the bubbles that pass by the bottom surface of the case have a negative effect on the acoustic wave transmitting and receiving of the hydroacoustic equipment. Further, when the vessel especially operates at a high speed thereby generating a stronger cavitation, it becomes impossible for the hydroacoustic equipment to perform its proper function due to the increased amount of bubbles.

[Means for Solving the Problem]

The present idea is configured such that a housing case of hydroacoustic equipment is provided with water conducting holes that connect inside and outside of a case body and which are mounted on the top and bottom surfaces of a hollow case body in which the bottom surface is flat and the top surface is made to have a streamlined expansion along the front to back direction of the vessel to thereby remove bubbles that pass by the bottom surface of the case so that the proper function of the hydroacoustic equipment can be sufficiently demonstrated.

[Operation]

In other words, the present invention provides an expansion in the flow line shape along the front to back direction of the vessel on the top surface of the case body that makes the current speed of the current flowing along the case top surface to be faster than the current flowing on the case bottom surface, and by this, bubbles flow more easily on the top side of the case while also utilizing the negative pressure made by the high flow rate area on the top side of the case to blow out water inside the case to the case top surface side by passing such water through water conducting holes on the case top surface thereby drawing the water that is flowing along the case bottom surface, together with the bubbles, into the case body from the water conducting holes on the case bottom surface to remove bubbles on the bottom surface side of the case.

[Embodiment of the Idea]

An embodiment of the present idea is given hereinafter with reference to FIGS. 1 to 5 of the housing case of hydroacoustic equipment vertically lowered into water.

In FIGS. 1 to 4, reference numeral 10 is a hollow case body that houses hydroacoustic equipment. This case body 10 is given a flat vessel shape having an expansion in the flow line shape on both sides. The case body 10 is formed in a dual divided shape composed of a lower case 10a and an upper case 10b made of fiber reinforced plastic (FRP) reinforced by glass fiber, and the lower case 10a and the upper case 10b are assembled by connecting flanges 11a and 11b formed on the outer periphery of the connecting area by screws 12 and 12.

The lower case 10a is made up of a bottom panel part together with perimeter wall parts that rise substantially perpendicular from the periphery thereof on which the flange 11a is formed on the outer periphery, and thus, the lower surface (bottom surface) of the lower case 10a becomes a flat surface. The corner areas of the bottom surface and the perimeter wall surfaces are curved so as to reduce the cavitation of the water flow generated in the corner areas. In addition, reinforcing walls 13 and 13 are integrally formed on the bottom panel part of the lower case 10a in a crisscross around the mountings of the hydroacoustic equipment arranged on the bottom panel part. Further, the upper case 10b provides an expansion in the flow line shape along the front to back direction of the vessel, which is to say the front to back direction of the case body, on the upper surface portion surrounded by the flange 11b of the outer periphery thereof, and reinforcing ribs 14 and 14 are integrally formed in a crisscross also on the inner surface of the upper case 10b. Additionally, a cylindrical support pipe assembly metal fitting 15 bolted to the lower end of the support pipe 3 that perpendicularly supports the case body 10 in the water is anchored by anchoring bolts 16 and 16 to the center of the top surface of the upper case 10b, and a cable through hole 17 for passing a cable through is provided on the part opposite in the support pipe assembly metal fitting 15 of the upper case 10b.

Meanwhile, A is the hydroacoustic equipment (acoustic current meter, echo sounding machine, fish finder, or the like) housed in the case body 10, and the hydroacoustic equipment A is water proof with a water proof covering over the outside thereof. The hydroacoustic equipment A is normally housed within a 2 set case body 10, and the hydroacoustic equipment A and A is installed on the bottom panel part of the lower case 10a in an arrangement as illustrated in FIG. 4 with the acoustic wave transmitting and receiving surface on the bottom side and is fixed to the bottom panel part of the lower case 10a by press fittings not illustrated. Note that (a) and (a) are cables leading from the hydracoustic equipment A and A, and these cables (a) and (a) lead out from the cable pass through hole 17 on the top surface of the case body 10 to inside the support pipe assembly fitting 15 and pass through the inside of the support pipe 3 and are connected to a measurement device or the like within the vessel.

In addition, multiplicities of water conducting holes 18 and 18 that connect the inner part of the case body 10 to the case body exterior are provided on the bottom surface of the bottom case 10a at the front and back thereof so as to avoid the installation position of the hydroacoustic equipment A and A as illustrated in FIG. 1 and FIG. 4, and multiplicities of water conducting holes 19 and 19 that connect the inner part of the case body 10 to the case body exterior, as illustrated in FIG. 1 and FIG. 3, are also provided on the top surface of the upper case 10b that has an expansion in the flow line shape. These water conducting holes 18 and 18 and 19 and 19 are provided to draw in water from the bottom surface side of the case body 10 into the case body 10 and then expel the water inside the case body 10 to the top surface side of the case body 10 such that the inside of the case body 10 is always filled with water when the case body 10 is in a lowered state into the water.

The housing case of hydroacoustic equipment is attached to the bottom end of the support pipe 3 that is vertically lowered by being extended from a vessel body 1 as illustrated in FIG. 8, and therefore, this case is lowered into the water so that the axis line in the front to back direction thereof is parallel to the axis direction of the front to back direction of the vessel body 1.

However, because an expansion in the flow line shape along the back to front direction of the vessel is provided on the top surface of the case body 10 in the housing case of the hydroacoustic equipment, the current speed of the current flowing along the case top surface is faster than the current flowing on the case bottom surface, and bubbles flow more easily on the top side of the case while also utilizing the negative pressure made by the high flow rate area on the top side of the case thereby drawing the water that is flowing along the case bottom surface, together with the bubbles, into the case body 10 from the water conducting holes 18 and 18 on the case bottom surface and thus bubbles on the bottom surface side of the case can be removed.

In other words, FIG. 5 illustrates the water flow around the case periphery when moving in conjunction with the operation of the vessel, and because the case body 10 has an expansion in the flow line shape while having a flat bottom surface, the water flow that is divided to the top and bottom of the case body 10 flows as illustrated by the broken line in the drawing, and thus, the flow velocity V_1 of the water flow that flows along the top surface of the case is faster than the flow velocity V_2 of the water flow that flows along the bottom surface of the case. Accordingly, even if bubbles are generated by cavitation of the water flow at the front of the case body 10, the majority of those bubbles will flow to the upper side of the case being drawn by the water flow having the faster current, and thus, the amount of bubbles around the bottom surface of the case will be fewer. In addition, when the flow velocity V1 of the water flowing along the top surface of the case is faster than the flow velocity V2 of the water flow flowing along the bottom surface of the case, the water pressure P1 of the top surface side of the case becomes negative pressure relative to the water pressure P2 of the bottom surface side of the case, and therefore, the water filled in the case body 10 on account of the water pressure difference between the top and bottom surfaces of the case passes through the water conducting holes 19 and 19 on the top surface of the case as illustrated by the arrow in FIG. 1 and is expelled at the top surface side of the case, while the water that flows along the bottom surface of the case is drawn into the case body 10 from the water conducting holes 18 and 18 of the bottom surface of the case, and accordingly, the bubbles that entered at the bottom surface side of the case and traveled along the bottom surface of the case are drawn, along with the water, into the case body 10, and thus bubbles on the bottom surface side of the case can be removed.

In other words, because the housing case of hydroacoustic equipment has a flat bottom surface and provides water conducting holes 19 and 18 that connect the inside and outside of the case body on the top and bottom surfaces of the hollow case body 10 that has an expansion in the flow line shape along the back to front direction of the vessel on the top surface, bubbles passing by on the case bottom surface can be removed and the proper function of the hydroacoustic equipment housed within the case can be sufficiently demonstrated. Further, according to the housing case of hydroacoustic equipment, because the water in the case body 10 is filled, a water temperature measuring instrument and the like may also be housed within the case body 10 in addition to the hydroacoustic equipment A and A, and measurement of the water temperature and the like can also be performed.

Note that in the embodiment given above, a description was given of a housing case of hydroacoustic equipment that is vertically dropped into the water such as that illustrated in FIG. 8, however, the present idea may also be applied to a housing case of hydroacoustic equipment attached to the vessel side such as that illustrated in FIG. 9. In other words, FIGS. 6 and 7 illustrate another embodiment of the present idea, and this embodiment provides a boat body attaching metal fitting 20 that attaches to the side of the vessel 1 on the top surface of a hollow case body 10 that is provided with a flat bottom surface and an expansion in the flow line shape along the front to back direction of the vessel on the top surface, wherein, such other configurations are similar to the embodiment given above. Note that in this embodiment protruding objects such as a flange are eliminated from the peripheral side surface of the case body 10 by aligning the lowercase 10a and the upper case 10b that configures the case body 10 by connecting with screws 21 and 21. By doing this, the water drawn and together with the bubbles from the bottom surface side of the case due to the water pressure difference between the top and bottom surfaces of the case flows not only within the case body but also across the outer wall surface of the case body to the top surface side of the case as illustrated by the broken line arrow in FIG. 6, and thus can more favorably remove the bubbles on the bottom surface of the case.

Note that with the embodiment given above, although the case body 10 is made from FRP, this case body may be formed by metal plating, and the flat shape of the case body 10 does not need to be shaped like a hull.

[Effect of the Idea]

The present idea provides an expansion in the flow line shape along the front to back direction of the vessel on the top surface of the case body that makes the current speed of the current flowing along the case top surface to be faster than the current flowing on the case bottom surface, and by this, bubbles flow more easily on the top side of the case while also utilizing the negative pressure made by the high flow rate area on the top surface side of the case to blow out water inside the case to the case top surface side by passing such water through water conducting holes on the case top surface thereby drawing the water that is flowing along the case bottom surface, together with the bubbles, into the case body from the water conducting holes on the case bottom surface to remove bubbles on the bottom surface side of the case; and therefore, bubbles of pass by the bottom surface of the case can be removed, and the proper function of the hydroacoustic equipment housed in the case can be sufficiently demonstrated.

4. Brief Description of Drawings

FIGS. 1 to 5 illustrate one embodiment of the present idea. FIG. 1 and FIG. 2 are a vertical cross-sectional side view and a vertical cross-sectional front view of the housing case. FIG. 3 and FIG. 4 are plan view and a bottom view of the housing case. FIG. 5 is a side view illustrating of water flowing around the case periphery. FIG. 6 and FIG. 7 are a lateral view and a front view of the housing case illustrating another embodiment of the present idea. FIG. 8 and FIG. 9 are drawings illustrating the mounting method of the hydroacoustic equipment mounted to the outside of the vessel.

10	case body
10a	lower case
10b	upper case
18, 19	water conducting holes
A	hydroacoustic equipment

Applicant Agent Attorney Takehiko SUZUE

FIG. 1

18 water conducting hole

19 water conducting hole

A hydroacoustic equipment

10 case body

801

Japanese Unexamined Utility Model Application No. S62-99877

Applicant: NIPPI Corporation

Agent: Takehiko SUZUE

⑲日本国特許庁（JP）　　⑪実用新案出願公開

⑫公開実用新案公報（U）　　昭62－99877

⑤Int.Cl.⁴	識別記号	庁内整理番号	㊸公開 昭和62年(1987) 6月25日
G 01 S 7/52		B－6707－5J	
B 63 B 49/00		8309－3D	

審査請求 有 （全 頁）

㉞考案の名称　水中音響機器の収納ケース

㉑実　願　昭60－191674

㉒出　願　昭60(1985)12月13日

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⑭代理人	弁理士 鈴江 武彦	外2名	

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明　細　書

1．考案の名称

水中音響機器の収納ケース

2．実用新案登録請求の範囲

船外に装備される水中音響機器の収納ケースであって、下面を水平にしかつ上面に船体の前後方向に沿う流線形の脹らみをもたせた中空ケース体の上下面に、ケース体内外を連通する通水孔を設けたことを特徴とする水中音響機器の収納ケース。

3．考案の詳細な説明

〔産業上の利用分野〕

この考案は船外に装備される水中音響機器の収納ケースに関するものである。

〔従来技術〕

海洋調査船や漁船等には、音響流速計、音響測深機、魚群探知機等の水中音響機器を船体内にもっているものと、上記水中音響機器を船外に装備しているものとがある。

第8図および第9図は船外に装備される水中音響機器の装備方式を示したもので、水中音響機器

Aは船体1の航行にともなう流水圧を直接受けないようにするためにケースB内に収納されており、第8図に示すように船体1の側方に張出したブーム2から垂下した支持パイプ3の下端に前記ケースBを取付けて装備されるか、あるいは第9図に示すように前記ケースBを船体1の船側外面に取付けて装備されている。

上記船外に装備される水中音響機器の収納ケースとしては、従来、上下面が水平な箱形のものが使用されており、音響機器は、その音波送受信面を下に向けてこのケース内の底板上に設置されている。

〔考案が解決しようとする問題点〕

ところで、上記水中音響機器の収納ケースは、上記のように船外に支持されて船体の航行にともない水中を移動するために、ケースのコーナー部における水流のキャビテーションにより気泡がを発生し、この気泡がケースの周囲をケース後方に向かって通過するが、この気泡はケースの下面も通過するために、このケース下面を通過する気泡

が水中音響機器の音波送受信に悪影響を及ぼすという問題があり、特に船体が高速で航行するときにはキャビテーションも強く発生して気泡量も多くなるから、水中音響機器に本来の機能を発揮させることができなくなる。

〔問題点を解決する手段〕

この考案は、水中音響機器の収納ケースを、下面を水平にしかつ上面に船体の前後方向に沿う流線形の脹らみをもたせた中空ケース体の上下面に、ケース体内外を連通する通水孔を設けた構成とすることにより、ケース下面を通る気泡をなくして、水中音響機器に本来の機能を十分に発揮させられるようにしたものである。

〔作用〕

すなわち、この考案は、ケース体の上面に船体の前後方向に沿う流線形の脹らみをもたせることによってケース上面に沿って流れる水流の流速がケース下面の流速よりも速くなるようにし、これにより気泡がケース上部側に流れやすくするとともに、ケース上面側の高流速域が負圧となるのを

利用してケース体内の水をケース体上面の通水孔を通してケース上面側に吸出すことにより、ケース下面に沿って流れる水を気泡とともにケース体下面の通水孔からケース体内に吸込んで、ケース下面側の気泡を除去するようにしたものである。

〔考案の実施例〕

以下、この考案の一実施例を、水中に垂下される水中音響機器の収納ケースについて第１図～第５図を参照し説明する。

第１図～第４図において、１０は水中音響機器を収納する中空のケース体であり、このケース体１０は、両側に流線形の脹らみをもたせた平面船形のものとされている。このケース体１０は、ガラス繊維で補強した繊維強化合成樹脂（ＦＲＰ）製の下ケース１０ａおよび上ケース１０ｂからなる二分割形のもので、下ケース１０ａと上ケース１０ｂは、その接合部の外周に形成したフランジ部１１ａ，１１ｂをビス１２，１２により接合して組立てられている。

前記下ケース１０ａは、底板部とその周囲から

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ほぼ垂直に立上がる外周に前記フランジ１１ａを形成した周壁部とからなるもので、この下ケース１０ａの下面（底面）は水平面とされており、この下面と周壁面とのコーナー部は、このコーナー部において発生する水流のキャビテーションを小さくするために曲面とされている。またこの下ケース１０ａの底板部上には、この底板部の上に配置される水中音響機器の設置部を囲んで縦横に補強壁１３，１３が一体に形成されている。また、前記上ケース１０ｂは、その外周の前記フランジ１１ｂで囲まれた上面部分に、ケース体前後方向つまり船体の前後方向に沿う流線形の脹らみをもたせたもので、この上ケース１０ｂの内面にも縦横に補強リブ１４，１４が一体に形成されている。またこの上ケース１０ｂの中央部上面には、ケース体１０を水中に垂下支持する支持パイプ３の下端にボルト止めされる筒状の支持パイプ取付け金具１５が固定ボルト１６，１６によって固定されており、上ケース１０ｂの支持パイプ取付け金具１５内に対向する部分には、ケーブル通し孔１７

が設けられている。

一方、Aは前記ケース体10内に収納された水中音響機器（音響流速計、音響測深機、魚群探知機等）であり、この水中音響機器Aは、その外側を防水被覆した防水型ものとされている。この水中音響機器Aは、通常2セットケース体10内に収納されており、この水中音響機器A，Aは、その音波送受信面を下側にして第4図に示すような配置で下ケース10aの底板部上に設置され、図示しない押え金具により下ケース10aの底板部に固定されている。なお、a，aは水中音響機器A，Aから導出されたケーブルであり、このケーブルa，aは、ケース体10上面のケーブル通し孔17から支持パイプ取付け金具15内に導出され、支持パイプ3内を通して船体内の測定装置等に接続されるようになっている。

また、前記下ケース10aの下面には、水中音響機器A，Aの設置位置を避けてその前後に、ケース体10の内部とケース体外を連通する多数の通水孔18，18が第1図および第4図に示すよ

うに設けられており、さらに流線形の脹らみをもたせた上ケース１０ｂの上面にも、ケース体１０の内部とケース体外を連通する多数の通水孔１９，１９が第１図および第３図に示すように設けられている。この通水孔１８，１８および１９，１９は、ケース体１０の下面側からケース体１０内に水を吸込むとともにケース体１０内の水をケース体１０の上面側に流出させるために設けられたもので、ケース体１０を水中に垂下させた状態では、ケース体１０内には常に水が充満するようになっている。

この水中音響機器の収納ケースは、第８図に示したように船体１から張出させて垂下された支持パイプ３の下端に取付けられるもので、このケースは、その前後方向の軸線が船体１の前後方向の軸線と平行になるようにして水中に垂下される。

しかして、この水中音響機器の収納ケースにおいては、ケース体１０の上面に船体の前後方向に沿う流線形の脹らみをもたせているから、ケース上面に沿って流れる水流の流速をケース下面の流

速よりも速くして気泡がケース上部側に流れやすくするとともに、ケース上面側の高流速域が負圧となるのを利用して、ケース下面に沿って流れる水を気泡とともにケース体下面の通水孔１８，１８からケース体１０内に吸込んでケース下面側の気泡を除去することができる。

つまり、第５図は船体の航行にともなって移動するケース周囲の水流を示したもので、前記ケース体１０は、その下面が水平で、上面は流線形の脹らみをもっているから、ケース体１０の上下に分流される水流は図に破線で示すように流れることになりそのためにケース上面に沿って流れる水流の流速V_1はケース下面に沿って流れる水流の流速V_2よりも速くなる。従って、ケース体１０の前部において水流のキャビテーションにより気泡が発生した場合でも、この気泡の大部分は、流速の速い水流に引かれてケース上部側に流れることになり、そのためにケース下面に回り込む気泡の量は少なくなる。また、ケース上面に沿って流れる水流の流速V_1がケース下面に沿って流れる

[redacted] [redacted]

水流の流速V_2よりも速くなれば、ケース上面側の水圧P_1がケース下面側の水圧P_2に対して負圧となるから、このケース上下面の水圧差によりケース体１０内に充満している水が第１図に矢印で示すようにケース体上面の通水孔１９，１９を通してケース上面側に吸出されるとともに、ケース下面に沿って流れる水がケース体下面の通水孔１８，１８からケース体１０内に吸込まれることになり、従って、ケース下面側に入り込んでケース下面を伝って移動してくる気泡も水とともにケース体１０内に吸込まれるから、ケース下面側の気泡を除去することができる。

すなわち、この水中音響機器の収納ケースは、下面を水平にしかつ上面に船体の前後方向に沿う流線形の脹らみをもたせた中空ケース体１０の上下面に、ケース体内外を連通する通水孔１９，１８を設けたものであるから、ケース下面を通る気泡をなくして、ケース内に収納した水中音響機器Ａ，Ａに本来の機能を十分に発揮させることができる。また、この水中音響機器の収納ケースに

よれば、ケース体１０内に水が充満するから、水中音響機器Ａ，Ａの他にケース体１０内に水温測定器等も収納して、水温の測定等も行なうことができる。

なお、上記実施例では、第８図に示すように水中に垂下される水中音響機器の収納ケースについて説明したが、この考案は、第９図に示すように船側に取付けられる水中音響機器の収納ケースにも適用することができる。すなわち、第６図および第７図はこの考案の他の実施例を示したもので、この実施例は、下面を水平にしかつ上面に船体の前後方向に沿う流線形の脹らみをもたせた中空ケース体１０の上面に、船体１の船側に取付けられる船体取付け金具２０を設けたものであって、その他の構成は上記実施例と同様である。なお、この実施例では、ケース体１０を構成する下ケース１０ａと上ケース１０ｂとを嵌め合わせてビス２１，２１で接合することによってケース体１０の周側面からフランジ等の突起物をなくしており、このようにすれば、ケース上下面の水圧差により

[redacted] [redacted]

ケース下面側から気泡とともに吸引される水が、ケース体内だけでなくケース体外壁面も伝って第6図に破線矢印で示すようにケース上面側に流れるから、さらに良好にケース下面の気泡を除去することができる。

なお、上記実施例では、ケース体１０をＦＲＰ製としているが、このケース体は金属板で形成してもよいし、またケース体１０の平面形状は必ずしも船型でなくてもよい。

〔考案の効果〕

この考案は、ケース体の上面に船体の前後方向に沿う流線形の脹らみをもたせることによってケース上面に沿って流れる水流の流速がケース下面の流速よりも速くなるようにし、これにより気泡がケース上部側に流れやすくするとともに、ケース上面側の高流速域が負圧となるのを利用してケース体内の水をケース体上面の通水孔を通してケース上面側に吸出すことにより、ケース下面に沿って流れる水を気泡とともにケース体下面の通水孔からケース体内に吸込んで、ケース下面側の気

泡を除去するようにしたものであるから、ケース下面を通る気泡をなくして、ケース内に収納した水中音響機器に本来の機能を十分に発揮させることができる。

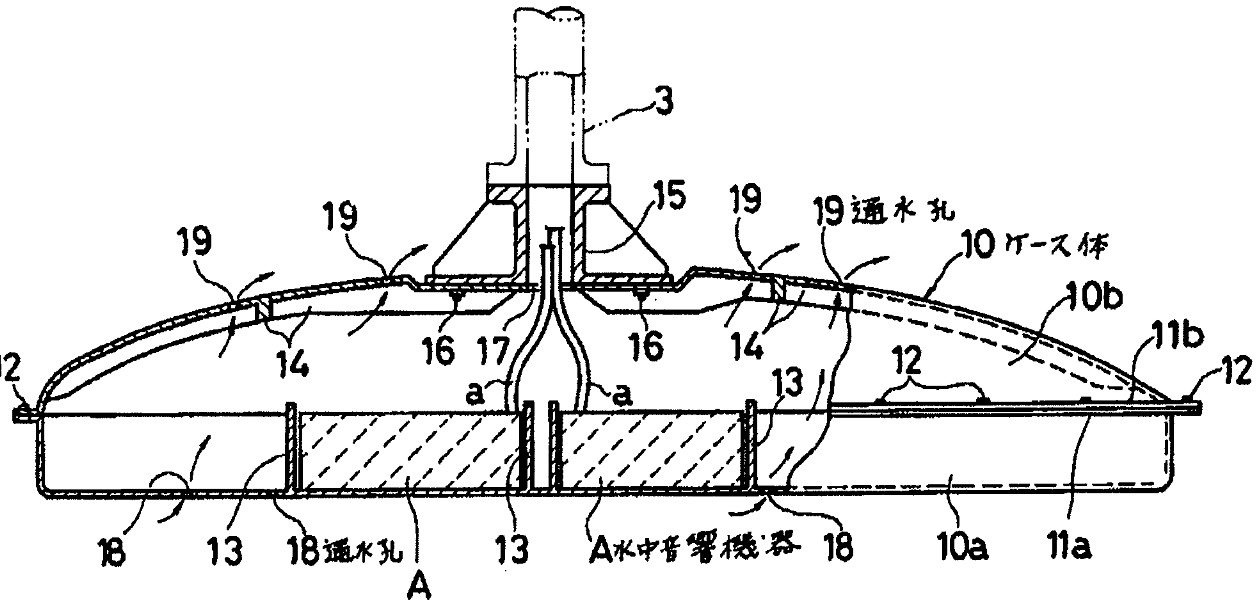
4．図面の簡単な説明

第1図～第5図はこの考案の一実施例を示したもので、第1図および第2図は収納ケースの縦断側面図および縦断正面図、第3図および第4図は収納ケースの平面図および底面図、第5図はケース周囲を流れる水流を示す側面図である。第6図および第7図はこの考案の他の実施例を示す収納ケースの側面図および正面図である。第8図および第9図は船外に装備される水中音響機器の装備方式を示す図である。

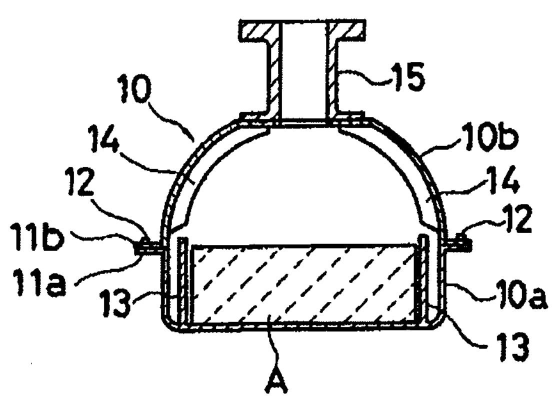
10…ケース体、10a…下ケース、10b…上ケース、18，19…通水孔、A…水中音響機器。

出願人代理人　弁理士　鈴江武彦

[redacted] [redacted]



第 1 図

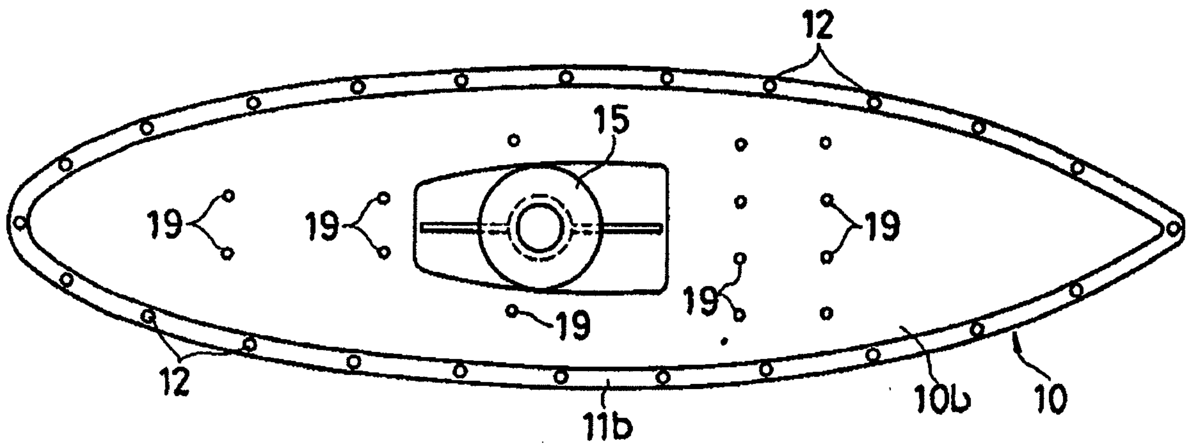


第 2 図

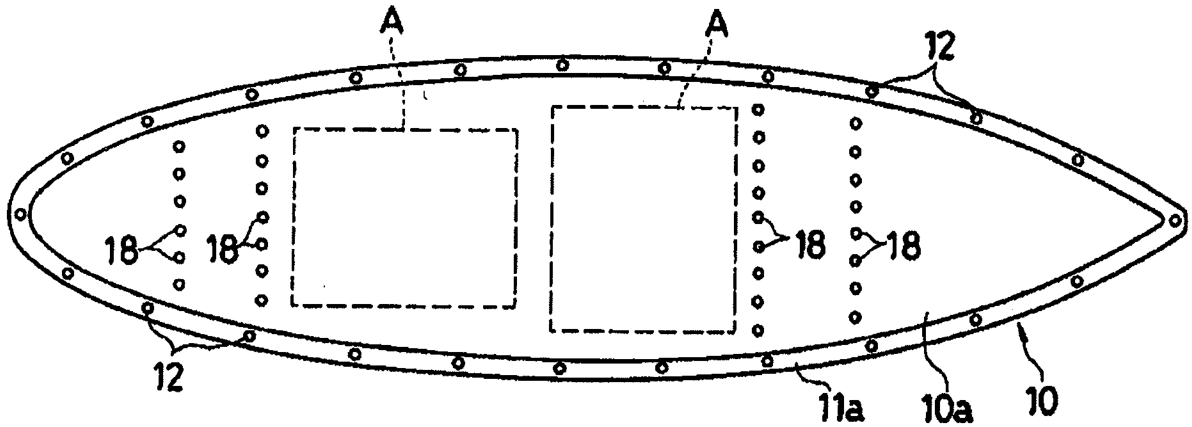
801

実開62-99877

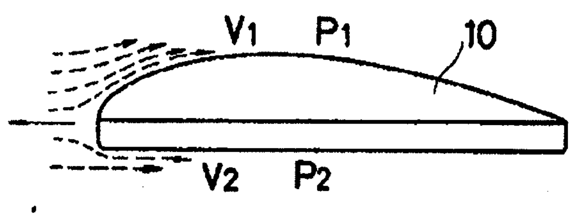
出願人 日本飛行機株式会社
代理人 鈴江武彦



第3図



第4図



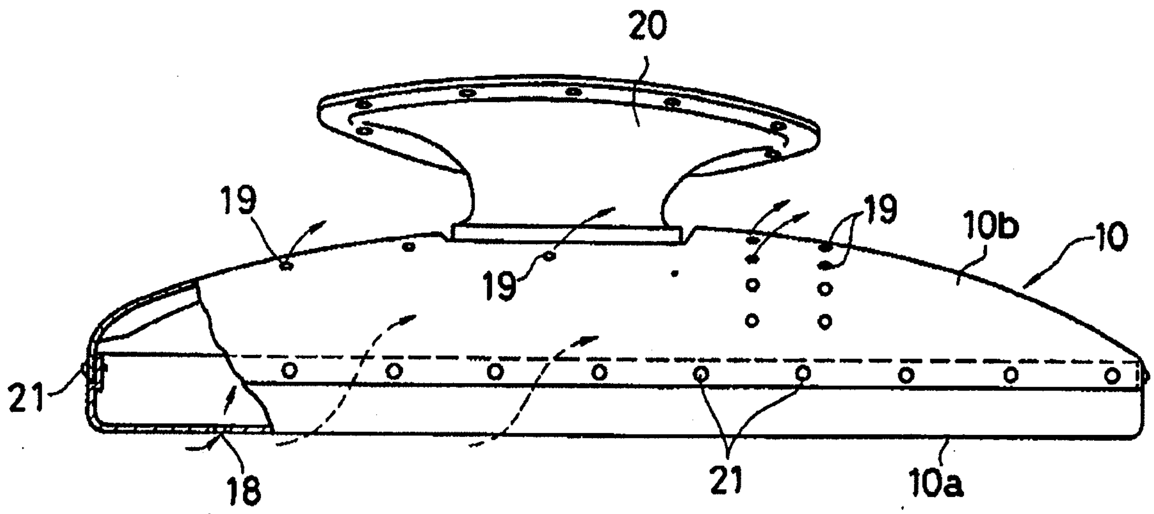
第5図

802

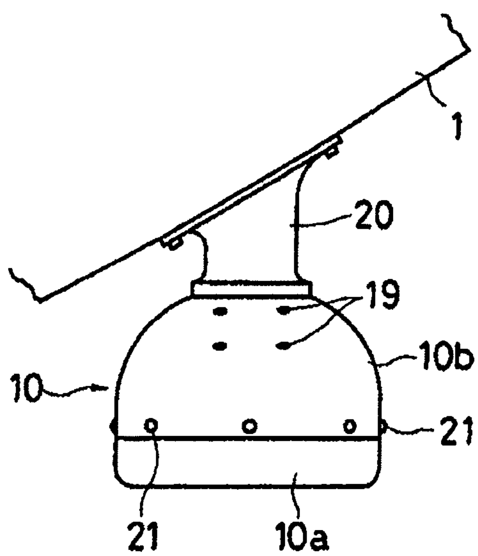
実開62-99877

出願人 日本飛行機株式会社
代理人 鈴江武彦

[redacted] [redacted]



第 6 図

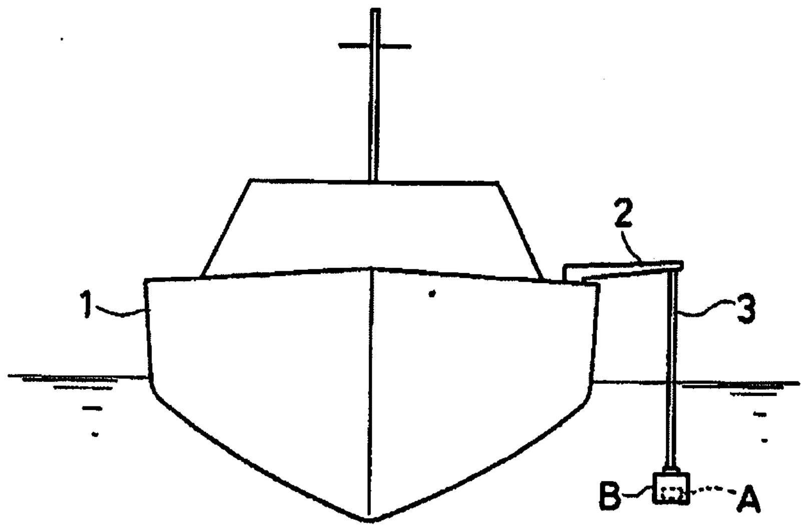


第 7 図

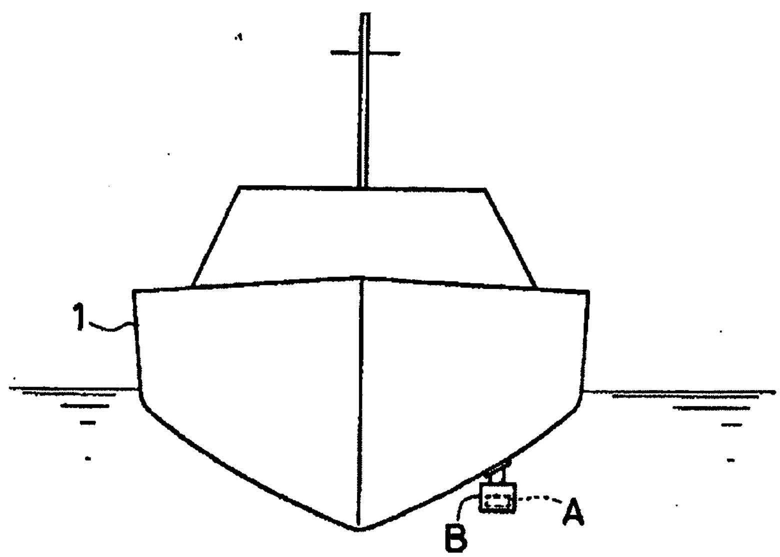
803

実開 62-99877

出願人 日本飛行機株式会社



第8図



第9図

804
実開62-99877

出願人 日本飛行機株式会社

Espacenet

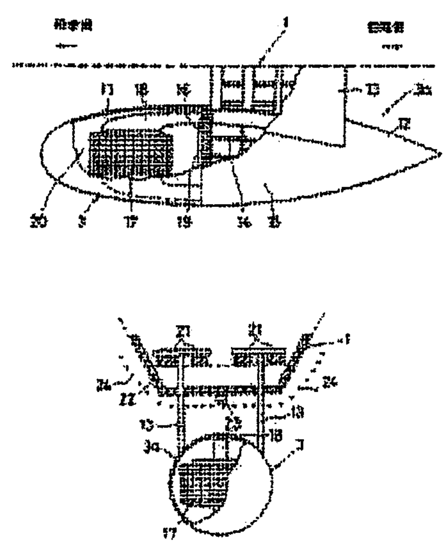
Bibliographic data: JP62190480 (A) — 1987-08-20

PROTECTING DEVICE FOR SONAR TRANSMITTER AND RECEIVER

Inventor(s):	HYODO TAKAYOSHI; KAMEI AKIHIRO ±	
Applicant(s):	JAPAN TECH RES & DEV INST; YOKOHAMA RUBBER CO LTD ±	
Classification:	**- international:**	***G01S7/52; G01S7/521;*** (IPC1-7): G01S7/52
	- European:	
Application number:	JP19860030682 19860217	
Priority number(s):	JP19860030682 19860217	
Also published as:	JP5028792 (B) JP1822078 (C)	

Abstract of JP62190480 (A)

PURPOSE:To improve prevention effect against noises from the bottom of a ship by fitting the columnar coupling material of a protecting device to the ship bottom through a rubber vibration insulator, mounting a sound shield material on the ship bottom, and covering the head part which contains a sonar transmitter and receiver with a rubber type elastic body.



CONSTITUTION:The protecting device 3 which contains the sonar transmitter and receiver 17 is separated from and coupled with the ship bottom 1 through the columnar coupling material 13 which streamlined section.; The device 3 is formed by joining the head part which contains the transmitter and receiver 17 with a tail part 12 made of a rigid body and the jacket of the head part is covered with the rubber elastic body 11 embedded in a fiber reinforcing material and isolated in a watertight state by a clamp 16 and a shield member 19. The upper end part of the coupling material 13 is fitted to the ship bottom 1 through the rubber vibration insulator 21 and the sound shield material 22 is mounted on the ship bottom 1. Air bubbles 24 are generated from an air discharge opening 23 to cover the ship bottom 1. Consequently, the prevention effect against noises from the ship bottom is improved without increase forward projection area.

⑲日本国特許庁（JP）　⑪特許出願公開

⑫公開特許公報（A）　昭62-190480

⑤Int.Cl.⁴　識別記号　庁内整理番号　㊸公開　昭和62年(1987) 8月20日
G 01 S 7/52　B-6903-5J
審査請求 有　発明の数 1 （全3頁）

㊹発明の名称　ソーナー送受波器用保護装置

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明細書

1. 発明の名称

ソーナー送受波器用保護装置

2. 特許請求の範囲

船底から流線形断面の柱状連結材を介してソーナー送受波器を収容した保護装置本体を分離連結したソーナー送受波器用保護装置において、前記柱状連結材の上端部を防振支持部材を介して船底に支持させるとともに、船底に遮音材料を装着し、前記柱状連結材の下端部に連結した保護装置本体を、ソーナー送受波器を収容する頭部と剛体製尾部とで接合させて構成すると共に、前記ソーナー送受波器を収容する頭部の外皮を、繊維補強材を埋設したゴム状弾性体により構成したことを特徴とするソーナー送受波器用保護装置。

3. 発明の詳細な説明

〔産業上の利用分野〕

この発明は、ソーナー送受波器用保護装置に係わり、更に詳しくはソーナー送受波器を船底からできるだけ離して取付けることにより騒音防止効果を上げることが出来、しかも航走抵抗を小さくすることが出来るソーナー送受波器用保護装置に関するものである。

〔従来技術〕

従来、この種のソーナー送受波器用保護装置としては、例えば第1図の投影図に示すように、船底1から柱状連結材2を介してソーナー送受波器を収容した保護装置3を分離連結し、その保護装置3はゴム膜製の外皮が使用されていた。

然し乍ら、このような従来の保護装置3は、騒音源としての船底1から出来るだけ離して取付けられてはいるが、その場合前方投影面積Sが増大し、航走抵抗の増加を招くので、僅かな分離で済ませており、また船底1と装置との最大面積で結合されているので、ソーナー送受波器に対する振動エネルギーは大きく、振動伝達量の小さいゴム膜に対しても多くの吸収材料を必要とする等の問題があった。

〔発明の目的〕

この発明は、かかる従来の問題点に着目して案出されたもので、その目的とするところは騒音源としての船底から保護装置本体を必要とするだけ分離させても、その場合前方投影面積の増大を招くことがなく、またソーナー送受波器を保護装置本体の中心位置に据えることが出来るため、ソーナー送受波器のソーナー送受波器膜面に対する偏りが小さくでき、騒音防止効果を著しく高めることが出来るソーナー送受波器用保護装置を提供するものである。

〔発明の構成〕

この発明は上記目的を達成するため、船底から流線形断面の柱状連結材を介してソーナー送受波器を収容した保護装置本体を分離連結したソーナー送受波器用保護装置において、前記柱状連結材の上端部を防振支持部材を介して船底に支持させるとともに、船底に遮音材料を装着し、前記柱状連結材の下端部に連結した保護装置本体を、ソーナー送受波器を収容する頭部と剛体製尾部とで接合させて構成すると共に、前記ソーナー送受波器を収容する頭部の外皮を、繊維補強材を埋設したゴム状弾性体により構成したことを要旨とするものである。

〔発明の実施例〕

以下添付図面に基いて、この発明の実施例を説明する。

なお以下の説明で、上記従来例と同一構成要素は同一符号を付して説明する。

第2図は、この発明の保護装置の前方投影図を示し、船底1から分離しても増加する面積S1は僅んどないことを示している。

次に、第3図及び第4図はこの発明を実施した保護装置3の側面図と、縦断正面図を示し、3aは保護装置本体、頭部の外皮は補強層を埋設したゴム製膜から成るゴム状弾性体11により構成されている。

また12は流線形の剛体製の尾部、13は尾部12を船底1に取付けるための流線形断面の柱状連結材で、上端は船底1、下端は保護装置3の尾部12に連結支持されている。14は尾部12の骨組であり、その外部は滑かな外板15で覆われており、内部に送受波器用のケーブルや加圧用配管等が通っている。

16はゴム状弾性体11を尾部12に水密性をもって取付けるためのクランプで、尾部12の前縁に一周配置してあり、また17はソーナー送受波器であって、送受波器支持具18で尾部12に結合されている。クランプ16の側面の前面には、吸音材、反射材を組合せた後方からの音響を遮断する遮断部材19が配設され、同時にゴム状弾性体11の内側に加える水圧に対する隔壁をなしている。20はゴム状弾性体11の内側空間部であって、この空間部20には水又は海水が充満され、内圧が加えられてゴム状弾性体11の外形を維持している。

次に、第4図に示す保護装置3を説明すると21は柱状連結材13を船底1と結合する時に使用する防振ゴム等の防振支持部材であって、船底1の振動を柱状連結材13等を伝わる保護装置3に到達することを防止するためのものである。また船底1には遮音材料22が取付けられ、船底1からの音の放射を減らす効果を与える。また23は保護装置3に対応する船底部につけた空気放出口であって、空気を供給することにより気泡24を発生させ、気泡24により船底1を覆うことにより船底1からの音の放射を防ぐ効果を与えるものである。

更に必要に応じて柱状連結材13の柱を昇降させる機構を付加することも可能であり、また保護装置3全体を船底1に収納することも付加できる。

〔発明の効果〕

この発明は上記のように船底から流線形断面の柱状連結材を介してソーナー送受波器を収容した保護装置本体を分離連結したソーナー送受波器用保護装置において、前記柱状連結材の上端部を防振支持部材を介して船底に支持させるとともに、船底に遮音材料を装着し、前記柱状連結材の下端部に連結した保護装置本体を、ソーナー送受波器を収容する頭部と剛体製尾部と

で接合させて構成すると共に、前記ソーナー送受波器を収容する頭部の外皮を、繊維補強材を埋設したゴム状弾性体により構成したため、以下のような優れた効果を奏するものである。

(a). ソーナー送受波器を騒音源としての船底から必要とするだけ分離しても前方からの投影面積の増大を招くことがない。

(b). ソーナー送受波器を円形断面の保護装置の中心に据えられるため、ソーナー送受波器の保護装置膜面に対する偏りが小さくできる。

(c). ゴム膜製保護装置の流れに対する騒音防止効果は従来の半周から全周となるために増加できる。

(d). 船底との柱状連結材は断面積が小さいため防振支持が容易となり、船内雑音の伝達を減らすことができる。

(e). 船底と保護装置とが分離されているので、船底からの放射雑音を遮音材（気泡入りゴム，気泡の放出等）の配置により大巾に低減できる。

(f). 保護装置を船底に収納することができる。

4.図面の簡単な説明

第1図は従来の保護装置を前方から見た投影面図、第2図はこの発明の保護装置を前方から見た投影面図、第3図は保護装置の縦断側面図、第4図は保護装置の正面図である。

1…船底、3…保護装置、3a…保護装置本体、11…ゴム状弾性体、12…尾部、13…柱状連結材、17…ソーナー送受波器、21…防振支持部材、22…遮音材料。

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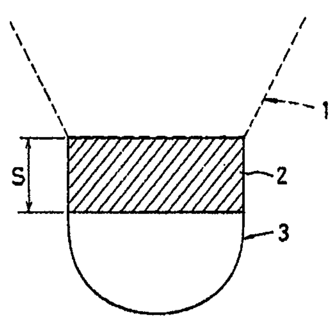
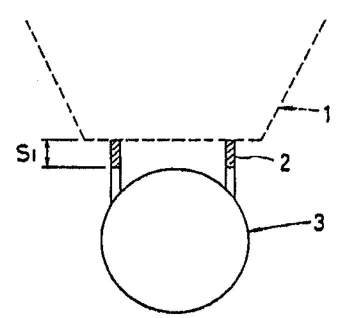
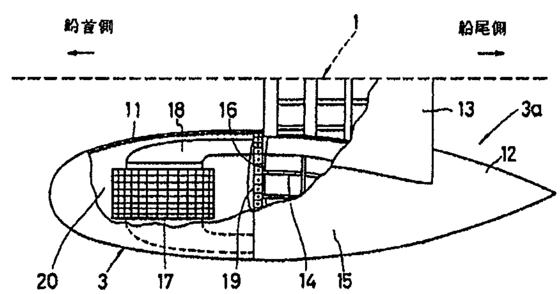
第1図



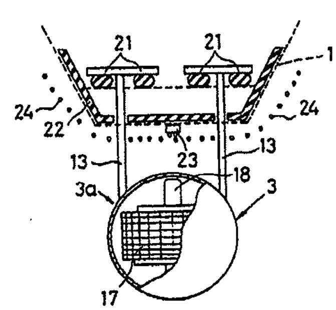
第2図



第3図



第4図



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⑭考案の名称　ソーナドームの取付構造

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明細書

1．考案の名称

ソーナドームの取付構造

2．実用新案登録請求の範囲

水没される船体外板から突出させて設けられるソーナドームの取付構造において、上記ソーナドームと上記船体外板との取付部に、周辺を流れる水流の流線に沿ってこれら間を接続して水流を案内する繊維強化プラスチックで形成したフェアリングプレートを設けたことを特徴とするソーナドームの取付構造。

3．考案の詳細な説明

［産業上の利用分野］

本考案はソーナドームの取付構造に係り、特にソーナドームの取付部周辺における雑音（フローノイズ）の発生を抑制するソーナドームの取付構造に関する。

［従来の技術］

一般に船舶、特に漁船等にあっては、水中へ音波を放射するためや水中を伝播してくる音波

等を捕えるためにソーナが設備されている。このソーナはソーナドームに内蔵されており、このソーナドームaは第4図に示すように、水没される船体外板bに、これより水中へ突出させて設けられている。

[考案が解決しようとする問題点]

ところで従来このソーナドームaは第4図及び第5図に示すように、流体力学的配慮から流線形状で形成されているが、この形状的配慮はソーナドームa単体のみについてであって、船体形状とは別個独立のものとして取り扱われていた。即ち、ソーナドームaと、これが取り付けられる船体外板bとの間の取付部cについては特に注意が払われていなかった。

ここに本願出願人がこの様な形状のドームについて検討したところによれば、その取付部cからは水流に沿ってコーナ渦dが、またソーナドームaの後縁部eから取付部cに向かって剥離渦fが発生する可能性のあることが判明した。これら渦d，fが発生すればそれがフローノイズに関係す

ることは明らかであり、ソーナに悪影響を与える問題があった。

殊に水中放射雑音対策がソーナの性能を充分に発揮させるようになった今日においては、フローノイズ低減の観点からこれら渦d，fの発生の抑制が望まれている。

［問題点を解決するための手段］

本考案は、水没される船体外板から突出させて設けられるソーナドームの取付構造において、ソーナドームと船体外板との取付部に、周辺を流れる水流の流線に沿ってこれら間を接続して水流を案内する繊維強化プラスチックで形成したフェアリングプレートを設けたものである。

［作　用］

フェアリングプレートは、夫々独立に流線形状で形成された従来の船体外板とソーナドームとの間の取付部に介在し、これら船体外板とソーナドームとを滑かに接続して周辺を流れる水流を、その流線の乱れをできる限り抑制しつつ案内して整流化するようになっている。またフェアリングプ

レートを繊維強化プラスチックで形成することにより、フェアリングプレート自体の工作性を良好なものとできるものである。

[実施例]

以下に本考案の好適一実施例を添付図面に従って詳述する。

第1図〜第3図に示すように、水没される船底外板等の船体外板1には、これより水中へ突出させてソーナドーム2が設けられる。このソーナドーム2は、ソーナが内蔵される本体部2aと、この本体部2aを船体外板1に支持させるためのスカート部2bとから構成される。またこのソーナドーム2は第2図に示すように、全体の平面断面が流線形状で形成される。

このように構成されたソーナドーム2、具体的にはソーナドーム2のスカート部2bと、このスカート部2bが直接取り付けられる船体外板1との取付部4には、この部分を覆ってフェアリングプレート5が設けられる。このフェアリングプレート5は、取付部4の周辺を流れる水流の流線に

沿って船体外板１とソーナドーム２との間を接続して水流を案内するように機能する。図示例にあってはフェアリングプレート５は第３図に示すように、横断面において、傾斜した船体外板１と、鉛直下方に延びるスカート部２ｂとの取付部４を、相当の傾斜で滑らかに接続して、水流をスムーズに案内するようになっている。また、フェアリングプレート５は第２図に示すように、平面断面において、流線形状のスカート部２ｂをより大きな曲率半径の弧で囲繞して船体外板１に接続して水流をスムーズに案内するようになっている。このようにフェアリングプレート５は全体として第２図に示すように、取付部４の急峻な形状変更部や曲率半径の小さい部分等を緩かな曲率半径で三次元的に滑らかに接続する形状で形成される。

　またここで、フェアリングプレート５は繊維強化プラスチック（以下「ＦＲＰ」という）で形成される。即ち、フェアリングプレート５を鋼板製とすると、次のような問題がある。

　①　鋼板を使用する場合、その曲面形状の複雑

さから、成型が困難である。

② 防蝕塗装工程が必要となり、工数の増加やコストアップを招く。

③ 鋼板でフェアリングプレートを製造した場合、取付方法として溶接接合が考えられるが、この溶接熱で本体部内のソーナの電子部品に悪影響を及ぼす虞れがある。殊にメンテナンス時、フェアリングプレートを脱着した際に、ソーナの動作を保証するために、調整復旧工事を行なう必要が生ずる。

これに対し本考案にあっては、フェアリングプレート5をＦＲＰで形成することにより、複雑な曲面であっても、曲率半径の小さな部分が存在しても簡単に一体成型することができる。また防蝕塗装を施す必要もない。

他方、本実施例にあっては、フェアリングプレート5は水流の流れ方向に沿って2分割された分割片5ａを組み合わせることで所定の形状となるように構成される。フェアリングプレート5について更に詳述すると、プレート5は表層5ｂが強

度の高いグラファイト繊維強化プラスチック（以下「ＧＦＲＰ」という）で形成され、この表層５ｂと船体外板１及びソーナドーム２との間のコア部５ｃは、水中での外圧によるプレート５自体の圧潰を防止するために、ポリエステル樹脂が充塡されて形成される。またフェアリングプレート５は、自重によりこれと船体外板１との取付部分に大きな応力が生じないようにするため、没水時みかけの比重が 1.0となるように、コア部５ｃに充塡するポリエステル樹脂の比重が調整される。

このように構成されたフェアリングプレート５は、船体外板１に対しては、外板１に予め溶接しておいたスタッドボルト或いはブラケット（図示せず）を利用して取り付けられる。またスタッドボルトに螺合するフェアリングプレート側のナット取付部分は、レセス構造とされ、一般的なゆるみ防止対策を施した後ポリエステル樹脂を充塡し、その上にＧＦＲＰを積層して表面を強化した後、周辺形状に合わせて整形される。このような取付方法を採用することにより、ソーナに対する熱的

悪影響を防止でき、メンテナンス作業を容易化できる。

［考案の効果］

以上要するに本考案によれば、次のような優れた効果を発揮する。

(1) 水没される船体外板と、これより突出させて設けられるソーナドームとの取付部に、フェアリングプレートを設けたので、取付部周辺で渦が発生するのを抑制でき、フローノイズの低減を達成できる。

(2) フェアリングプレートをＦＲＰで形成したので、複雑な曲面部分や曲率半径の小さい部分が存在しても容易に一体成型でき、また塗装も不要なことから良好な工作性、製作コストの低減を確保できる。

4．図面の簡単な説明

第１図は本考案の好適一実施例を示す側面図、第２図はその平面断面図、第３図は第２図におけるⅢ－Ⅲ線矢視断面図、第４図及び第５図は従来例を示す側面図及び平面図である。

図中、1は船体外板、2はソーナドーム、4は取付部、5はフェアリングプレートである。

実用新案登録出願人

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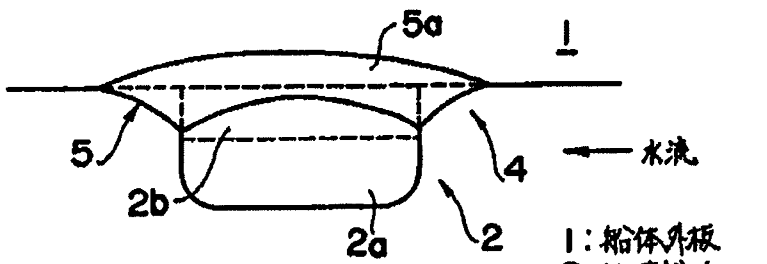
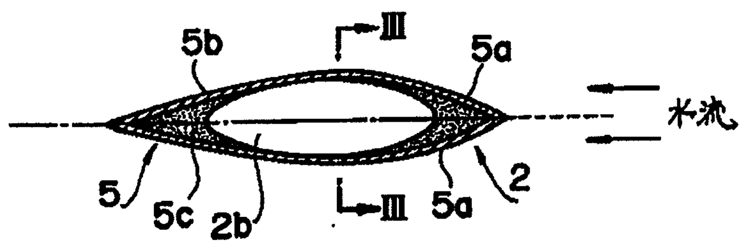
代理人弁理士

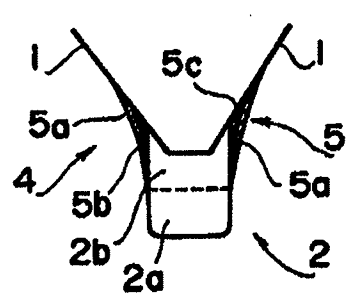
絹谷信雄



第 1 図



第 2 図



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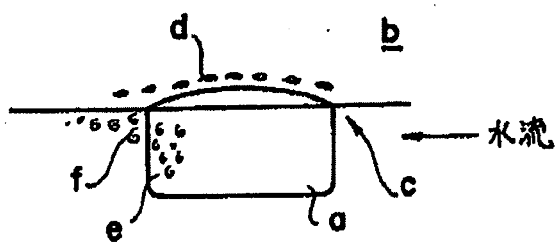
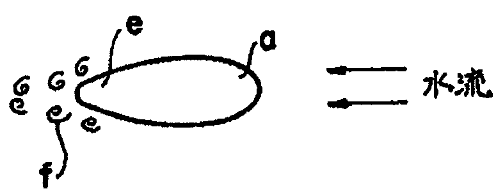
第 3 図



第４図



第５図

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実開62-1340

Espacenet

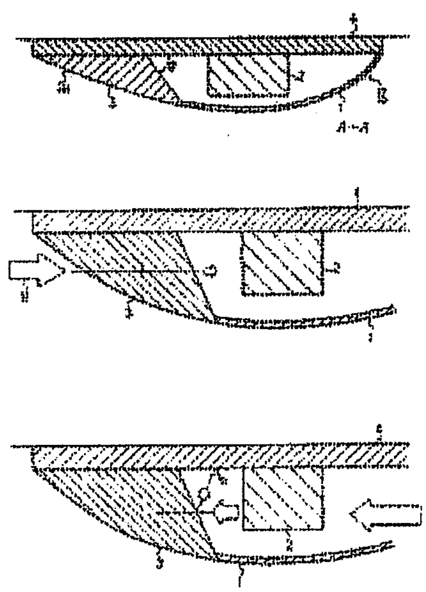
Bibliographic data: JP63261181 (A) — 1988-10-27

SONAR DOME

Inventor(s):	IWASE KOUJI +
Applicant(s):	NEC CORP +
Classification:	**- international:** ***B63G8/39; G01S7/52; G01S7/521;*** (IPC1-7): G01S7/52
	- European:
Application number:	JP19870094689 19870417
Priority number (s):	JP19870094689 19870417

Abstract of JP63261181 (A)

PURPOSE:To remove an unnecessary sound wave effectively without using any baffle plate whose machining is complicated by providing a sound absorber at the rear part so that a sound wave from the rear is intercepted and setting the front surface part of the sound absorber at an acute angle to the fitting surface for a sonar dome. CONSTITUTION:The sonar dome 12 is formed in a streamline lower-half shape and the reflection of a sound at the upper part of the dome is minimized by using a sound absorber. A sound absorber 3 is charged in the dome, the rear part slants gently as shown by 3a, and the side of a transmitter and receiver 2 is at an acute angle theta to the surface of a skirt part 4. Then when a ship body radiation noise 11 arrives from the rear, the sound absorber 3 absorbs the noise 11 and a noise reaching the transmitter and receiver 2 is extremely small. Further, a sound from the front reaches the front surface of the sound absorber 3 and the majority of it is absorbed, but the remainder is reflected. The reflected component is reflected toward the skirt part 4 because the front surface of the sound absorber 3 is at the acute angle to the skirt part 4, and absorbed by the skirt part 4. A component reflected by the skirt part 4 is extremely small and there is no influence upon the transmitter and receiver 2.



⑲日本国特許庁（JP）　⑪特許出願公開

⑫公開特許公報（A）　昭63-261181

㉛Int.Cl.⁴　識別記号　庁内整理番号　㊸公開　昭和63年(1988)10月27日
G 01 S　7/52　B－6903－5J

審査請求　未請求　発明の数　1　（全4頁）

㊿発明の名称　ソーナードーム

㉑特　願　昭62－94689
㉒出　願　昭62(1987)4月17日

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㉑出願人　日本電気株式会社　東京都港区芝5丁目33番1号
㉔代理人　弁理士　井ノ口　壽

明　細　書

1.発明の名称

ソーナードーム

2.特許請求の範囲

流線形状の下半分の形状をなし、中央部に送受波器を収容するソーナードームにおいて、後方部に吸音材を、後方部からの音波を前記送受波器に対して遮音するように設け、かつ、吸音材の前面部が、ソーナードームの取付面に対し鋭角になるような角度とし、前方からの音波の当該吸音材で吸収されない成分を前記送受波器以外の部分に反射するように構成したことを特徴とするソーナードーム。

3.発明の詳細な説明

（産業上の利用分野）

本発明はソーナードームの構造、さらに詳しく云えば後方から発せられる船体の放射雑音に対する影響の軽減化を考慮したソーナードームに関する。

（従来の技術）

ソーナー装置における問題の一つに船体後方から放射される雑音がある。

従来はこの雑音の低減化方法として第5図および第6図に示すようにドーム内後方にバッフル板を取付けている。

第5図はソーナードームのB－B断面図であり、第6図はソーナードーム外殻を取除いて底面から見た図である。各図において、ソーナードーム10は船底9に固着されており、スカート部8とソーナードーム外殻部5より構成されている。

ソーナードーム10の中央部には送受波器6が収容されている。船体後方からの放射雑音11は上述のように送受波器6の後方に設けられているバッフル板7によつて遮ぎられる。

（発明が解決しようとする問題点）

しかしながら従来の低減化方法は

①　ソーナードーム以外にドーム内部にバッフル板を設けなければならない。

② また、音波の回折する角度は大きいことから、バッフル板のエッジより音が回折して送受波器に雑音が入射する。

③ 従来のバッフル板はその前面部を吸音部、後面部を遮音材としているのでバッフル板の加工が複雑になる、という欠点があつた。

本発明の目的は上述の欠点を解決したソーナードームを提供することにある。

(問題点を解決するための手段)

前記目的を達成するために本発明によるソーナードームは流線形状の下半分の形状をなし、中央部に送受波器を収容するソーナードームにおいて、後方部に吸音材を、後方部からの音波を前記送受波器に対して遮音するように設け、かつ、吸音材の前面部が、ソーナードームの取付面に対し鋭角になるような角度とし、前方からの音波の当該吸音材で吸収されない成分を前記送受波器以外の部分に反射するように構成してある。

(実 施 例)

以下、図面を参照して本発明をさらに詳しく説明する。第1図は本発明によるソーナードームの実施例を示すA－A断面図、第2図はソーナードームの外殻を取除いた底面図である。

ソーナードーム12は流体雑音の少ない流線形の下半分の形状をしている。

ドームのスカート部4には吸音材を用いて、ドーム上部での音の反射を最小限になるようにしている。

ドーム内後部に吸音材3を充填し、第1図、第2図に示すような形状を形成している。

すなわち後方部は緩やかな傾斜3aとし、送受波器側はスカート部4の面に対し鋭角θになるように、かつ底面から見た場合、外延が曲線3bになるような形状である。

第3図および第4図は遮音効果を説明するためのソーナードームの断面図である。

第3図は船体放射雑音が後方から入射した場合の図で、吸音材3によつて船体放射雑音11が吸音され、送受波器2に到達する雑音は微少な

ものとなる。

第4図は前方からの音波で、吸音材3の前面に入射し、大部分は吸収されるが、その一部が反射する。反射成分は吸音材3の前面の傾斜がスカート部4に対して鋭角であるので、スカート部4に向かつて反射され、スカート部4で吸音され、さらにその一部が反射する。しかし、スカート部4で反射される成分は微少であるので送受波器2にほとんど影響を及ぼすことはない。

また、吸音材3の前面の中央付近ではなく左右に入射した音波は大部分が吸音され、反射成分は第2図の3bの曲線形状より明らかなように送受波器2の方向ではなく外側に反射される。

(発明の効果)

以上、説明したように本発明はソーナードームの後方部に吸音材を充填し、後方部からの船体の放射雑音を送受波器に対し遮ぎるような形状とし、かつ送受波側の面を、ドームスカート部に対し鋭角にして前方からの音波の反射成分が送受波器以外の方向に反射されるように構成

されているので、加工が複雑であるバッフル板を用いることなく効果的に不要音波を除去できるという効果がある。

4.図面の簡単な説明

第1図は本発明によるソーナードームの実施例を示すA－A断面図、第2図は第1図のソーナードームで、その外殻を取除いて底面から見た図、第3図、第4図は遮音効果を説明するための図で、第3図は音源が後方にある場合、第4図は音源が前方にある場合である。

第5図は従来のソーナードームの一例を示すB－B断面図、第6図は従来のソーナードームで、その外殻を取除いて底面から見た図である。

1…流線形ソーナードーム

2…送受波器　　3…吸音材

4…ソーナードームスカート部(吸音材施行)

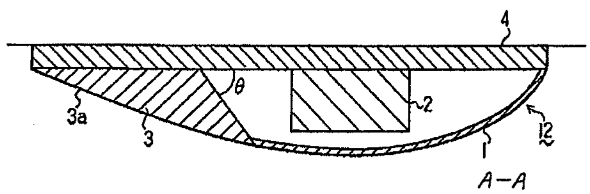
5…ソーナードーム外殻　　6…送受波器

7…バッフル板

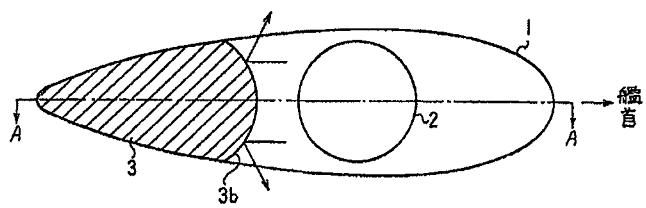
8…ソーナードームスカート部

9…船底　　10…ソーナードーム

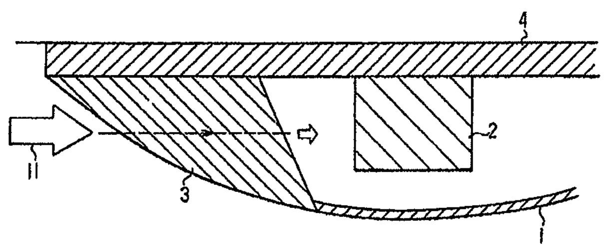
第1図



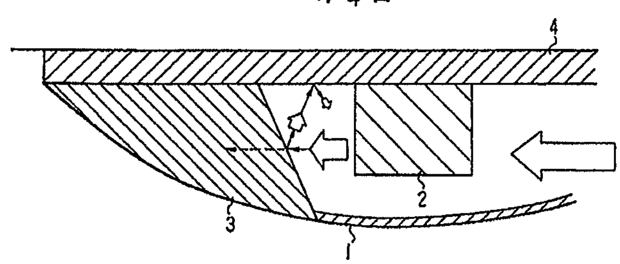
第2図



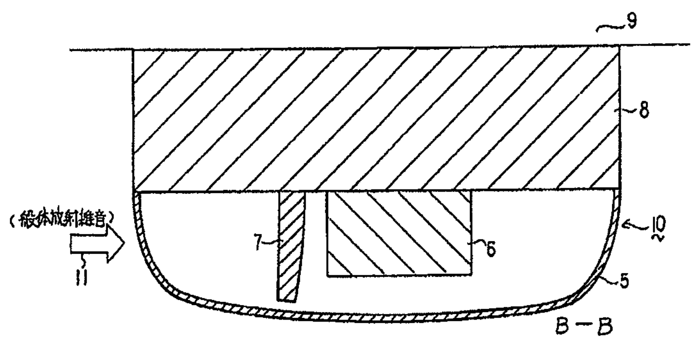
第3図



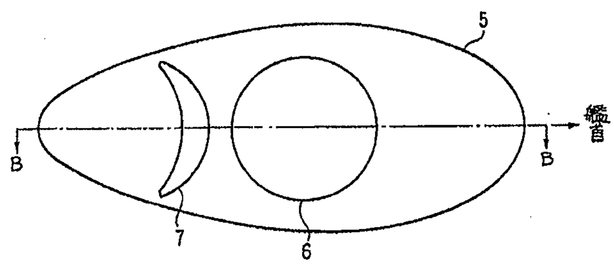
第4図



第5図



第6図



Espacenet

Bibliographic data: JP7031042 (A) — 1995-01-31

LAYING METHOD OF UNDERWATER CABLE

Inventor(s): YAMADA NORIO; OTONARI TADAMASA +

Applicant(s): FUJIKURA LTD +

Classification:
- international: ***G01S15/06; H02G1/10; H02G9/02;*** (IPC1-7): G01S15/06; H02G9/02
- European:

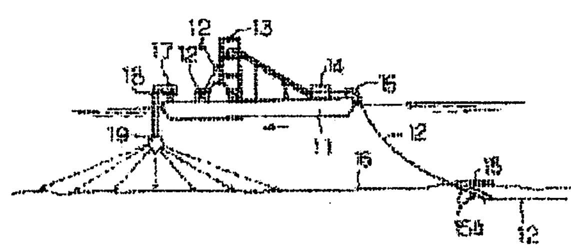
Application number: JP19930193132 19930708

Priority number (s): JP19930193132 19930708

Also published as: JP2977175 (B2)

Abstract of JP7031042 (A)

PURPOSE:To avoid an obstacle positively while monitoring the bottom face of water by scanning the advancing direction of a cable laying boat over the width thereof using a side-scan sonar provided for the cable laying boat. CONSTITUTION:A cable laying boat 11 sails on a cable laying route and feeds a underwater cable 12 continuously thus laying the cable on the bottom face of water. In this regard, a side-scan sonar 19 scans the advancing direction (shown by an arrow) of the boat 11 while reciprocating in the breadthwise direction of the boat 11 perpendicular to the advancing direction of the boat 11. Consequently, the forward position of the boat 11 can be monitored over some range in the breadthwise direction from the cable laying position. This method can find and avoid an obstacle located on the cable laying route or in the vicinity thereof and can lay the cable 12 in safety.



(12) Official Gazette of Unexamined Patent Applications (A)

(19) Japan Patent Office (JP)

(11) Patent Application Publication No. Hei 7[1995]-31042

(43) Publication Date January 31, 1995

(51) Int. Cl.^{6}:	ID Codes	Sequence Nos. for Office Use	FI	Technical Disclosure Section
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G01S 15/06		9382-5J		

Examination Request: Not requested No. of Claims: 1 FD (Total of 3 pages)

(21) Filing No.: Hei 5[1993]-193132

(22) Filing Date: July 8, 1993

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(54) [Title] Method for Laying Underwater Cable

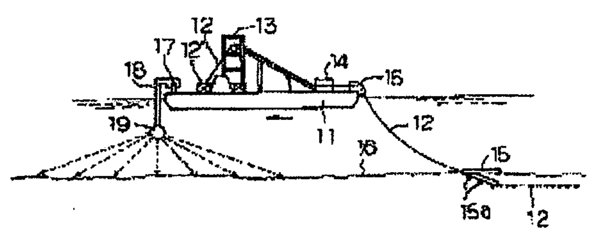
(57) Abstract

Objective

To avoid obstructions reliably and lay underwater cable while monitoring the seafloor surface.

Constitution

A side-scan sonar 19 that scans to the front of and behind the direction of advance of a cable-laying ship 11 is provided on the cable-laying ship so as to be capable of moving in a reciprocating manner in the width direction of the ship. The cable-laying ship 11 buries an underwater cable 12 by means of an underwater cable burying machine 15 while monitoring the seafloor surface 16 in front of the ship for a range that is the width of the ship 11 by means of the side-scan sonar 19, which scans to the front of and behind the direction of advance of the ship. If an obstruction exists on or in the vicinity of the laying route, this obstruction can be discovered and avoided with sufficient leeway, and the cable-laying operation can be performed safely.



Claims
Claim 1
A method for laying underwater cable characterized in that underwater cable on a cable-laying ship is continuously laid on the sea floor [literally, 'bottom of the water'] while a side-scan sonar, which moves in a reciprocating manner in the lateral direction of the ship, perpendicularly with respect to the direction of advance of the cable-laying ship, scans in front of and behind the direction of advance of the cable-laying ship to monitor the surface of the sea floor.

Detailed Explanation of the Invention
[0001]
Industrial Application Field
This invention pertains to a method for laying underwater cable whereby underwater cable is reeled out from a cable-laying ship that is traveling, and this cable is laid on and buried in the sea floor; in particular, it pertains to a method for laying underwater cable that is executed while monitoring for the presence of obstructions on the surface of the sea floor.

[0002]
Prior Art
During an underwater cable laying operation whereby an underwater cable (primarily a seafloor cable) is reeled out from a cable-laying ship and is laid and buried simultaneously using a burying machine that is towed by the cable-laying ship, when there is an obstruction on the surface of the sea floor, it becomes impossible to lay and bury the underwater cable, or there is the risk of an accident, such as when the burying machine strikes the obstruction and overturns; therefore, to avoid this situation it is necessary to scan the surface of the sea floor on the underwater cable laying route to confirm whether obstructions exist. Therefore, as shown in Figure 4, with the prior art a side-scan sonar 1 is towed along the laying route by a tow 2 prior to the operation to lay the underwater cable, and as shown in Figure 5 a suitable width B of the surface of the sea floor 3) is scanned to the left and right, at right angles with respect to the cable-laying route, to check for the presence of obstructions. In addition, as described above the suitable width B is scanned because the actual location where the cable is laid sometimes varies slightly from the predetermined location, so the scanning must be performed with some amount of a margin (range) in the left/right directions.

[0003]
Problem to be Solved by the Invention
As described above, with the conventional method the check for the presence of obstructions is not performed simultaneously with the operation of laying the underwater cable; in other words, the check is performed prior to the laying of the cable. Therefore, if there is any change on the surface of the sea floor in the interval between the completion of the investigation of the seafloor surface and the start of the laying work – for example, if anything that would become an obstruction to the burying machine on the laying route is illegally dumped – the laying operation is performed without recognizing this situation,

despite this dangerous change in the laying route due to this [literally, 'inconvenience'], and therefore there is a risk that an unforeseen accident may occur.

[0004]
The present invention has been devised in light of the aforementioned points, the objective being to provide a novel method for laying underwater cable with which it is possible to lay and bury an underwater cable safely by monitoring the seafloor surface and reliably avoiding obstructions when laying and burying, by means of a burying machine, an underwater cable that is reeled out from a cable-laying ship.

[0005]
Means to Solve the Problem
The method of the present invention, which solves the aforementioned problem, is characterized in that underwater cable on a cable-laying ship is continuously laid on the sea floor while a side-scan sonar, which moves in a reciprocating manner in the lateral direction of the cable-laying ship perpendicularly with respect to the direction of advance of the cable-laying ship, scans in front of and behind the direction of advance of the cable-laying ship to monitor the surface of the sea floor.

[0006]
Operation
With the aforementioned configuration the cable-laying ship travels on the cable-laying route and continuously reels out and lays on the sea floor the underwater cable that is stacked [on the ship]. In this case, the side-scan sonar moves in a reciprocating manner in the lateral direction of the ship, perpendicularly with respect to the direction of advance of the cable-laying ship, scanning in front of and behind the direction of advance of the cable-laying ship; therefore, it is possible to monitor the area in front of the cable-laying ship some distance to the left and right of the planned location for laying of the cable. Accordingly, if an obstruction exists on or in the vicinity of the laying route, this obstruction can be discovered and avoided with sufficient leeway, and the cable can be laid safely.

[0007]
Application Example
In the following, one application example of the present invention will be explained with reference to Figure 1 and Figure 2. In Figure 1, code 11 is a cable-laying ship. This cable-laying ship 11 performs an operation whereby, for example, an underwater cable 12 from a cable coil 12' passes through a tower 13, a brake 14, a stern sieve 15, and the like, and the underwater cable 12 is buried simultaneously with the excavation of the seafloor surface 16 by a burying machine 15 towed with a wire rope. Typically a water-jet burying machine or a ski-type burying machine is used for the burying machine 15. The burying machine 15 shown in the figure is water-jet burying machine equipped with a nozzle 15a that sprays water.

[0008]
The aforementioned configuration is the typical conventional configuration, but with the application example of this invention a rail-type frame 17, which extends in the width direction of the ship (the direction of arrow (a) in Figure 2) and is for attachment of the-side scan sonar, is installed at the bow of the ship. A side-scan sonar 19, which scans in the direction perpendicular to the direction of movement along the frame 17 (in other words, the width direction of the ship), is attached to the lower end of a reverse-L-shaped support member 18 that moves in a reciprocating manner in the width direction of the ship along this frame 17. Accordingly, as shown in Figure 1 this side-scan sonar 19 scans to the front of and behind the direction of advance of cable-laying ship 11.

[0009]

When the operation to lay the underwater cable is performed by cable-laying ship 11 and burying machine 15, the underwater cable 12 is continuously reeled out from the cable coil 12' and laid and buried on the seafloor surface 16 as the cable-laying ship 11 travels along the laying route and the seafloor surface is excavated by underwater cable burying machine 15. In this case, side-scan sonar 19 moves along frame 17 in a reciprocating manner in the width direction of the ship (the arrow (a) direction), which is the direction perpendicular to the direction of advance of cable-laying ship 11. Accordingly, side-scan sonar 19 scans thoroughly to the front of and behind the direction of advance of cable-laying ship 11 as far as the width B' of cable-laying ship 11. Thus, the area in front of the ship can be monitored for a range having a margin that is the width B' to the left and right from the predetermined cable-laying (burying) location. Accordingly, if an obstruction exists on or in the vicinity of the laying route, this obstruction can be discovered and avoided with sufficient leeway, and the cable-laying operation can be performed safely.

[0010]
In addition, as in the application example the position where the side-scan sonar 19 is provided suitably is the bow of the ship, but it is not necessarily restricted to the bow of the ship; it can be an intermediate position, or the stern of the ship. Furthermore, with the application example the explanation involved the burying of the underwater cable 12 using the underwater cable burying machine 15, but the present invention also can be applied when the cable is merely laid without excavating the seafloor surface 16. Furthermore, the cable-laying ship can be a self-propelled type or can be a towed type.

[0011]
Effect of the Invention
By means of the present invention an underwater cable is laid on the sea floor while a side-scan sonar, which is provided on the cable-laying ship so as to be capable of moving in a reciprocating manner in the width direction of the ship, scans to the front of and behind the direction of advance of the cable-laying ship and monitors the seafloor surface for a range that is almost the same as the width of the ship. Therefore, it is possible to scan the area in front of the cable-laying ship over a range that is [almost] the same as the width of the ship. Accordingly, if an obstruction exists on or in the vicinity of the laying route, this obstruction can be discovered and avoided with sufficient leeway, and the cable-laying operation can be performed appropriately and safely. This is particularly effective for underwater cable laying and burying operations wherein an underwater cable is buried using an underwater cable burying machine.

Brief Description of the Figures
Figure 1 is a schematic explanatory diagram showing the laying of underwater cable by the method of one application example of the present invention.
Figure 2 is a plan view of Figure 1.
Figure 3 is a front view of Figure 1.
Figure 4 is a diagram for the purpose of explaining the conventional method; it illustrates the state in which the sea floor is being investigated by means of a side-scan sonar towed body prior to the laying of a underwater cable.
Figure 5 is a front view of Figure 4.

Explanation of Codes
11 Cable-laying ship
12 Underwater cable
15 Underwater cable burying machine
16 Sea floor
17 Frame
18 Support member

19 Side-scan sonar

Fig. 1

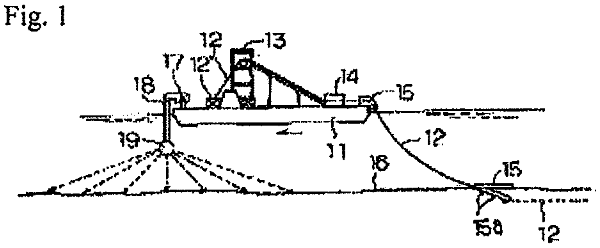


Fig. 2

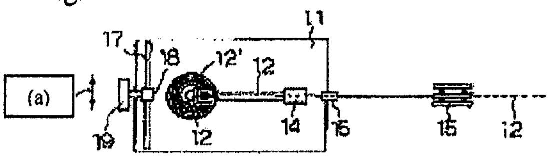


Fig. 3

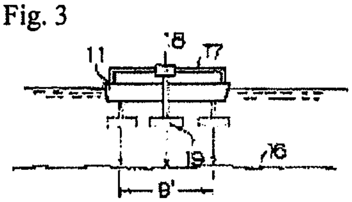


Fig. 4

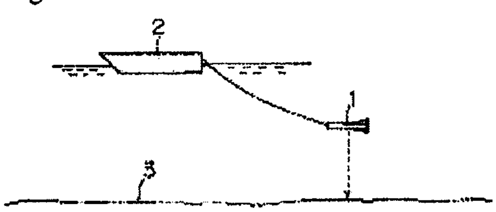
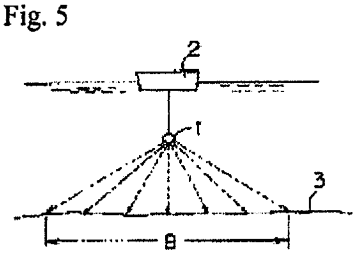


Fig. 5



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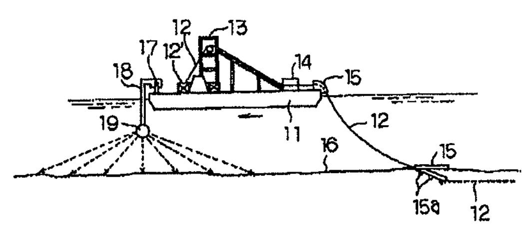
(54)【発明の名称】　水底ケーブルの布設方法

(57)【要約】

【目的】　水底面を監視しながら障害物を確実に回避して水底ケーブルを布設する。

【構成】　ケーブル布設船11に，ケーブル布設船進行方向の前後を走査するサイドスキャンソナー19を布設船幅方向に往復移動可能に設ける。ケーブル布設船11は進行方向前後に走査するサイドスキャンソナー19により前方の水底面16を布設船11の幅の範囲にわたって監視しながら，水底ケーブル埋設機15により水底ケーブル12を埋設する。布設ルートおよびその近傍に障害物があれば，その障害物を十分余裕を持って発見して回避することができ，水底ケーブルの布設作業を安全に行うことができる。



【特許請求の範囲】

【請求項1】 ケーブル布設船の進行方向と直交する布設船幅方向に往復移動するサイドスキャンソナーによりケーブル布設船進行方向の前後を走査して水底面を監視しつつ，ケーブル布設船上の水底ケーブルを水底に繰り出し布設していくことを特徴とする水底ケーブルの布設方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】この発明は，航行するケーブル布設船から水底ケーブルを繰り出して，これを水底に布設埋設していく水底ケーブルの布設方法に関し，特に，水底面の障害物の有無を監視しつつ行う水底ケーブルの布設方法に関するものである。

【0002】

【従来の技術】ケーブル布設船により曳航される埋設機を用いて，ケーブル布設船からり繰り出される水底ケーブル（主として海底ケーブル）を水底面の掘削と同時に布設埋設していく水底ケーブルの布設作業において，水底面に障害物があると，水底ケーブルを布設埋設していくことができなくなるばかりか，埋設機が障害物に衝突して転倒する等の事故を生じるおそれがあるので，これを避けるために，水底ケーブル布設ルートの水底面を調査して，障害物の有無を確認する必要がある。このため従来は，水底ケーブルの布設作業に先立ち，予め図4に示すようにサイドスキャンソナー1を布設ルートに沿って曳船2で曳航しつつ，図5に示すように布設ルートと直交する左右方向の適宜幅Bの水底面3を走査して，障害物の有無の確認を行っている。なお，上述のように適宜幅Bを走査しておくのは，実際のケーブル布設位置が予め決定しておいた位置から若干左右にずれる場合があるので，左右方向にある程度の余裕（範囲）を持たせて調査する必要があるからである。

【0003】

【発明が解決しようとする課題】上記のように従来の方法では，障害物の有無の確認が水底ケーブルの布設作業と同時に行われるものではないため，つまりケーブルの布設に先立ち予め行っておくものであるため，水底面調査を終了してから布設作業を開始するまでの間に布設ルートの水底面に何らかの変化があった場合，例えば布設ルート上に埋設機にとって障害となるものが不法投棄された場合等には，布設ルートがこのように不都合で危険な状態に変化しているにもかかわらず，このような状況を把握し得ないまま布設作業を行ってしまうことになり，そのため不慮の事故に遭遇するおそれがあった。

【0004】本発明は上記の点に鑑みなされたもので，ケーブル布設船から繰り出した水底ケーブルを埋設機によって布設埋設していく際に，水底面を監視しつつ障害物を確実に回避して水底ケーブルを安全に布設埋設することのできる新規な水底ケーブルの布設方法を提供することを目的とする。

【0005】

【課題を解決するための手段】上記課題を解決する本発明の水底ケーブルの布設方法は，ケーブル布設船の進行方向と直交する布設船幅方向に往復移動するサイドスキャンソナーによりケーブル布設船進行方向の前後を走査して水底面を監視しつつ，ケーブル布設船上の水底ケーブルを水底に繰り出し布設していくことを特徴とする。

【0006】

【作用】上記構成において，ケーブル布設船は布設ルート上を航行し，積載した水底ケーブルを連続的に繰り出して水底に布設する。その際，サイドスキャンソナーは，ケーブル布設船の進行方向と直角な布設船幅方向に往復移動しながら布設船進行方向の前後を走査するので，ケーブルの布設予定位置から左右方向にある程度の幅をもった範囲でケーブル布設船の前方位置を監視することができる。したがって，布設ルートおよびその近傍に障害物があれば，この障害物を十分余裕を持って発見して回避することができ，ケーブルを安全に布設していくことができる。

【0007】

【実施例】以下，本発明方法の一実施例を図1，図2を参照して説明する。図1において，符号11はケーブル布設船である。このケーブル布設船11は，例えばケーブルコイル12'よりヤグラ13，ブレーキ14，船尾シーブ15等を経て水底ケーブル12を繰り出し，ワイヤロープで牽引する埋設機15で水底面16を掘削すると同時に水底ケーブル12を埋設する作業を行う。前記埋設機15は，ウォータジェット埋設機またはスキ式埋設機が通常用いられる。図示例の埋設機15はウォータジェット埋設機であり，水を噴射するノズル15aを備えている。

【0008】上述の構成は従来の一般的な構成であるが，この発明の実施例では，ケーブル布設船11の例えば船首側に布設船幅方向（図2の矢印（イ）方向）に延びるサイドスキャンソナー取付用のレール状の架台17を設置し，この架台17に沿って布設船幅方向に往復駆動される逆L字形の支持部材18の下端に，架台17に沿う移動方向（すなわち布設船幅方向）に対して直交する方向に走査するサイドスキャンソナー19を取り付けている。したがって，このサイドスキャンソナー19は，図1に示すようにケーブル布設船11の進行方向の前後に走査する。

【0009】上記のケーブル布設船11および埋設機15により水底ケーブルの布設作業を行う場合，ケーブル布設船11は布設ルート上を航行し，水底ケーブル埋設機15により水底面16を掘削しながら，ケーブルコイル12'より水底ケーブル12を連続的に繰り出して水底面に布設埋設する。その際，サイドスキャンソナー19は，架台17に沿ってケーブル布設船11の進行方向

と直角な布設船幅方向（矢印（イ）方向）に往復移動する。したがって，サイドスキャンソナー１９は，ケーブル布設船１１の進行方向前後をほぼケーブル布設船１１の幅Ｂ’の範囲についてくまなく走査する。これによりケーブルの布設（埋設）予定位置から左右方向に幅Ｂ’なる余裕をもった範囲の布設船１１の前方位置が監視され，障害物の有無の確認がなされる。したがって，布設ルートおよびその近傍に障害物があれば，その障害物を十分余裕をもって発見して回避することができ，ケーブルの布設作業を安全に実施することができる。

【００１０】なお，サイドスキャンソナー１９を設ける位置は実施例のように船首側が適当であるが，必ずしも船首に限定されず，中間位置あるいは船尾でもよい。また，実施例では，水底ケーブル埋設機１５を用いて水底ケーブル１２を埋設する場合について説明したが，水底面１６を掘削せずに布設する単なるケーブル布設だけの場合にも本発明の適用が可能である。さらに，ケーブル布設船は自航式でも曳船式でもよい。

【００１１】

【発明の効果】本発明によれば，ケーブル布設船に布設船幅方向に往復移動可能に設けたサイドスキャンソナーでケーブル布設船進行方向前後をほぼ布設船の幅の範囲にわたって走査して水底面を監視しながら，水底ケーブルを水底に布設するものであるから，走行中のケーブル布設船の前方位置を布設船の幅の範囲にわたって監視することができる。したがって，布設ルートおよびその近傍に障害物があれば，その障害物を十分余裕を持って発見して回避することができ，ケーブル布設作業を適切かつ安全に実施することができる。特に，水底ケーブル埋設機を用いて水底ケーブルを埋設する水底ケーブル布設埋設作業において効果的である。

【図面の簡単な説明】

【図１】本発明の一実施例の方法により水底ケーブルを布設している状況を示す概略説明図である。

【図２】図１の平面図である。

【図３】図１の正面図である。

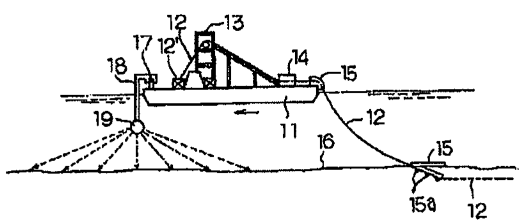
【図４】従来方法を説明するもので，水底ケーブルの布設作業に先き立って，サイドスキャンソナー曳航体により水底面の調査を行っている状態の説明図である。

【図５】図４の正面図である。

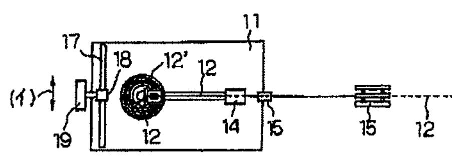
【符号の説明】

１１　ケーブル布設船
１２　水底ケーブル
１５　水底ケーブル埋設機
１６　水底面
１７　架台
１８　支持部材
１９　サイドスキャンソナー

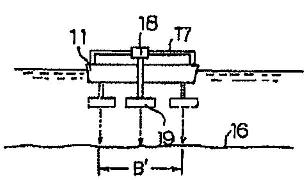
【図１】



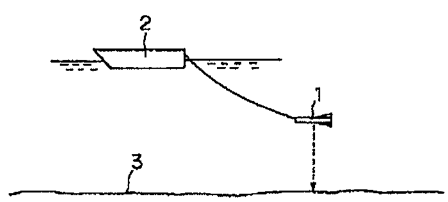
【図２】



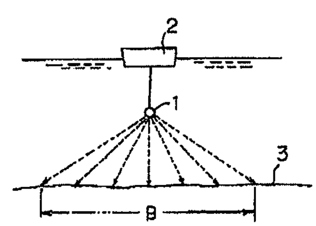
【図３】



【図４】



【図５】



Espacenet

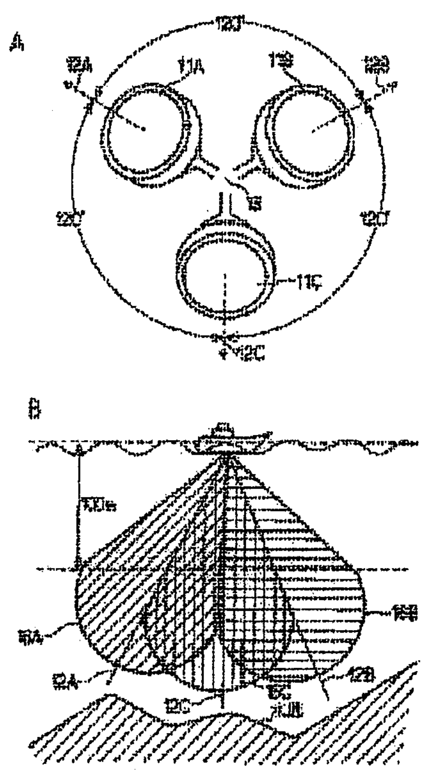
Bibliographic data: JP10186030 (A) — 1998-07-14

DIRECTION DETECTABLE FISH FINDER

Inventor(s):	ISHIKAWA YOSHINAO; KATO TAKESHI; NAGAREGO SHIGERU ±	
Applicant(s):	KODEN ELECTRONICS CO LTD ±	
Classification:	**- international:**	***G01S15/06; G01S15/96;*** (IPC1-7): G01S15/06; G01S15/96
	- European:	
Application number:	JP19970296716 19971029	
Priority number (s):	JP19970296716 19971029; JP19960290506 19961031	
Also published as:	JP3849999 (B2)	

Abstract of JP10186030 (A)

PROBLEM TO BE SOLVED: To detect the fish school position by a vertical fish finder. SOLUTION: Langevin oscillators 11A, 11B, 11C having the same characteristic of half value total angle or 40 deg. are arranged at an angle space of 120 deg. so that their normal lines 12A, 12B, 12C are crossed at an angle of 20 deg. in one point on a vertical line 13. Ultrasonic pulses are emitted from the oscillators 11A, 11B, 11C, each reflected wave is received by the corresponding emitting oscillator, each received level is detected, and the this school position is determined by the relative ratio of the three received levels from the same fish school.



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	15/06			15/06

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(32)優先日　平８(1996)10月31日

(33)優先権主張国　日本（ＪＰ）

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(54)【発明の名称】　方向検出可能魚群探知機

(57)【要約】
【課題】　垂直魚群探知機で魚群位置の検出を可能とする。
【解決手段】　半減全角か４０°の同一特性のランジュバン振動子１１Ａ，１１Ｂ，１１Ｃを、その法線１２Ａ，１２Ｂ，１２Ｃが鉛直線１３上の１点で２０°の角度で交差し、１２０°角間隔で配置し、振動子１１Ａ，１１Ｂ，１１Ｃよりそれぞれ超音波パルスを放射し、その各反射波を対応放射振動子でそれぞれ受波し、その各受波レベルを検出し、同一魚群からの３つの受波レベルの相対比により、その魚群位置を求める。

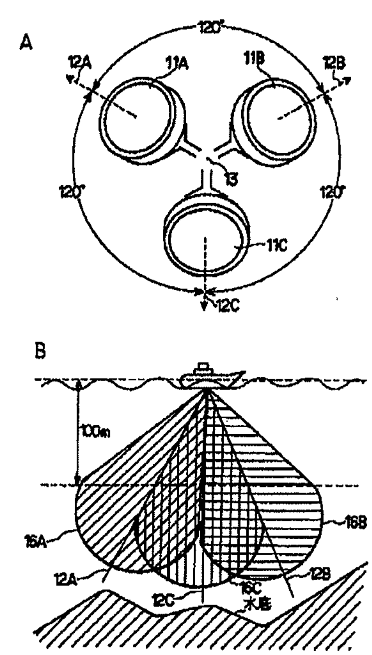


図3

【特許請求の範囲】

【請求項１】　比較的広い指向性ビームが一部を互いに重ねて設けられた第１、第２超音波送受波器と、
これら第１、第２送受波器から、それぞれ超音波パルスを放射する手段と、
上記放射超音波の反射波の対応放射送受波器での受波レベルを検出する手段と、
同一反射物標よりの反射波に対する上記第１、第２送受波器の相対的受波レベルの差から上記反射物標の方向を求める手段とを具備する方向検出可能魚群探知機。

【請求項２】　比較的広い指向性ビームを有し、上記超音波送受波器の各指向性ビームと一部が重ねられて設けられた第３超音波送受波器と、
その第３送受波器から超音波パルスを放射する手段と、
その第３送受波器からの放射超音波と対する反射波のその第３送受波器での受波レベルを検出する手段と、
同一反射物標よりの上記第１乃至第３送受波器の各相対的受波レベルからその反射物標の位置を求める手段とを含むことを特徴とする請求項１記載の方向検出可能魚群探知機。

【請求項３】　上記複数の超音波送受波器はほぼ水平面上で直線的に配列されていることを特徴とする請求項１又は２記載の方向検出可能魚群探知機。

【請求項４】　上記第１、第２、第３送受波器の受波信号をそれぞれ検波する手段と、その検波出力を合成する手段と、各放射パルスごとの上記検波出力の合成信号を１本の表示線として表示し、その表示を新旧の順に配列したＢスコープ表示と、原点に船の図形を配した座標と、その座標に上記求めた物標位置を示す像及び上記求めた方向を示す線を示す表示とを行う表示器とを含む請求項２記載の方向検出可能魚群探知機。

【請求項５】　上記第１、第２、第３送受波器は、その法線が鉛直線上の一点で交差し、かつ鉛直線を中心とし等角間隔となるように、等角間隔にかつ送受波面が水平面に対し、わずか傾むいて配されていることを特徴とする請求項２又は４記載の方向検出可能魚群探知機。

【請求項６】　上記第１、第２、第３送受波器は、何れの水平面上で直線的に配列され、これらの各送受波面が水平面に対し、わずか傾いており、その真中の送受波器の送受波面の法線の交点を通る鉛直線に対し、両側の送受波器の各法線状を、上記交点で交差するように移動させたとすると上記３つの法線は上記鉛直線を中心として等角間隔になるように、上記第１、第２、第３送受波器の向きが選定されていることを特徴とする請求項２又は４記載の方向検出可能魚群探知機。

【請求項７】　上記第１、第２、第３送受波器の合成探知信号より探知信号上の物標反射位置を検出する手段と、上記第１、第２、第３送受波器の各受波信号から上記検出した物標反射位置の信号をそれぞれ抽出する手段と、これら抽出信号中の最大ピーク値を基準として第１、第２、第３送受波器の各検出信号に対して自動利得制御を行う手段と、これら自動利得制御がなされた各抽出信号をそれぞれ検波して上記各受波レベルを得る手段とを有することを特徴とする請求項４乃至６の何れかに記載の方向検出可能魚群探知機。

【発明の詳細な説明】

【０００１】

【発明が属する技術分野】この発明は魚群の方向又は／及び位置をも検出可能とする魚群探知機に関する。

【０００２】

【従来の技術】一般に魚群の位置や移動方向を検出する装置として、電子スキャンニングソナーや、サーチライトソナーが用いられてきた。又その変形的ソナーとしてサイドスキャンソナー、セクタスキャンソナー等も利用されている。これらの装置は、海面下を３次元的に表現出来る点で優れている。しかし電子スキャンニングソナー等は装置が大がかりとなり、コストも高く艤装も大変である。比較的小型のサーチライトソナー等はコストも比較的低く押さえられるが、メカニックスキャンの為早い探索や魚群の早い動きに追従出来ない場合があった。又映像表示がＰＰＩ表示のため操作には、熟練を要すると言われている。サイドスキャンニングソナーには、電子スキャンニング法とメカニックスキャンニング法がある。又、両者を組み合わせたセクタ電子スキャンニング法等種々の方法が開発されているが同様の欠点がある。

【０００３】その他、電子スキャンソナーやサーチライトソナーは、超音波ビームをできるだけ狭く絞って方位分解能を上げようとするため、海底の底質（岩盤、砂地、等）の判断は難しい事が上げられる。

【０００４】

【発明が解決しようとする課題】この発明の目的は超音波ビームを走査（スキャンニング）することなく、反射物標の方向又は／及び位置を検出でき、しかも小型、安価に構成することができる魚群探知機を提供することにある。

【０００５】

【課題を解決するための手段】この発明によれば、比較的広い指向性ビームをもちその指向性ビームが一部互いに重ねられた第１、第２超音波送受波器より超音波パルスがそれぞれ放射され、その反射波の対応放射送受波器での受波レベルがそれぞれ検出され、同一反射物標よりの反射波に対する第１、第２送受波器の受波レベルの差からその反射物標の方向が検出される。

【０００６】第１、第２送受波器の各指向性ビームと一部が重ねられた比較的広い指向性ビームの第３超音波送受波器が更に設けられ、この第３送受波器より放射された超音波パルスの反射波についての第３送受波器での受波レベルが検出され、同一反射物標よりの第１乃至第３送受波器の各受波レベルからその反射物標の位置が求められる。

【0007】
【発明の実施の形態】この発明ではサイドローブが非常に少なく、比較的広い、例えば半減全角が40°程度の指向性ビームをもつ超音波送受波器が用いられる。このような送受波器としては図1Aに示すランジュバン円形振動子を用いることができる。ランジュバン振動子の例えばTGM50／200B／12Lの指向特性の50kHzでの実測データを図1Bに示す。この指向特性からわかるようにサイドローブはほとんどない。ランジュバン振動子は円形振動子であるため、全周にわたり対称性がよい指向特性が得られる。

【0008】このような同一の広い指向性の2つの送受波器がその指向性ビームを一部互いに重ねて設けられる。例えば図2Aに示すように、2つのランジュバン振動子11A，11Bがその中心線12A，12Bを鉛直線13に対し、互いに反対側に20°傾斜させて設けられる。送受波器11A，11Bの送受波面をそれぞれ20°の俯角を与える。両送受波器の指向特性は図2Bの曲線14A，14Bとなる。いま図2Bに示すように、鉛直方向に対し、－30°の方向から10°づつ順次異なる方向で＋30°方向にそれぞれ反射物標P_1～P_7があったとすると、これら各物標よりの反射波の送受波器11A，11Bでの各受波レベルはそれぞれ異なったものとなる。例えば物標P_2についてみると、送受波器11Aの感度が－0dB、送受波器11Bの感度は－20dBであるから、送受波器11Aの方が送受波器11Bより受波レベルが20dB大きい、物標P_4については、送受波器11A，11Bの感度が共に－4dBであり、受波レベルに差がない。各物標P_1～P_7についての送受波器11A，11Bの感度は図2Cに示すようになる。

【0009】従って送受波器11A，11Bの各法線12A，12Bの内側にある物標については、送受波器11A，11Bの感度差、つまり受波レベル差から、物標の方向（方位）を求めることができる。物標の方向を決めることができるのは両送受波器11A，11Bとも感度が得られる角度範囲であり、一方の送受波器のみしか感度が得られない場合は、例えば送受波器11Aのみしか受波レベルが検出できない場合はその物標は－30°～－60°の概略方向に在ることと判断される。

【0010】このように2つの送受波器11A，11Bにより物標方向を検出する場合におけるBスコープ表示には、送受波器11A，11Bの両検出受信レベルを加算した信号を用いる。更にこの発明では同一の広い指向ビーム特性をもつ3つの送受波器を用いて、物標位置の検出を可能とする。このため、図3Aに示すように3つの送受波器11A，11B，11Cの法線方向12A，12B，12Cが鉛直線13に対し120°の等角間隔となり、かつ図2Aに示したようにそれぞれ送受波面が水平面に対して20°の俯角を互いに外側にもつように送受波器11A，11B，11Cが配される。この時図3Bに示すように送受波器11A，11B，11Cの各放射ビーム16A，16B，16Cは互いに一部重なった状態となる。送受波器11A，11B，11Cの位置から100m下における法線12A，12B，12Cの各位置、各送受波器11A，11B，11Cの各等感度線（等音圧分布線）17A，17B，17Cは図4Aに示すようになる。各放射ビーム16A，16B，16Cは鉛直線13に対し、それぞれ20°傾斜しているため、図4Bに示すように100mの深度で水平に切断すれば、その断面は楕円となるから、感度線17A，17B，17Cは実際にはそれぞれ楕円となる。

【0011】もし送受波器11A，11B，11Cの相対感度差が20dBまで測定可能であれば、1辺が116mの正三角形18の内側の範囲では送受波器11A，11B，11Cの相対感度差が測定できる。この正三角形18の内側の各点は3つの等感度線17A，17B，17Cの交点と対応し、よって送受波器11A，11B，11Cの各感度の組により、位置が一義的に定まる。従って正三角形18の内側における1点にある物標からの反射波の送受波器11A，11B，11Cでの受信レベルを求めれば、その組合せよりその物標の位置を求めることができる。送受波器11A，11B，11Cの感度差が12dBまでしか測定することができなければ、1辺が58mの正三角形19の内側にある物標の位置を測定できる。ここで送受波器11A，11B，11Cの感度及び指向特性がよく揃っているものとする。

【0012】以上の説明から、3つの送受波器11A，11B，11Cを用い、水深100mで感度差が20dBまで測定できれば、図4Cに示すように領域ウ内の物標は3つの送受波器11A，11B，11Cでその反射波の受信レベルを検出できるから位置を正確に求めることができる。領域イ内の物標は、2つの送受波器11Aと11B、11Bと11C、11Cと11Aの何れかでその反射波の受信レベルを検出できるから方向を正確に検出することができる。領域ア内の物標はその反射波の受信レベルは送受波器11A，11B，11Cの何れか1つでしか検出できないから、概略の方向が判断される。

【0013】以上の測定原理を用いたこの発明の魚群探知機の実施例を図5に示す。送受波器11A，11B，11Cは図3を参照して説明したものと同様のものであり、これらに対し、送信部21A，21B，21Cからそれぞれ独立に励振パルスを印加することができるようにされる。このように広角超音波ビームの送受波を行うと、他魚船の魚群探知機との干渉が問題となる。この点から、同一周波数帯での送受波器の使用を避けること、超音波パルス放射周期をランダム（規則性がない）にすることが考えられる。図5の例では乱数発生部22により、例えば送信周期の1／10程度の範囲内で発信タイ

ミングをランダムに変化させ、その発信タイミング、つまり０ｍ位置信号により送信制御部２３が起動され、送信制御部２３は送信部２１Ａ，２１Ｂ，２１Ｃを順次制御し、送受波器１１Ａ，１１Ｂ，１１Ｃよりシーケンス的に超音波パルスが放射される。

【００１４】送受波器１１Ａ，１１Ｂ，１１Ｃはその指向特性と感度がよく揃ったものが望ましい。指向特性は送受波器の形状などで決まりかなり揃うが、感度に関しては、固有振動周波数f_0などのずれ、その他の素因により厳密に揃えることは困難である。そこで送受波器１１Ａ，１１Ｂ，１１Ｃの感度差を予め測定し、これら３つの送受波器１１Ａ，１１Ｂ，１１Ｃの感度が揃うように、受信前置増幅器２４の前段に設けた電子減衰器２５Ａ，２５Ｂ，２５Ｃで補正する。この感度補正データは感度補正ＲＯＭ２６に記憶され、また発信時の感度を下げると共に、遠方よりの反射波の受信感度を上げるいわゆるＳＴＣ用制御信号がＳＴＣ用ＲＯＭ２７に記憶されている。

【００１５】送受波器１１Ａ，１１Ｂ，１１Ｃの各受波信号はそれぞれ電子減衰器２５Ａ，２５Ｂ，２５Ｃへ供給され、電子減衰器２５Ａ，２５Ｂ，２５Ｃの出力は受信切換器２８で順次切換えられて受信前置増幅器２４へ供給される。シーケンス切換制御部２９により、何れの送受波器による送受波を行うかの順序のタイミングが制御され、そのタイミングにより乱数発生部２２よりの乱数発生が行われ、また送信制御部２２の送信タイミングが制御され、更にＳＴＣ特性、感度校正部３１を通じ、更に感度補正用ＲＯＭ２６の補正データが減衰器制御３２を通じて電子減衰器２５Ａ，２５Ｂ，２５Ｃに対し、初期設定がなされ、またＳＴＣ用ＲＯＭ２７のデータによる電子減衰器制御部３２を通じる電子減衰器２５Ａ，２５Ｂ，２５Ｃに対するＳＴＣ制御が行われ、更に受信機切換器２８が制御され、励振送受波器、例えば１１Ａと対応した電子減衰器２５Ａの選択がなされる。

【００１６】前置増幅器２４の出力に手動感度調整器３３を通じ、更に後段増幅器３４を通じて検波器３５へ供給されて検波され、その検波出力はＡ／Ｄ変換器３６でデジタル信号に変換され、その変換デジタルの探知信号３９Ａは加算器３７で加算されて、バッファメモリ３８、領域３８Ａに書込まれる。バッファメモリ３８への書込みは、次に送受波器１１Ｂが励振されると、その時の探知信号３９Ｂが前回の探知信号３９Ａと加算されて、領域３８Ａに書込まれ、次に送受波器１１Ｃの励振により得られた探知信号３９Ｃが領域３８Ａの信号と加算されて領域３８Ａに書込まれる。領域３８Ａには探知信号３９Ａ，３９Ｂ，３９Ｃが加算され、１つの探知信号３９が得られる。

【００１７】この探知信号３９は海底検出部４１及びターゲット自動検出部４２へ供給される。海底検出部４１は乱数発生部２２よりの０位置信号（発信信号）とその入力されて探知信号３９から海底位置を検出する。この検出は従来の魚群探知機で行われている手法と同様に行われる。ターゲット自動検出部４２は前記０位置信号と検出海底位置信号との間の探知信号３９中から魚群などの物標からの反射信号を検出し、その検出した各物標反射波信号ごとにそのタイミングでまた対応する時間だけアナログスイッチ４３を閉にする自動ゲート信号を生成する。

【００１８】バッファメモリ３８よりの探知信号３９はＢスコープ映像化処理部４４で処理され、更にビデオ信号変換部４５を通じてラスタスキャン表示器４６へ供給され、例えば表示面に上下方向へ１本の表示線に１探知信号３９が表示され、その表示線が表示面の左右の一端より他端にないものから順に表示される。例えば図6に示すように通常の魚群探知機における表示が得られる。この表示には発信線表示４７、水底像４８、魚群像４９が表示される。

【００１９】操作員はこの表示画像を見て最新データにおける、例えば魚群像４９の右端にカーソルを位置させてヒットすることによりターゲット手動検出部５１から魚群反射位置、その長さと対応した手動ゲート信号が生成され、これら手動、自動切換スイッチ５０により自動ゲート信号と切換えられてアナログスイッチ４３へ供給される。

【００２０】アナログスイッチ４３は物標からの反射波が受信されている間オンとされ、これを受信前置増幅器２４の出力が通過され、ＡＧＣ回路５２へ供給され、更に後段増幅器５３で増幅された後検波器５４で検波される。この検波出力のピークがピーク検出器５５で検出され、この検出出力に応じてＡＧＣ制御部５６によりＡＧＣ回路５２の利得が制御され、受信信号のレベルの変化範囲がほぼ一定とされるが、送受波器１１Ａ，１１Ｂ，１１Ｃの各受波信号中の最も高いレベルの信号に対してＡＧＣ制御が行われ、それ以外の受波信号に対しては最も高いレベルの信号に対して制御された利得に保持される。つまり３つの送受波器１１Ａ，１１Ｂ，１１Ｃによる同一物標からの反射波の受波信号中の、最も強い信号レベルが飽和しない基準レベルになるようにＡＧＣがかけられ、そのＡＧＣ感度（利得）で他の送受波器の受波信号も増幅され、これら送受波器１１Ａ，１１Ｂ，１１Ｃの同一物標からの反射波の受波レベル差が、最大縮尺率で計測される。

【００２１】検波器５４の検波出力はＡ／Ｄ変換器５７でデジタル信号に変換され、そのデジタル信号の物標反射波受波信号は送受波器１１Ａ，１１Ｂ，１１Ｃの受波信号別に切換器５８で切換えられてバッファメモリ５９の領域５９Ａ，５９Ｂ，５９Ｃに物標信号６１Ａ，６１Ｂ，６１Ｃとして記憶される。このようにして、同一物標からの物標信号６１Ａ，６１Ｂ，６１Ｃはその物標の方向に応じて互いに異なる受信レベルとなる。ターゲッ

ト位置方位計算部６２でバッファメモリ５９よりの物標信号から同一物標について先に述べた手法により、その物標の位置又は方向が計算され、その計算結果が、模式図化し、又は方位、距離、深度など数値化して表示器４６に表示される。

【００２２】例えば図６において、表示面上の物標像がない部分に上側の魚群像４９_1に対し、円とその中心を通る直交線の座標像６４とその原点位置の縦軸と平行した船像６５に対し、魚群像４９の検出位置が丸点像６６のブリンキング表示とされ、かつ、その魚群探知機を装備した魚船の船首方向に対する魚群像４９の魚群の方位θと、魚船からその魚群までの距離Ｒと、魚群補正の深度Ｄとの数値表示６７が、座標表示６４の近くになされる。同様に下側の魚群像４９_2に対し、座標表示６４′、船像６５′に検出した船首方向に対する方位表示６８と、その方位のθ′の数値表示６７′が行われる。魚群像４９_2は送受波器１１Ａ，１１Ｂ，１１Ｃ中の２つから反射波を受波できず、位置の検出ができなかった場合である。

【００２３】この魚船に取付けられた傾斜センサ７１の出力が傾斜センサ処理部７２に入力され、魚船が規定の角度より傾斜して、物標反射信号６１Ａ，６１Ｂ，６１Ｃのレベルが変化して正確に位置、方位を計算できない状態になると、ターゲット位置方位計算部６２の計算を中止させ、あるいは傾斜センサ７１で検出した傾き角度、傾き方位に応じて、ターゲット位置方位計算部６２での計算を補正するようにする。

【００２４】図５中の切換器２８，５７を省略し、かつ送信部２１Ａ，２１Ｂ，２１Ｃから互いに異なる周波数の超音波パルスで同時に送受波器１１Ａ，１１Ｂ，１１Ｃを励振する場合の例を図７に図５と対応する部分に同一符号を付けて示す。この場合は送信制御部２２により送信部２１Ａ，２１Ｂ，２１Ｃに対し同時に送信制御がなされ、電子減衰器２５Ａ，２５Ｂ，２５Ｃの出力はそれぞれ前置増幅器２４Ａ，２４Ｂ，２４Ｃへ供給され、これより、手動底度調整手段３３′により調整される電子減衰器８１Ａ，８１Ｂ，８１Ｃへ供給され、更に後段増幅器３４Ａ，３４Ｂ，３４Ｃを通じて、検波器３５Ａ，３５Ｂ，３５Ｃへ供給され、それぞれ検波され、これら検波出力は加算回路８２で電圧加算されてＡ／Ｄ変換器３６へ供給され、これよりデジタルの探知信号３９が得られる。つまり図６中の加算器３７、バッファメモリ３８は省略される。

【００２５】また前置増幅器２４Ａ，２４Ｂ，２４Ｃの各出力はアナログゲート４３Ａ，４３Ｂ，４３Ｃに分岐供給され、これよりそれぞれ、ＡＧＣ回路５２Ａ，５２Ｂ，５２Ｃ、更に後段増幅器５３Ａ，５３Ｂ，５３Ｃをそれぞれ通して検波器５４Ａ，５４Ｂ，５４Ｃで検波され、これら検波出力はピーク検出回路５５へ供給されると共に、Ａ／Ｄ変換器５７Ａ，５７Ｂ，５７Ｃへ供給され、これらＡ／Ｄ変換出力がターゲット位置方位計算部６２へ供給される。この図７の構成はハードウェア規模が図６に示したものより大になるが、高速の探査が可能である。

【００２６】送受波器１１Ａ，１１Ｂ，１１Ｃの各受波レベルの相対値は、深度に関係しない、つまり、２つの受波レベルの差で決まる方向（方位）は比でみれば、距離に関係しないで、一定であり、同様に３つの受波レベルの比でみれば、これにより決る位置の相対関係は深度に関係なく、つまり、深度が深くなれば、これに比例して、隣接位置の間隔が大となるだけで、相対関係はかわりない。従って、送受波器１１Ａ，１１Ｂ，１１Ｃの各受信レベルの相対比と、相対位置を予め求めておき、これをメモリに記憶しておき、そのメモリを物標信号６１Ａ，６１Ｂ，６１Ｃの相対比で読み出し、相対位置を求め、その相対位置を、その物標の深度により絶対位置に変換するようにしてもよい。同様に２つの物標信号６１Ａと６１Ｂ、６１Ｂと６１Ｃ、６１Ｃと６１Ａの各相対比と方向（方位）との関係を予め求め、これをメモリに記憶しておき、このメモリと検出した２つの物標信号の相対比で読出して方向を決定してもよい。

【００２７】上述において送受波器を４つ以上設けてもよい。上述では２又は３つの送受波器を鉛直線１３を中心として各送受波器の送受波面の中心法線が１点で交差するように配したが、この交差点をわずかずらすことにより、水平面内で直線的に配置してもよい。その実施例を図１０に示す。図２Ａ、図３Ａに示した配置関係の例えばランジュバン振動子よりなる送受波器１１Ａ，１１Ｂ，１１Ｃをそれぞれの角度姿勢を保持したまま、送受波器１１Ａの両側に送受波器１１Ｂ，１１Ｃを配し、これらがほぼ水平面内でほぼ一直線上に、その送受波面の中心点が位置するように配置する。

【００２８】この場合、送受波器１１Ａの送受波面中心を通る鉛直線１３に対し、その両側の送受波器１１Ｂ（１１Ｃ）の法線１２Ｂは図１１Ａ，Ｂの破線で示すように、水平方向に前記中心間の距離Ｒｃだけずれる。送受波面の各中心間の距離Ｒｃ（図１０）は例えば１５ｃｍ程度である。各送受波器の送受波面の水平線に対する角度、前記例では２０°に保持されているため、鉛直線１３と法線１２Ｂ（１２Ｃ）とのなす角度は変わらないため、図２Ａ，図３Ａの配置状の鉛直線１３と法線１２Ｂとの関係が図１１Ａ，Ｂに実線で示す状態から、破線で示す状態に、水平方向にＲｃだけずれるだけであり、このずれは深さが１０ｍでも１００ｍでも同じである。従って図１０の右に示したように直線状に配置して前述のように検出方向を測定した場合の測定誤差は、深さの大きさに関わらず一定で、Ｒｃ、前記例では１５ｃｍに過ぎず、この程度の誤差は実質的には無視できる。

【００２９】図２Ａ，図３Ａに示したように送受波器１１Ａ，１１Ｂ，１１Ｃを円形配置した場合は、その全体

としての送受波器１０１は図１２Ｂに示すように厚みのある円板状のモールド品とされるが、図１０の右側に示すように直線状に配置した場合の全体としての送受波器１０２は図１３Ｂに示すように細長の長方体状のモールド品と構成される。従って、この送受波器１０２を、例えば漁船に対し、その船首方向、つまり進行方向と平行になるように取付けられると、図１２Ｂの送受波器１０１と比較して、体積が３割程度小とすることができ、かつ液体抵抗が小さい。

【００３０】このように送受波器をほぼ水平でほぼ直線的に配置する適用例は送受波器の数が３個に限らず、２個、４個以上でもよい。また送受波器をほぼ水平面内でほぼ直線状に配列する場合に限らず、ほぼ鉛直面内で、ほぼ直線状に配列してもよい。

【００３１】

【発明の効果】以上述べたようにこの発明によれば、機械的走査をさせないで、物標の方位、位置を検出することができ、可動部のない安定度が高いものが得られる。また電子走査をさせないで物標の方位、位置を検出できるので、電子回路が簡単になり、設計が容易であって、送受波器において位相合成などの処理を必要とせず、送受波器の配線なども簡単になる。従来の何れの走査方式より小形かつ安価に構成することができる。

【００３２】サイドローブの少ない送受波器を用いるので偽像がほとんどなく、誤った判断が少ない。各探知信号を１本の表示線として表示し、その表示線を配列する。Ｂスコープ表示をすることができ、従来の記録紙による記録表示形式になれている操作員に見易い表示を行うことができ、しかも物標の位置、方位を検出することができる。

【００３３】広い超音波ビームの送受波器を複数用いるため、その合成ビームの指向角は前記具体例では８０°にもおよび、従来のサイドスキャンニングソナーと同程度の探査範囲を探索することができ、探査漏れが少ない。本船とこれに対する物標の位置の相対関係を模式図で表示することにより、読み取りに熟練を要しない、かつ物標の移動方向も知ることができる。また、数値表示により正確な値を知らせることができる。

【００３４】送受波器の合成指向角が極めて広いため、水底の地質の判断が可能となる。つまり狭い指向角の送受波器を用いた場合は図８Ａに示すように超音波の水底９２への到達時間差はそのビームの軸心９１ａと周辺９１ｂとでわずかである。従って図８Ｂに示すように送信パルス９３のパルス幅Ｔｃと、ほぼ等しいパルス幅Ｔｃの反射波９４が受波される。水底９２が岩盤の場合はその反射波９４の受波レベルが大きなものとなる。水底９２が砂地の場合は図９Ｃに示すように反射波９４の幅は同様にＴｃであるが、受波レベルが小さくなる。しかし、これら図８Ｂ，Ｃの両反射波の差により地質を推定することは比較的困難である。

【００３５】しかし、超音波ビーム９１が広角の場合は図９Ａに示すように、超音波ビーム９の中心９１ａと周辺９１ｂとで超音波が水底９２に到達する時間に比較的大きな差Ｔｂが生じる。このため、水底９２が岩盤の場合は、反射波９４の波形は図９Ｂに示すように急に大きく立上り、送信パルス幅Ｔｃの後に徐々に低下した後、Ｔｃだけ一定値を保持して、立下るものとなる。一方水底９２が砂地の場合は、砂地中に超音波が入り大きく減衰し、その減衰は中心線９１ａよりも周辺９１ｂの方が著しく、反射波９４は図９Ｃに示すように、レベルが小さく、図９Ｂの反射波９４のあるレベル以上に相当する部分の波形となる。従って、この図９Ｂ，Ｃの両反射波９４の波形が図８Ｂ，Ｃの場合と比較して、大きく相違し、反射波９４の波形により水底９２の地質を推定することができる。

【００３６】更に、図１０に示したように送受波器を直線状に配列すると、円形配置の場合より３割程度小さくなり、それだけ水の抵抗が小となり、例えばこの魚群探知機が取付けられる船体の船首方向、つまり進行方向と平行にすることにより、水の抵抗を著しく小さくすることができる。またランジュバン振動子の場合は、一般の直線配列のモールドであり、方向検出可能な魚群探知機用送受波器でも同じ型を用いて作ることができ、安価に構成することができる。

【００３７】更に直線状であるため、方向検出可能な魚群探知機用送受波器の特徴である送受波器取付けの際の方向が見分け易い。

【図面の簡単な説明】

【図１】Ａは広い指向角の超音波ビーム特性をもつ超音波送受波器の例を示す図、Ｂはその指向角特性を示す図である。

【図２】Ａは超音波ビームを一部重ねた２つの送受波器の配置例を示す図、Ｂはその指向角特性を示す図、Ｃは同図Ｂ中の物標P_1～P_7に対する両ビームの感度を示す図である。

【図３】Ａは超音波ビームを互いに一部重ねた３つの送受波器の配置例を示す図、Ｂはその３つの超音波ビームの模式図である。

【図４】Ａは図３Ｂの水深１００ｍでの各超音波ビームの等感度（等音圧）曲線及び位置検出領域を示す図、Ｂは送受波器位置とその法線の水深１００ｍでの鉛直線に対する距離の関係を示す図、Ｃは図３Ｂにおける物標位置検出領域、物標方位検出領域、物標概略方位検出領域を示す図である。

【図５】この発明の実施例の機能構成を示すブロック図。

【図６】図５中の表示器４６の表示例を示す図。

【図７】この発明の他の実施例の機能構成を示すブロック図。

【図８】Ａは狭角ビームによる水底探査を示す図、Ｂは

送信パルスと反射波を示す図、Cは反射波の他の例を示す図である。

【図9】Aは広角ビームによる水底探査を示す図、Bは送信パルスと反射波を示す図、Cは反射波の他の例を示す図である。

【図１０】送受波器の円形配列と直線状配列と配置関係例を示す図。

【図１１】送受波器の円形配列と直線状配列とにおける鉛直線と送受波器の法線方向の関係を示す図。

【図１２】Aは送受波器の円形配列を示す図、Bはその全体を示す斜視図である。

【図１３】Aは送受波器の直線状配置を示す図、Bはその全体を示す斜視図である。

【図１】

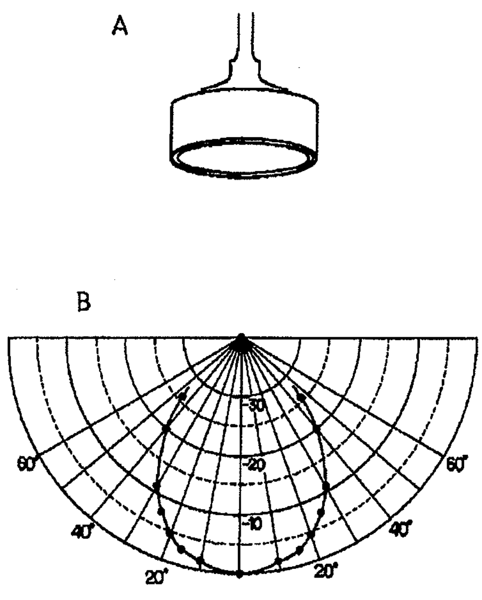
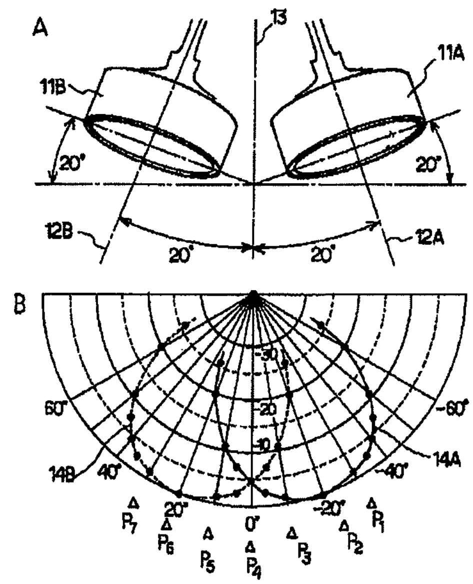


図1

【図２】



C

物標	11A ビーム感度	11B ビーム感度
P1	−2dB	受信感度ナシ
P2	0dB	−20dB
P3	−2dB	−11dB
P4	−4dB	−4dB
P5	−11dB	−2dB
P6	−20dB	0dB
P7	受信感度ナシ	−2dB

図2

【図１０】

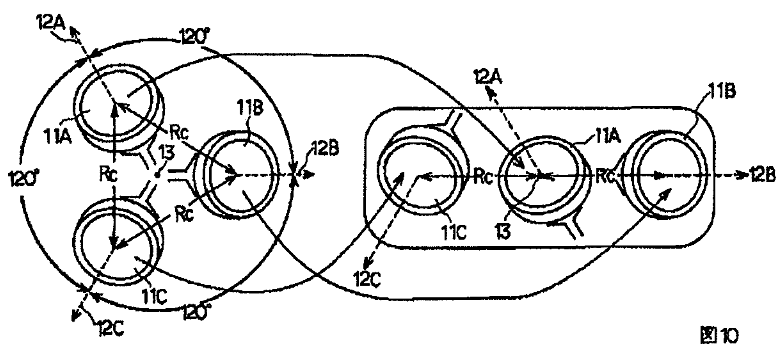


図10

【図3】

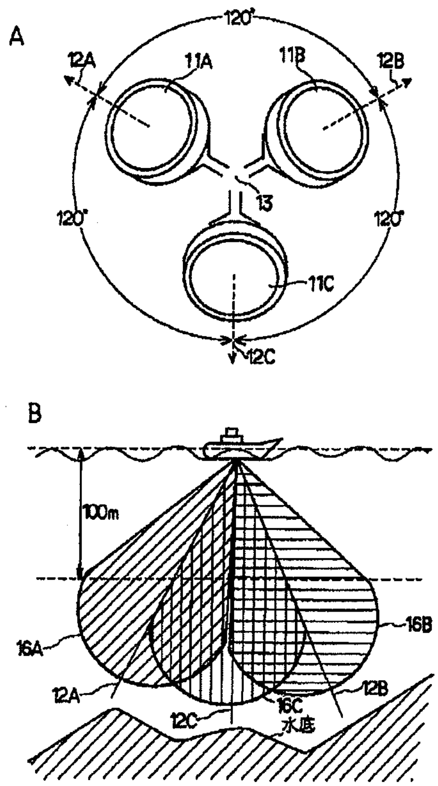


図3

【図4】

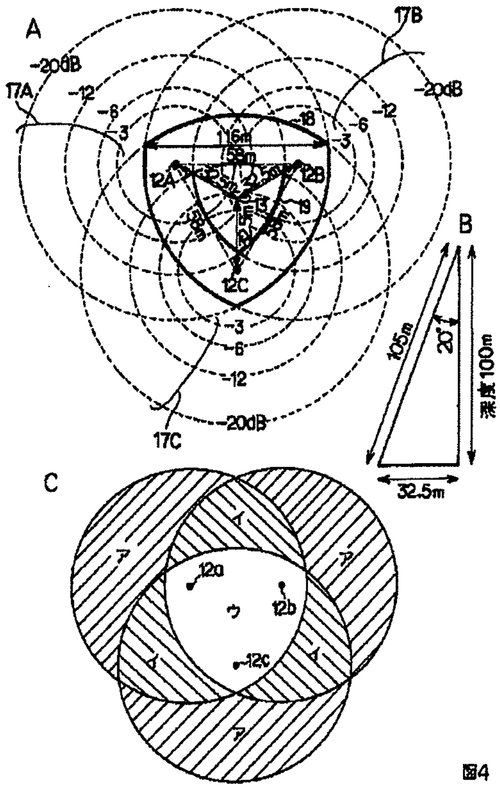


図4

【図6】

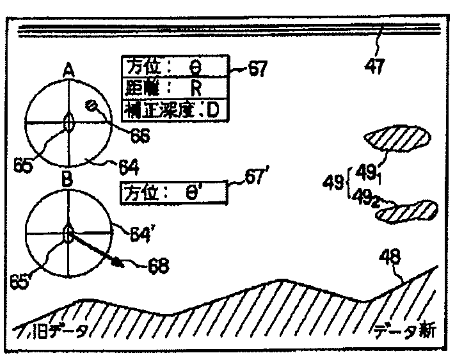


図6

【図11】

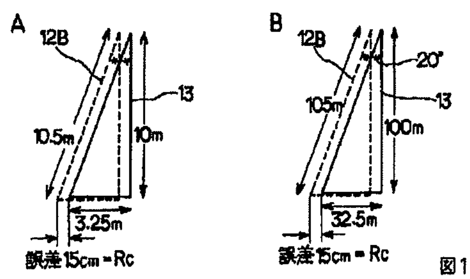


図11

【図12】

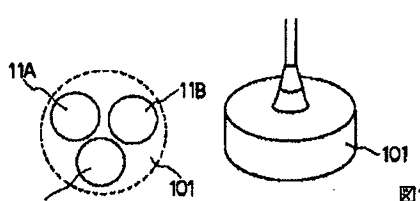


図12

【図5】

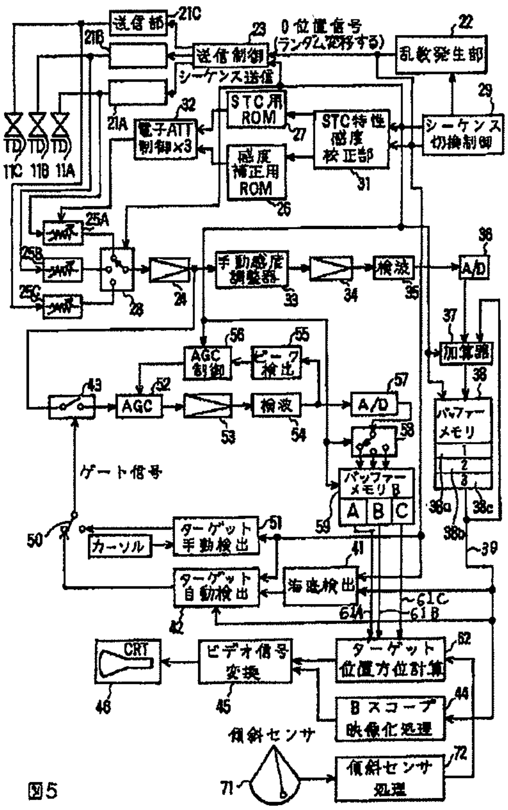


図5

【図7】

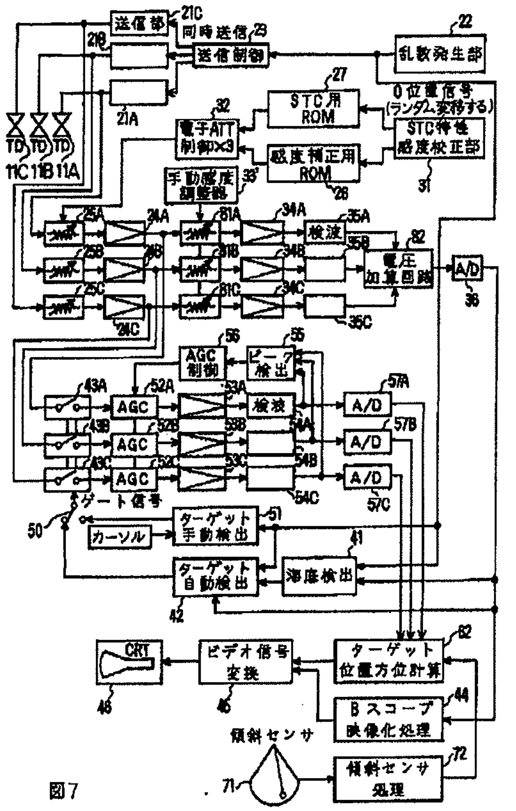


図7

【図13】

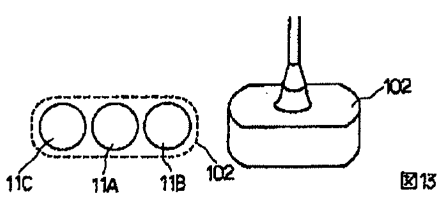


図13

【図8】

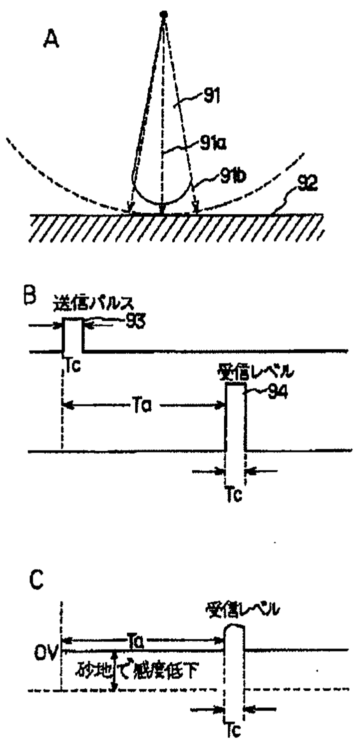
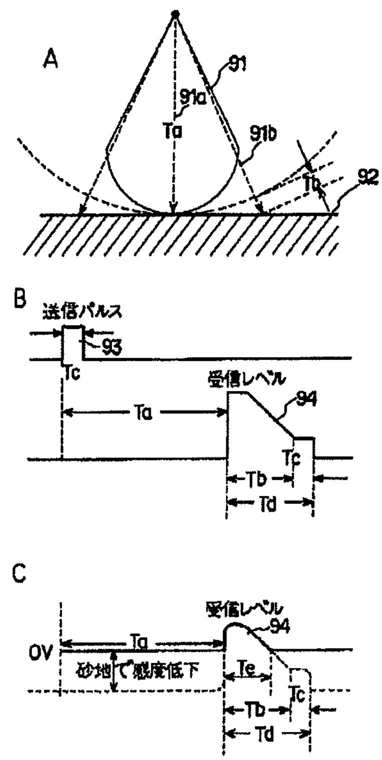

A
91
91a
91b
92
B
送信パルス
93
Tc
Ta
受信レベル
94
Tc
C
受信レベル
0V
Ta
砂地で感度低下
Tc

図8

【図9】


A
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送信パルス
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受信レベル
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Ta
Tc
Tb
Td
C
受信レベル
94
0V
Ta
砂地で感度低下
Te
Tc
Tb
Td

図9

Espacenet

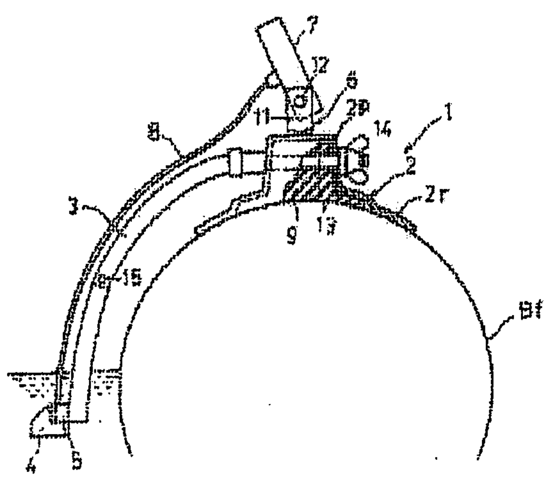
Bibliographic data: JP2001074840 (A) — 2001-03-23

ATTACHMENT FOR FISH-FINDER

Inventor(s):	USUI HIROHISA +	
Applicant(s):	ACHILLES CORP +	
Classification:	- international:	***A01K75/00; B63B7/08; G01S15/96;*** (IPC1-7): A01K75/00; B63B7/08; G01S15/96
	- European:	
Application number:	JP19990245391 19990831	
Priority number (s):	JP19990245391 19990831	
Also published as:	JP4183217 (B2)	

Abstract of JP2001074840 (A)

PROBLEM TO BE SOLVED: To install a fish-finder at a place suitable for fish finding so that the space in the boat can widely be used, when installed in a small boat or the like. SOLUTION: The attachment has its main body 2 fixed to a fitting seat (g) provided to the float part Bf of an inflatable boat B, and a sensor 4 is fitted at the tip end of an arm 3 extending into water from the main body 2, and a monitor part 7 is fitted to the upper part of the main body 2, so that a signal detected by the sensor 4 is displayed on the screen of the monitor part 7. Further, the arm 3 is made freely rotatable on the axis of an arm support shaft 13, and an intermediate part of the arm 3 is made foldable.



(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号

特開2001－74840

（P2001－74840A）

(43)公開日　平成13年３月23日（2001.3.23）

(51)Int.Cl.⁷	識別記号	ＦＩ	テーマコード*（参考）
Ｇ０１Ｓ　15/96		Ｇ０１Ｓ　15/96	２Ｂ１０６
Ａ０１Ｋ　75/00		Ａ０１Ｋ　75/00　Ｋ	５Ｊ０８３
Ｂ６３Ｂ　7/08		Ｂ６３Ｂ　7/08　Ｂ	

審査請求　未請求　請求項の数４　ＯＬ　（全 ４ 頁）

(21)出願番号　特願平11－245391

(22)出願日　平成11年８月31日（1999.8.31）

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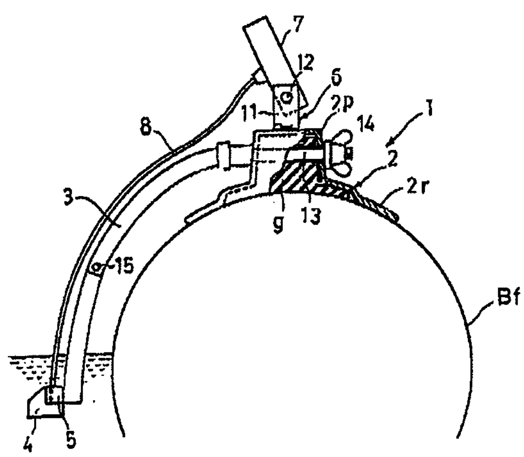
Ｆターム（参考）　2B106 PA01
5J083 AA02 AB01 AC31 AE04 AF15
CA01 CA32 EB04

(54)【発明の名称】　魚群探知機用アタッチメント

(57)【要約】

【課題】　小型ボート等に魚群探知機を設置する際、船内のスペースを広く活用出来、また、魚群探知に適した箇所に適切に配置出来るようにする。

【解決手段】　インフレータブルボートＢのフロート部Ｂｆに設けられる取付座ｇにアタッチメント１の本体２を固定し、この本体２から水中に向けて延出するアーム３の先端にセンサ４を取付けるとともに、本体２の上部にモニター部７を取り付け、センサ４で検知した信号をモニター部７の画面に表示する。また、アーム３をアーム支持軸１３の軸周りに回動自在にし、更にアーム３の中間部を折り畳み可能にする。



【特許請求の範囲】
【請求項1】 船体の一部に取付けられる本体と、この本体から水中に向けて延出するアームと、このアームの先端に形成されるセンサ取付部を備えた魚群探知機用アタッチメントであって、前記アームの根元部は、所定方向に揺動可能にされることを特徴とする魚群探知機用アタッチメント。
【請求項2】 請求項1に記載の魚群探知機用アタッチメントにおいて、前記アームは折り畳み可能にされることを特徴とする魚群探知機用アタッチメント。
【請求項3】 請求項1又は請求項2に記載の魚群探知機用アタッチメントにおいて、前記本体には、魚群探知機のモニター部を取付けるためのモニター取付部が形成されることを特徴とする魚群探知機用アタッチメント。
【請求項4】 請求項1乃至請求項3のいずれか1項に記載の魚群探知機用アタッチメントにおいて、前記本体は、インフレータブルボートのフロート部の取付座に取付け可能にされることを特徴とする魚群探知機用アタッチメント。
【発明の詳細な説明】
【0001】
【発明の属する技術分野】本発明は、例えば小型船舶等に魚群探知機を装着する際の補助治具となる魚群探知機用アタッチメントに関する。
【0002】
【従来の技術】近年、マリンレジャーの普及に連れてインフレータブルボート等の小型ボートを使用したボート釣りが盛んになっており、またポータブル式の魚群探知機が安価に出回るようになたため、ボート釣りで魚群探知機を使用する機会が増えている。この際、エンジン取付用のトランサム板を備えた船外機付きボート等であれば、トランサム板等を利用して魚群探知機のセンサを取付けることが可能であるが、チューブ式のフロート部が主体となるゴムボート等では、例えば両舷のフロート部の間に架け渡される座席板や、底板等を利用して魚群探知機のセンサやモニター部等を固定せざるを得なかった。
【0003】
【発明が解決しようとする課題】ところが、上記のように座席板や底板を利用して魚群探知機を固定する場合は、狭い船内での各種作業等の邪魔になりやすく、また船内スペースも制約されて乗員の移動や物品搭載等に不便であった。
【0004】そこで本発明は、船内のスペースを広く活用することが出来、また、魚群探知に適した箇所に適切に配置出来るようにすることを目的とする。
【0005】
【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は、船体の一部に取付けられる本体と、この本体から水中に向けて延出するアームと、このアームの先端に形成されるセンサ取付部を備えた魚群探知機用アタッチメントを設け、アームの根元部を、所定方向に揺動可能にした。
【0006】そして、アタッチメントの本体を船体の一部に取り付け、先端にセンサを取付けたアームを水中を延出させて魚群探知を行い、任意の箇所に設置したモニター部で監視するが、この際、本体の取付部を船体の船べり等に設ければ、乗員の作業の邪魔にならず、船内スペースを広く活用することが出来る。また、アームの根元部を揺動自在にしておけば、例えば水上の浮遊物等がアームの先端に引っ掛かったり、アームの先端が傷害物等に衝突したような時でも、アームに無理な力が作用せず、アームの損傷等が防止される。このため、少なくとも船の進行方向に揺動可能にしておくことが好ましい。
【0007】ここで、船のタイプ等はインフレータボートやＦＲＰ製等の小型ボートに好適であり、手漕ぎ式の小型ボートでも、船外機付きのボートでも、帆走式のボートでも良いが、その他のタイプの船舶でも良い。
【0008】また請求項2では、前記アームを折り畳み可能にした。このように折り畳み可能にすれば、例えばアーム長を長くしても、収納時等にコンパクトに折り畳んで搬送等を行うことが出来、便利である。
【0009】また請求項3では、前記本体に、魚群探知機のモニター部を取付けるためのモニター取付部を形成するようにした。こうすれば、魚群探知機の構成部品一式を纏めてアタッチメントに取付けることが可能となり、また本体周囲の空間を有効に活用出来る。
【0010】また請求項4では、本体を、インフレータブルボートのフロート部の取付座に取付け可能にした。ここで、インフレータブルボートのフロート部の取付座とは、例えば釣竿支持用の受具等を固定するため、既にチューブ式のフロート部に貼着されている直方体ブロック状の弾性部材であり、この取付座を利用してアタッチメント本体を取付けるようにすれば、場所的にも好適であり、また既存のインフレータブルボートをそのまま活用出来て便利である。
【0011】
【発明の実施の形態】本発明の実施の形態について添付した図面に基づき説明する。ここで図1は本魚群探知機用アタッチメントが取付けられるボートの一例を示す全体図、図2は本魚群探知機用アタッチメントの一例を示す説明図、図3は本体に形成されるモニタ取付部の説明図、図4はアームの構造の一例を示す説明図である。
【0012】本発明に係る魚群探知機用アタッチメント1は、例えば図1に示すようなインフレータブルボートBのフロート部Ｂｆにポータブル式等の魚群探知機を取付ける際の補助治具として構成され、図2にも示すように、フロート部Ｂｆの上面の取付座ｇに取付けられる本体2と、この本体2から水中に向けて延出するアーム3を備えており、このアーム3の先端には、センサ4を取

付けるためのセンサ取付部５が設けられている。

【００１３】そしてこの実施形態では本体２の上部にモニター取付部６が形成されており、このモニター取付部６にモニター部７が取付けられるとともに、このモニター部７の背面側に接続される接続コード８の延出端部が前記センサ４に接続されている。

【００１４】前記取付座ｇは、例えば釣竿を支持する受具等を固定するため、殆どのインフレータブルボートＢのフロート部Ｂｆの上面に接着等で固定されているものであり、ソリッドゴム等の弾性部材から直方体ブロック状に構成されるとともに、中間部に貫通孔が形成されている。

【００１５】前記本体２は、取付座ｇに嵌合可能な嵌合部２ｐと、フロート部Ｂｆの上面形状に倣った円弧部２ｒを備えており、嵌合部２ｐには、取付座ｇに嵌合させた際に取付座ｇの貫通孔に連通する軸挿通孔ｈ（図３）が形成されている。そしてこの軸挿通孔ｈには、後述するアーム支持軸１３が取付座ｇの貫通孔を通して挿通され、アーム支持軸１３の一端側に形成されるネジ部にナット１４を螺合させて本体２を取付座ｇに固定出来るようにしている。

【００１６】また、前記モニター取付部６は、図３にも示すように、嵌合部２ｐの上面にピン９により枢着されて所定角度範囲（実施形態では４５度範囲）内で水平に揺動自在な水平板１０と、この水平板１０の両端部にヒンジ等を介して起伏自在に設けられる一対の取付板１１を備えており、この取付板１１には、モニター７を固定するためのネジ挿通孔ｉが設けられている。

【００１７】そして、両方の取付板１１を起こした状態で、間にモニター部７をセットし、ネジ挿通孔ｉを通したネジ１２（図２）によりモニター部７を固定するようにし、また収納時には、取付板１１を倒してスペースが広がらないようにしている。

【００１８】前記アーム３は、図４にも示すように、前記アーム支持軸１３の一端側に、軸周りに回動自在に設けられており、また中間部が分割されてピン軸１５で枢着されている。このため、アーム３全体をアーム支持軸１３の軸周りに回動させると、アーム３の下端部のセンサ取付部５が揺動し、またアーム３の下方部をピン軸１５回りに揺動させると、図４の鎖線に示すように折り畳むことが出来るようにされている。またアーム３の下端部のセンサ取付部５は、センサ４をネジ止めで固定出来るようにされている。

【００１９】以上のように構成される魚群探知機用アタッチメント１において、本体２上部のモニター取付部６にモニター部７を取り付け、このモニター部７に接続コード８を介して接続されるセンサ４を、アーム３先端のセンサ取付部５に取付けるとともに、本体の２の嵌合部２ｐを、図２に示すフロート部Ｂｆの取付座ｇに取付ける。

【００２０】そして図２に示すようにアーム３の先端のセンサ４を水中に浸漬し、センサ４から音波を発振し、反射波を受信してその信号をモニター部７の画面に表示することで、魚群を探知する。この際、モニター部７を保持する水平板１０は、所定角度揺動するため、見やすい方向にセットして監視することが出来る。

【００２１】こうしてセットした魚群探知機によりモニター部７の画像を監視しつつ、例えばボートＢを走行させるような場合、アーム３は、少なくともボートＢの進行方向に揺動可能にされているため、走行中にアーム３の下端部が傷害物等に衝突したり、水上浮遊物等がアーム３の下端部に引っ掛かっても、アーム３の下端部はアーム支持軸１３周りに揺動し、アーム３に無理な力がかかるようなことがなく、アーム３の折損等を未然に防止することが出来る。

【００２２】また、このような魚群探知機用アタッチメント１は、インフレータブルボートＢを使用しないで収納するような際、簡単に取外して持ち運ぶことが可能であるが、アーム３が折り畳み可能であるため、コンパクトな形態で嵩張らないようにして搬送することが出来る。

【００２３】尚、本発明は以上のような実施形態に限定されるものではない。本発明の特許請求の範囲に記載した事項と実質的に同一の構成を有し、同一の作用効果を奏するものは本発明の技術的範囲に属する。例えば、上記の実施形態では、モニター部７をアタッチメント１の上部に取り付けるようにしているが、アタッチメント１の上部に釣竿支持用の受具等を取付け、モニター部７を別の箇所に設けるようにしても良い。また、アタッチメント１をフロート部Ｂｆの取付座ｇ以外の箇所、例えば図１のインフレータブルボートＢのトランサム板Ｂｔ等に設けるようにしても良い。

【００２４】更に、本アタッチメント１が取り付けられる船は、インフレータブルボート以外のＦＲＰ製の小型ボートや、木製のボート等でも良く、またインフレータブルボートの種類等も任意である。

【００２５】

【発明の効果】以上のように本発明に係る魚群探知機用アタッチメントは、船体の一部に取付けられる本体から水中に向けてアームを延出させ、このアームの先端にセンサを取付けるようにしたため、アタッチメントを船体の船べり等に取付ければ、乗員の作業の邪魔にならず、船内スペースを広くすることが出来る。またアームの根元部を、所定方向に対して揺動可能にしているため、例えば水上の浮遊物等がアームの先端に引っ掛かったような時でも、アームに無理な力が作用せず、アームの損傷等が防止される。

【００２６】また請求項２のように、アームを折り畳み可能にすれば、収納時等にコンパクトに折り畳んで搬送等を行うことが出来る。また請求項３のように、本体に

モニター取付部を形成すれば、魚群探知機の構成部品一式を纏めてアタッチメントに取付けることが可能となり便利である。更に、請求項4のように、本体をインフレータブルボートのフロート部の取付座に取付け可能にすれば、既存のインフレータブルボートをそのまま活用して取付けることが可能である。

【図面の簡単な説明】

【図1】本魚群探知機用アタッチメントが取付けられるボートの一例を示す全体図

【図2】本魚群探知機用アタッチメントの一例を示す説明図

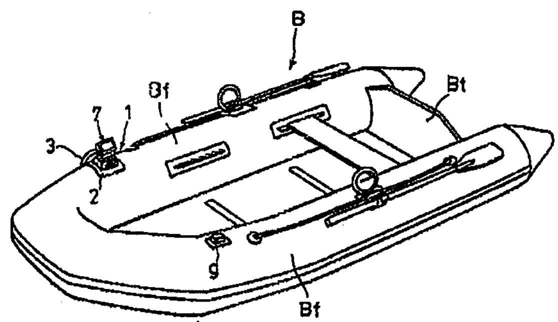
【図3】本体に形成されるモニタ取付部の説明図

【図4】アームの構造の一例を示す説明図

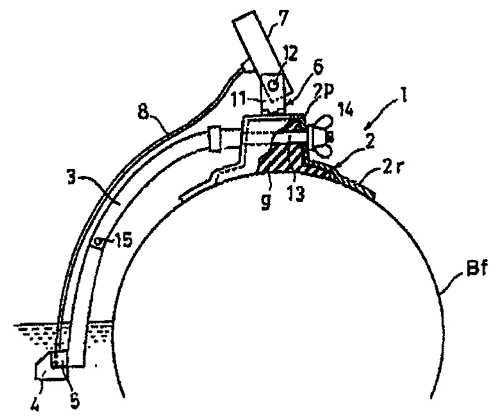
【符号の説明】

1…魚群探知機用アタッチメント、2…本体、3…アーム、4…センサ、5…センサ取付部、6…モニター取付部、7…モニター部、B…インフレータブルボート、g…取付座。

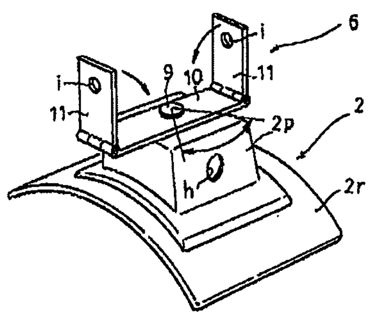
【図1】



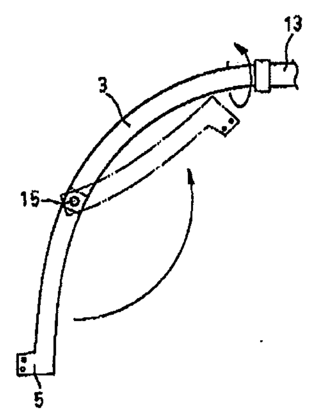
【図2】



【図3】



【図4】



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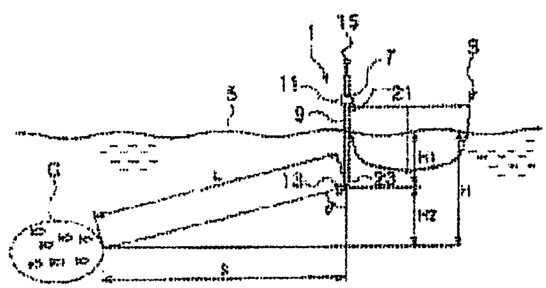
FISH FINDER

Inventor(s):	SATO KEIICHI ±
Applicant(s):	HONDA ELECTRONIC ±

Classification:	**- international:**	***G01S15/96;*** (IPC1-7): G01S15/96
	- European:	
Application number:	JP20020173113 20020613	
Priority number(s):	JP20020173113 20020613	

Abstract of JP2004020276 (A)

PROBLEM TO BE SOLVED: To find fish swimming in an area near to a water surface. ; SOLUTION: This finder is provided with a clump 7 attached to a ship, a support rod 9 attached to the clump 7 to position an end part 23 under the surface 5 of the water, an ultrasonic oscillator 13 supported adjustably in oscillation to the end part 23 of the support rod 9, and for making an emission and reception direction of an ultrasonic wave change-regulatable to a water depth direction and a direction crossed therewith, and an operation means 15 for change-regulating the emission and reception direction of the ultrasonic oscillator 13. A turning means 11 for supporting rotatably an intermediate part of the support rod 9 is provided between the clump 7 and the support rod 9, an the turning means 11 rotation-moves the support rod 9 to be switched between a using condition where the ultrasonic oscillator 13 is positioned in the underwater and a storing condition where it is positioned on the water surface. ; COPYRIGHT: (C)2004,JPO



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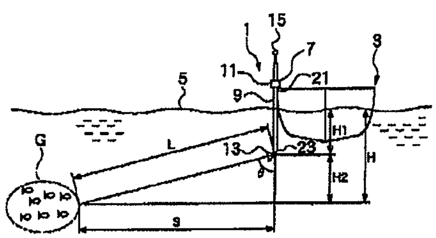
(54)【発明の名称】魚群探知装置

(57)【要約】
【課題】水面近くを泳いでいる魚群の探知を可能とする。
【解決手段】船に取り付けられるクランプ７と、クランプ７に取り付けられ端部２３を水面５下に位置させ得る支持杆９と、支持杆９の端部２３に首振り調整可能に支持され超音波の発受信方向を水深方向及びこれに交差する方向へ変更調整可能な超音波振動子１３と、超音波振動子１３の発受信方向を変更調整する操作手段１５とを備え、クランプ７と支持杆９との間に、支持杆９の中間部を回転可能に支持する回動手段１１を設け、回動手段１１は、支持杆９を超音波振動子１３が水中に位置する使用状態と水面上に位置する格納状態とに回転移動させ得ることを特徴とする。
【選択図】　図1



【特許請求の範囲】
【請求項1】
船に取り付けられるクランプと、
該クランプに取り付けられ端部を水面下に位置させ得る支持杆と、
前記支持杆の端部に首振り調整可能に支持され超音波の発受信方向を水深方向及びこれに交差する方向へ変更調整可能な超音波振動子と、
前記超音波振動子の発受信方向を変更調整する操作手段とを備えたことを特徴とする魚群探知装置。
【請求項2】
請求項１記載の魚群探知装置であって、
前記クランプと支持杆との間に、該支持杆の中間部を回転可能に支持する回動手段を設け、
該回動手段は、前記支持杆を前記超音波振動子が水中に位置する使用状態と水面上に位置する格納状態とに回転移動させ得ることを特徴とする魚群探知装置。
【請求項3】
請求項２記載の魚群探知装置であって、
前記回動手段は、前記支持杆を前記超音波振動子が水中に位置する使用状態に付勢する付勢手段及び該付勢手段による付勢力を受け止めて前記支持杆を前記使用状態に対応して位置決めるストッパ手段と、前記支持杆を前記超音波振動子が水面上に位置する格納状態に対応して位置決めるロック手段とを備えたことを特徴とする魚群探知装置。
【請求項4】
請求項２又は３記載の魚群探知装置であって、
前記回動手段は、前記クランプにより前記支持杆が前記船の右舷又は左舷に取り付けられたとき該回動手段を境として前記支持杆の超音波振動子側を前記船の進行方向後方側へ回転移動させることを特徴とする魚群探知装置。
【請求項5】
請求項２又は３記載の魚群探知装置であって、
前記回動手段は、前記クランプにより前記支持杆が前記船の後部の右舷寄り又は左舷寄りに取り付けられたとき該回動手段を境として前記支持杆の超音波振動子側を前記船の中央部側へ回転移動させることを特徴とする魚群探知装置。

【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は、小型船等に取り付けられる簡易な魚群探知装置に関する。
【０００２】
【従来の技術】
従来より小型船等で用いられる簡易な魚群探知装置としては、例えば特開２００２−６０３８号公報に記載されたものなどがある。この魚群探知装置は、超音波を発受信する超音波振動子がガイド竿に糸を介して吊り下げられたものである。また、超音波振動子が小型船の船底に取り付けられたものも等も存在する。いずれの場合も水深方向にのみ超音波を発信することにより、どれぐらいの水深位置に魚群が存在するかを検出できるようになっている。
【０００３】
【発明が解決しようとする課題】
しかしながら、上記のように水深方向でのみ魚群を探知する構成であると、例えば船の真下から少し離れた所にいるバス等のような魚を探知することは困難であるという問題があった。
【０００４】
これに対し、大型船などでは超音波の発受信方向を変更調整可能にしたものが存在する。しかしながら、大型船の構造をそのまま単純に小さくして小型船に適用することはできず

、構造が複雑となり著しく高価な魚群探知装置となるという問題がある。
【0005】
本発明は、簡易かつ安価でありながら超音波の発受信方向を水深方向及びこれに交差する方向へ変更調整可能な魚群探知装置の提供を課題とする。
【0006】
【課題を解決するための手段】
請求項1の発明は、船に取り付けられるクランプと、該クランプに取り付けられ端部を水面下に位置させ得る支持杆と、前記支持杆の端部に首振り調整可能に支持され超音波の発受信方向を水深方向及びこれに交差する方向へ変更調整可能な超音波振動子と、前記超音波振動子の発受信方向を変更調整する操作手段とを備えたことを特徴とする。
【0007】
請求項2の発明は、請求項1記載の魚群探知装置であって、前記クランプと支持杆との間に、該支持杆の中間部を回転可能に支持する回動手段を設け、該回動手段は、前記支持杆を前記超音波振動子が水中に位置する使用状態と水面上に位置する格納状態とに回転移動させ得ることを特徴とする。
【0008】
請求項3の発明は、請求項2記載の魚群探知装置であって、前記回動手段は、前記支持杆を前記超音波振動子が水中に位置する使用状態に付勢する付勢手段及び該付勢手段による付勢力を受け止めて前記支持杆を前記使用状態に対応して位置決めるストッパ手段と、前記支持杆を前記超音波振動子が水面上に位置する格納状態に対応して位置決めるロック手段とを備えたことを特徴とする。
【0009】
請求項4の発明は、請求項2又は3記載の魚群探知装置であって、前記回動手段は、前記クランプにより前記支持杆が前記船の右舷又は左舷に取り付けられたとき該回動手段を境として前記支持杆の超音波振動子側を前記船の進行方向後方側へ回転移動させることを特徴とする。
【0010】
請求項5の発明は、請求項2又は3記載の魚群探知装置であって、前記回動手段は、前記クランプにより前記支持杆が前記船の後部の右舷寄り又は左舷寄りに取り付けられたとき該回動手段を境として前記支持杆の超音波振動子側を前記船の中央部側へ回転移動させることを特徴とする。
【0011】
【発明の効果】
請求項1の発明では、船にクランプを取り付け、該クランプに支持杆を支持して水面下に位置する支持杆の端部に超音波振動子を首振り調整可能に支持することができる。そして、操作手段によって超音波振動子の発受信方向を変更調整し、超音波の発受信方向を水深方向及びこれに交差する方向へ変更調整することが可能となる。
【0012】
従って、魚群が船に対して水深方向に位置する場合に限らず、船から少し離れた位置にいる魚群に対しても超音波振動子を向けて超音波の発受信を行うことができ、水面よりすぐ下を泳いでいる魚群を的確に探知することができる。
【0013】
しかも、超音波振動子を船に取り付けられるクランプに取り付けられた支持杆に首振り調整可能に支持し、操作手段によって変更調整するという簡単な構造によって、超音波の発受信方向を変更調整することができ、簡易な構造によって安価に製造することができる。
【0014】
請求項2の発明では、請求項1の発明の効果に加え、前記クランプと支持杆との間に該支持杆の中間部を回転可能に支持する回動手段を設けたため、前記支持杆を前記超音波振動子が水中に位置する使用状態と水面上に位置する格納状態とに回転移動させることができる。従って、船が進行する場合に、支持杆及び超音波振動子が水の抵抗を受けることがな

く、船の進行を円滑に行わせることができる。

【００１５】

請求項３の発明では、請求項２の発明の効果に加え、前記回動手段は、前記支持杆を前記超音波振動子が水中に位置する使用状態に付勢する付勢手段及び該付勢手段による付勢力を受け止めて前記支持杆を前記使用状態に対応して位置決めるストッパ手段を備えたため、支持杆を使用状態で確実に位置決め、超音波振動子による超音波の発受信を調整された方向に対し的確に行うことができる。

【００１６】

また前記支持杆を前記超音波振動子が水面上に位置する格納状態に対応してロック手段によって確実に位置決めることができる。従って、船が進行する際に支持杆の超音波振動子側が水の抵抗を受けることがなく、船の進行をより確実且つ円滑に行わせることができる。

【００１７】

請求項４の発明では、請求項２又は３の発明の効果に加え、前記回動手段は、前記クランプにより前記支持杆が前記船の右舷又は左舷に取り付けられたとき該回動手段を境として前記支持杆の超音波振動子側を前記船の進行方向後方側へ回転移動させることができる。従って、超音波振動子により魚群探知をしながら船を進行させるとき、水中の異物が支持杆に当たって支持杆に船の進行方向後方側へ無理な力が作用しても、前記のように回動手段を境として前記支持杆の超音波振動子側が船の進行方向後方側へ回転移動することで異物を逃がすことができる。このため、水中の異物が支持杆に当たってもクランプ等に無理な力が働くのを抑制することができ、クランプ等の破損、船からの離脱等を抑制することができ、簡単な構造で魚群探知を正確に行わせることができる。

【００１８】

請求項５の発明では、請求項２又は３の発明の効果に加え、前記クランプにより支持杆を前記船の後縁の右舷寄り又は左舷寄りに取り付けたとき、前記回動手段によって前記支持杆の超音波振動子側を前記船の中央部側へ回動移動させることができる。従って、支持杆の超音波振動子側が船の右舷寄り又は左舷寄りに突出するのを抑制することができ、右舷側又は左舷側を接岸するような場合等にも、支持杆の超音波振動子側が邪魔にならず、接岸等を円滑に行わせることができる。

【００１９】

【発明の実施の形態】

図１、図２は本発明の一実施形態に係り、図１は魚群探知装置１を備えた船として小型船であるボート３を水面５との関係で示した正面図、図２は同右舷側側面図、図３は同平面図である。この図１，図２，図３のように、前記魚群探知装置１はクランプ７と、支持杆９と、回動手段１１と、超音波振動子１３と、操作手段１５とを備えている。前記超音波振動子１３は、配線１７によって探知器１９に接続されている。

【００２０】

前記クランプ７は、船の縁である前記ボート３の右舷の縁部２１に取り付けられている。前記支持杆９は、前記クランプ７に取り付けられ、一方の端部２３が水面５下に位置している。前記回動手段１１は、前記クランプ７と支持杆９との間に設けられ、支持杆９の中間部を回転可能に支持している。

【００２１】

前記超音波振動子１３は、前記支持杆９の端部２３に首振り調整可能に支持され、超音波の発受信方向を水深方向及びこれに交差する方向である斜め方向、水平方向などに変更調整可能となっている。

【００２２】

前記操作手段１５は、前記超音波振動子１３の発受信方向を変更調整するものである。

【００２３】

また本実施形態では、支持杆９を回動手段１１に対し軸周りに回転させることができ、例えば図１のように超音波振動子１３を水深方向に対しθの角度を有して斜めに変更調整さ

れた状態で、さらに水平方向に回動させることができる。
【００２４】
前記探知器１９はバッテリによって駆動され、前記超音波振動子１３を駆動して超音波を発信させ、超音波振動子１３が受信した信号を受けて発信から受信までの往復時間を距離に換算し、発受信方向が水深方向である場合には深度として表示する。また反射波の強弱により魚群の大きさや密度あるいは海底の形状や底質を画像に識別表示する。
【００２５】
前記超音波振動子１３による超音波の発受信方向が水深方向に交差する図１のような場合には、超音波の発信から受信までの往復時間を距離Ｌに換算する。また深度としては超音波振動子１３の水深方向に対する斜めの角度θ及び水面５からの水深Ｈ１を探知器１９にテンキー操作などによって入力し、あるいは検出によって自動的に入力することにより、水深Ｈ及び水平距離Ｓを例えば次のように演算する。
【００２６】
$H=H1+H2=H1+L\cos\theta$　…（１）
$S=L\sin\theta$　…（２）
なお、前記超音波振動子１３の水面５からの水深Ｈ１をセンサによって検出する場合には、回動手段１１と支持杆９との間に位置センサを設け、該位置センサの検出値から換算することになる。またＨ１をテンキーの操作によって手動で入力する場合には、支持杆９と回動手段１１との間に目盛りを付けておき、該目盛りを読み込むことによってＨ１を入力することができる。
【００２７】
前記水深方向に対する角度θは、支持杆９と超音波振動子１３との間に設けた回転角センサ等により検出し、探知器１９に入力することができる。また角度θを手動で入力する場合には、操作手段１５と支持杆９との間に角度θに対応した目盛りを付けておくことにより、該目盛りを読み込んで探知器１９に入力することができる。
【００２８】
前記支持杆９の超音波振動子１３側は、その使用状態で水中に位置しているため、ボート３を進行させる場合には水の抵抗を受け易くなっている。このため前記回動手段１１によって前記支持杆９を前記超音波振動子１３が水中に位置する使用状態と水面上に位置する図２鎖線図視上位側の格納状態とに回転移動させ得る構成となっている。
【００２９】
すなわち図２の格納状態では、支持杆９の超音波振動子１３側が水面５上に位置し、ボート３の進行に伴って支持杆９の超音波振動子１３側が水の抵抗を受けることがなく、ボート３を円滑に進行させることができる。
【００３０】
また、前記回動手段１１は、前記クランプ７により前記支持杆９が前記ボート３の右舷に取り付けられたとき該回動手段１１を境として前記支持杆９の超音波振動子１３側を前記ボート３の進行方向後方側へ図２鎖線図視中位のように回転移動させることができる。従って、超音波振動子１３により魚群探知をしながらボート３を進行させるとき、水中の異物Ｗが支持杆９に当たって支持杆９にボート３の進行方向後方側へ無理な力が作用しても、前記のように回動手段１１を境として前記支持杆９の超音波振動子１３側が船の進行方向後方側へ回転移動することで異物Ｗを逃がすことができる。このため、水中の異物Ｗが支持杆９に当たってもクランプ７等に無理な力が働くのを抑制することができ、クランプ７等の破損、船からの離脱等を抑制することができ、簡単な構造で魚群探知を正確に行わせることができる。
【００３１】
なお、魚群探知装置１のクランプ７、支持杆９等を、ボート３の左舷に取り付けたときも同様に構成することができる。
【００３２】
次に、図４～図１３を用いて具体的構造をさらに説明する。図４はクランプ７及び支持杆

９などをボート３から取り外して示す斜視図、図５は同側面図、図６は同平面図、図７はクランプの正面図、図８は回動手段を説明する要部の拡大断面図、図９は回動手段を説明する同正面図、図１０は押さえプレートを示し、（ａ）は正面図、（ｂ）は側面図、図１１は付勢手段として右舷用のコイルスプリングを示し、（ａ）は断面図、（ｂ）は側面図、図１２、図１３は超音波振動子の回動操作を説明する斜視図である。

【００３３】

図４～図７のように、前記クランプ７は、クランプブラケット２５と締結具２７とからなっている。前記クランプブラケット２５は樹脂で形成され、一対の足部２９，３１を備えている。一方の足部２９には、前記締結具２７が螺合支持されている。締結具２７の螺合支持は前記足部２９に固定された六角ナット３３に締結具２７のねじ軸３５が螺合することによって行われている。締結具２７には、ねじ軸３５の前端にスラストパッド３７が設けられ、後端にノブ３９が設けられている。

【００３４】

前記足部３１の後面４１は、ボート３の縁部２１の外面に当接する固定面として構成されている。前記足部３１には、外筒部４３が設けられている。外筒部４３の前面には、フランジ部４５が設けられている。フランジ部４５の上下中央において左右一側に図７のようにストッパピン４７が突設されている。前記外筒部４３の先端側上部には、ロック孔４８が貫通形成されている。前記外筒部４３に対し、ヒンジブラケット４９が軸周りに回転可能に支持されている。

【００３５】

図８，図９をも参照すると、前記ヒンジブラケット４９には、上下に支持部５１，５３が設けられている。前記支持部５１は、固定側部５５と着脱可能な押さえプレート５７とを備えている。固定側部５５は、円弧状の凹部５９と両側の突き当て部６１とからなっている。突き当て部６１には雌ねじ部６３が設けられている。

【００３６】

前記押さえプレート５７は、図１０をも参照すると、円弧状の凹部６５と突き当て部６７とからなっている。突き当て部６７には貫通孔６９が設けられている。この押さえプレート５７の突き当て部６７を前記固定側部５５の突き当て部６７に対向させ、凹部５９，６５で支持杆９の外面を包囲して支持する円弧を構成することができる。

【００３７】

前記押さえプレート５７は、貫通孔６９を貫通させた図６で示す締結具７１を固定側部５５の雌ねじ部６３に締め込むことによって、凹部５９，６５により支持杆９を締結支持することができる。支持杆９の締結状態において対向部６１，６７間には図８のように隙間７３が構成されている。従って、支持杆９をヒンジブラケット４９に締結具７１の締め込みによって所定の締結力により支持させることができる。この状態で支持杆９は支持部５１において一定の締結力により軸周りに回転可能かつ軸方向へは摩擦係合によって移動不能に支持されている

前記支持部５３は、図８，図９のように壁部７５によって囲まれた断面U字状の凹部７７を備えている。凹部７７の奥側の面は、前記凹部５９の円弧状と同様な曲率の円弧状に形成されている。従って、凹部７７により支持杆９の外面をガイド支持することができる。

【００３８】

前記ヒンジブラケット４９には、前記外筒部４３に嵌合する内筒部７９が設けられている。外筒部４３と内筒部７９との間には、付勢手段としてコイルスプリング８１が介設されている。

【００３９】

前記コイルスプリング８１には、図１１に示すように、両端部に係合部８３，８５が設けられている。係合部８３は前記外筒部４３の係止凹部８７に周方向に係合し、前記係合部８５は前記内筒部７９の係止穴部８９に嵌合係止されている。

【００４０】

前記コイルスプリング８１の後端には、外筒部４３と内筒部７９との間において樹脂ワッ

シャ９１が配置され、内筒部７９に係合する止め輪９３によって抜け止めが行われている。
【００４１】
前記外筒部４３、内筒部７９、及びコイルスプリング８１は、前記回動手段１１を構成している。すなわち前記ヒンジブラケット４９をクランプブラケット２５に対し図９の矢印Ａ方向の格納状態へ回転移動させることができる。前記コイルスプリング８１は、図９の使用状態を維持するようにヒンジブラケット４９をクランプブラケット２５に対して回動付勢している。この図９の状態は、前記超音波振動子１３が水中に位置する図１の使用状態となっている。
【００４２】
前記内筒部７９の根元側には、図９のように外筒部４３外においてストッパ係合部９５，９７が設けられている。ストッパ係合部９５は右舷用であり、ストッパ係合部９７は左舷用となっている。従って、ヒンジブラケット４９は右舷用、左舷用に共用することができる。
【００４３】
本実施形態は、右舷用として用いられているため、前記コイルスプリング８１の付勢力に対しストッパ係合部９５が前記ストッパピン４７に係合して受け止め、前記支持杆９を前記使用状態に対応して位置決める構成となっている。従って、本実施形態においてストッパ係合部９５、ストッパピン４７はストッパ手段を構成している。
【００４４】
前記内筒部７９には、図８のようにロック孔９９が設けられている。ロック孔９９は、前記支持杆９を前記超音波振動子１３が水面上に位置する格納状態としたとき、前記外筒部４３のロック孔４８に対向する。この両ロック孔４８，９９に対し、図４で示すロックピン１０１を差し込むことによって、クランプブラケット２５に対しヒンジブラケット４９を格納状態でロックすることができる。この状態で前記支持杆９を前記超音波振動子１３が水面５上に位置する格納状態に対応して位置決めることができ、ロック孔４８，９９、ロックピン１０１は本実施形態においてロック手段を構成している。前記ロックピン１０１は、前記ねじ軸３５等に紐１０２で支持されている。
【００４５】
前記支持杆９は、例えばアルミパイプで形成され、その中間部が前記ヒンジブラケット４９に支持されている。前記支持杆９の上下には、樹脂キャップ１０３，１０５が設けられている。
【００４６】
前記操作手段１５は、操作ノブ１０７と操作ロッド１０９とを備えている。また本実施形態において、前記操作手段１５は前記樹脂キャップ１０３に一体に設けられた操作アーム１１１を備えている。
【００４７】
前記操作ノブ１０７は、前記操作ロッド１０９の先端に取り付けられている。操作ロッド１０９には、操作ノブ１０７側においてストッパ１１３が設けられている。ストッパ１１３は前記樹脂キャップ１０３の端面に当接して操作ロッド１０９の樹脂キャップ１０３に対する押し込め移動を位置決める。前記樹脂キャップ１０３には、固定具１１５が螺合されている。固定具１１５を締め込むことによって、固定具１１５先端が前記操作ロッド１０９に突き当たり、操作ロッド１０９を任意の位置で位置決めることができる。
【００４８】
前記操作ロッド１０９の他端は、前記樹脂キャップ１０５を貫通してベルクランク１１７の一端に回転自在に結合されている。ベルクランク１１７は、前記樹脂キャップ１０５に設けられたブラケット１１９に回転自在に支持されている。ベルクランク１１７には、前記超音波振動子１３が支持されている。なお、配線１７は、前記支持杆９内を通されている。
【００４９】

前記支持杆９等を前記ボート３の右舷の縁部２１に取り付けるには、クランプ７の締結具２７を緩め、後面４１とスラストパッド３７との間の間隔を広げる。この状態において、クランプ７をボート３の縁部２１の上縁を跨がせるように装着する。この状態でクランプ７の後面４１はボート３の縁部２１外面に対向し、スラストパッド３７は同内面に対向する。

【００５０】
次いで、締結具２７のノブ３９を回して、ねじ軸３５を六角ナット３３に対して螺合移動させ、スラストパッド３７をボート３の右舷の縁部２１内面に突き当てる。さらに縁部２１を後面４１とスラストパッド３７とで締め上げることによって支持杆９等は図１，図２のようにボート３の右舷の縁部２１に簡単に取り付けられる。

【００５１】
このような支持杆９の取り付けにより、図２のように超音波振動子１３が水中に位置する使用状態にセットすることができる。この状態は、コイルスプリング８１の付勢力によって外筒部４３に対し内筒部７９が回転付勢され、ストッパ係合部９５がストッパピン４７に係合することによって位置決められ、支持杆９をほぼ垂直状態の使用状態に確実にセットすることができる。

【００５２】
図１～図3，図5の使用状態で、前記固定具１１５を緩め、操作ノブ１０７を押し込めあるいは押し上げることによって、操作ロッド１０９を介しベルクランク１１７をブラケット１１９に対して回動させることができる。

【００５３】
このベルクランク１１７の回動によって、超音波振動子１３を図５の実線図示及び図１２の状態から図５一点鎖線図示及び図１３へのほぼ９０°の範囲で回動させ、発受信方向を変更調整することができる。なお角度θは９０°以上の範囲、同以下の範囲で調整するように構成することも可能である。

【００５４】
また支持杆９は支持部５１において一定の締結力により軸周りに回転可能かつ軸方向へは摩擦係合によって移動不能に支持されているため、操作アーム１１１を把持して支持杆９をヒンジブラケット４９に対し軸周りに回転させることができる。これによって例えば図５の一点鎖線図示の方向に向いた超音波振動子１３を紙面直交方向に回動させることにより、ほぼ３６０°回転させて超音波振動子１３を振り向けることができる。

【００５５】
このような超音波振動子１３の変更調整によって、図1のようにボート３の真下から少し離れた所にいるバス等の魚群Gを的確かつ容易に探知することができる。また前記のように、超音波振動子１３を水深方向及びこれに交差する方向と水平方向の回動によって変更調整することができるため、魚群Gが水面5の近くにおいてボート３の後方、側方、前方のいずれにいる場合でも的確に探知することができる。

【００５６】
前記支持杆9を図３の鎖線図視の格納状態とするには、支持杆９を把持して超音波振動子１３側がボート３の中央側へ回動するように操作する。これによってヒンジブラケット４９がクランプブラケット７に対して図９の矢印A方向へ回動する。

【００５７】
前記支持杆9がほぼ９０°回転移動したところで、ロック孔４８，９９が対向する。この対向位置で、図４で示すロックピン１０１をロック孔４８，９９に差し込み、ヒンジブラケット４９をクランプ7に対し固定する。従って、支持杆９を図３の格納状態で確実に固定することができる。

【００５８】
図１４，図１５は左舷用のクランプ７Ａ及びコイルスプリング８１Ａを示している。図１４はクランプ７Ａの正面図、図１５（ａ）はコイルスプリング８１Ａの断面図、（ｂ）は同側面図である。

【００５９】
図１４のように、左舷用のクランプ７Ａでは、ストッパピン４７Ａが前記図７の右舷用のストッパピン４７に対し１８０°ずれた反対側に設けられている。またコイルスプリング８１Ａは、前記図１１の右舷用のものに対して係合部８３、８５の位置が逆位置に設定されている。これに応じて、クランプ７の外筒部４３に形成された係止凹部８７、ヒンジブラケット４９の内筒部７９に形成された係止穴部８９も逆位置に設定されている。
【００６０】
このようなクランプ７Ａとコイルスプリング８１Ａを用いた場合には、クランプ７Ａによって支持杆９がボート３の左舷に取り付けられることになる。また支持杆９の格納位置では、図２と同様にボート３の後方側へ回動させた形態となる。
【００６１】
このようにクランプ７，７Ａ、コイルスプリング８１，８１Ａを交換するだけで右舷用、左舷用のいずれにも適用することができ、部品の共用化が図れ、容易かつ安価に対応することができる。
【００６２】
また回動手段１１は、右舷用、左舷用のいずれか一方にのみ対応する構造にすることなく、コイルスプリングのばね力が両方向に作用するように構成し、右左舷両用とすることも可能である。例えば、右舷用、左舷用のコイルスプリングを一対設け、いずれの方向からも使用状態に付勢する構造とし、支持杆９の使用状態において双方のばね力が釣り合うように構成する。これにより右舷用、左舷用のいずれにも対応することができる。この場合、ストッパピン４７，４７Ａは不要となる。
【００６３】
なお、超音波振動子１３は上下方向にのみ発受信方向を調整可能に構成することもできる。
【００６４】
またボート３は小型の船であればモーターボート、クルーザ等にも適用することは可能である。
【００６５】
前記操作手段１５は、手動によって操作する構成としたが、小型モータとラックアンドピニオン等を用いることによって駆動することも可能である。
【００６６】
上記実施形態では支持杆９をボート３の右舷又は左舷に取り付ける構造としたが、ボート３の先端部あるいは後縁部に取り付けることもできる。
【００６７】
図１６，図１７は、前記クランプ７により支持杆９を、ボート３の後部に取り付けた実施形態を示し、図１６は使用状態の平面図、図１７は格納状態の平面図である。なお、魚群探知装置１の全体的な構成は上記実施形態のものと同様であり、対応する構成には同符号を付して説明する。
【００６８】
本実施形態において、回動手段１１は、前記クランプ７により前記支持杆９等がボート３の後縁部２１Ａの右舷寄りに取り付けられたとき、回動手段１１を境として前記支持杆９の超音波振動子１３側を前記ボート３の中央部側へ回動変位させるようにしている。回動手段１１は、前記クランプ７により前記支持杆９等が前記ボート３の後縁部２１Ａの左舷寄りに取り付けられたときは、図１７とは逆の状態に回動することになる。
【００６９】
このような回動によって、格納状態において支持杆９の超音波振動子１３側がボート３の右舷側又は左舷側に大きく突出することがなく、ボート３を接岸させるような場合においても支持杆９の超音波振動子１３側が邪魔になることが抑制され、接岸等を円滑に行うことができる。
【００７０】

本実施形態では、支持杆９全体をボート３のほぼ幅内に収める形態となっており、ボート３の操作に際して格納状態の支持杆９全体がボート３操作等の障害になることを抑制できる。

【図面の簡単な説明】

【図１】本発明の一実施形態に係る魚群探知装置を備えたボートの正面図である。

【図２】一実施形態に係り、支持杆使用状態のボートの右舷側の側面図である。

【図３】一実施形態に係り、支持杆格納状態のボートの平面図である。

【図４】一実施形態に係り、クランプ及び支持杆周辺の斜視図である。

【図５】一実施形態に係り、クランプ及び支持杆周辺の側面図である。

【図６】一実施形態に係り、クランプ及び支持杆周辺の平面図である。

【図７】一実施形態に係り、クランプの正面図である。

【図８】一実施形態に係り、回動手段周辺の要部拡大断面図である。

【図９】一実施形態に係り、ヒンジブラケットの正面図である。

【図１０】一実施形態に係り、（ａ）は押さえプレートの側面図、（ｂ）は同正面図である。

【図１１】一実施形態に係り、（ａ）はコイルスプリングの断面図、（ｂ）は同側面図である。

【図１２】一実施形態に係り、操作状態を示す側面図である。

【図１３】一実施形態に係り、操作状態を示す側面図である。

【図１４】一実施形態に係り、左舷用のクランプを示す正面図である。

【図１５】左舷用のコイルスプリングを示し、（ａ）は断面図、（ｂ）は側面図である。

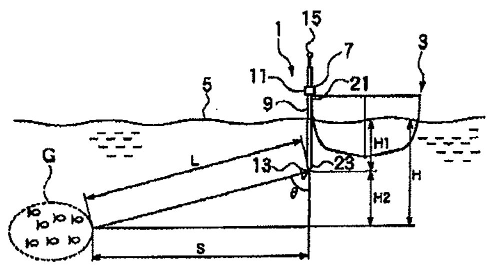
【図１６】本発明の他の実施形態に係り、支持杆使用状態のボートの平面図である。

【図１７】他の実施形態に係り、支持杆格納状態のボートの平面図である。

【符号の説明】

１　魚群探知装置
３　ボート（船）
５　水面
７，７Ａ　クランプ
９　支持杆
１１　回動手段
１３　超音波振動子
１５　操作手段
２３　端部
４７，４７Ａ　ストッパピン（ストッパ手段）
４８，９９　ロック孔（ロック手段）
８１，８１Ａ　コイルスプリング（付勢手段）
９５，９７　ストッパ係合部（ストッパ手段）
１０１　ロックピン（ロック手段）

【図1】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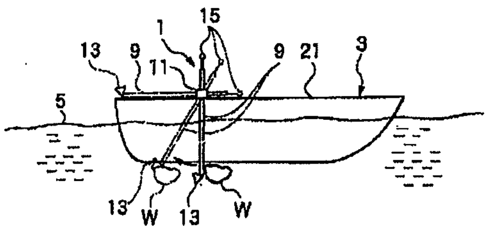
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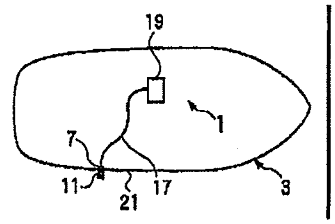
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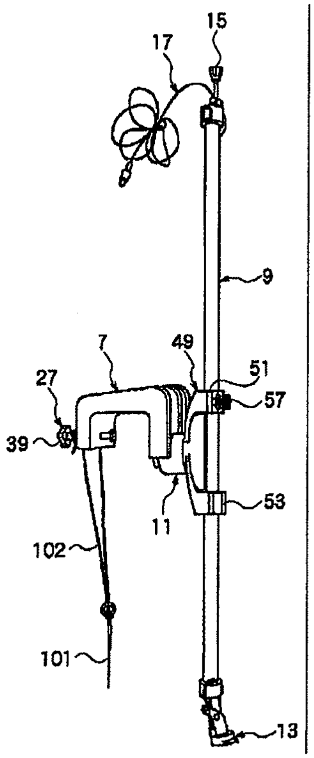
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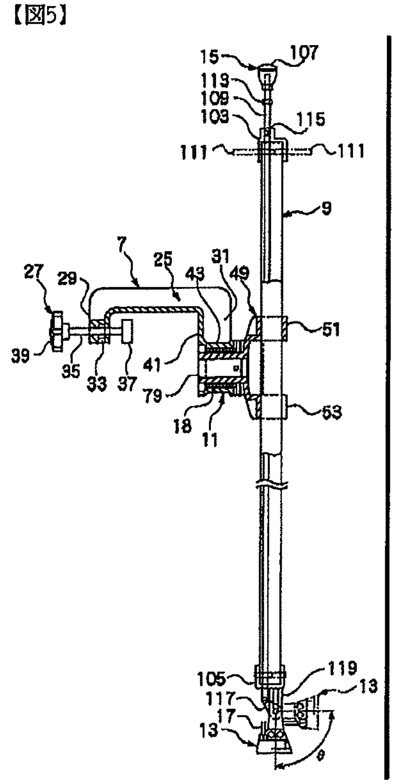
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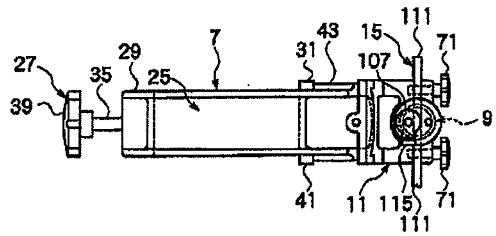
【図6】



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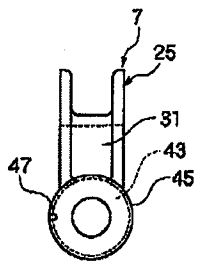

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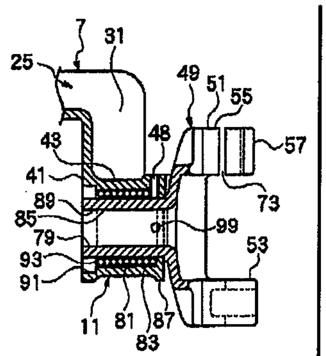

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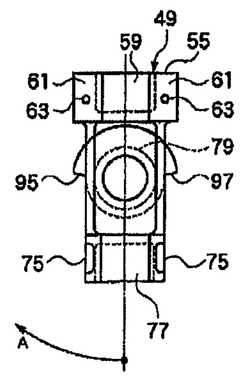

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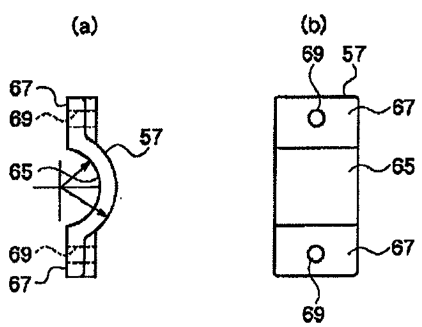

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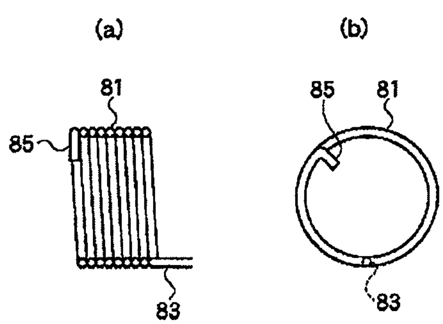

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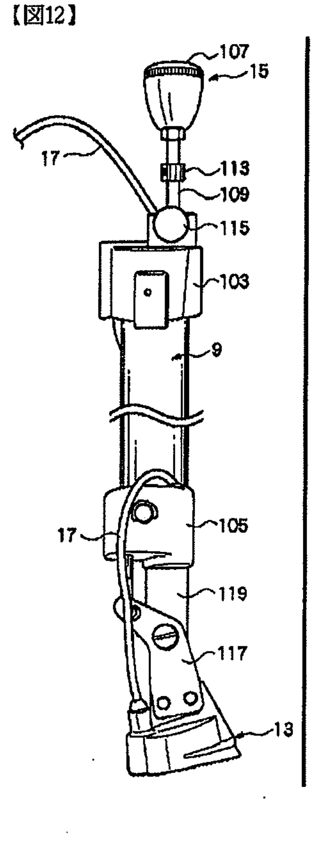

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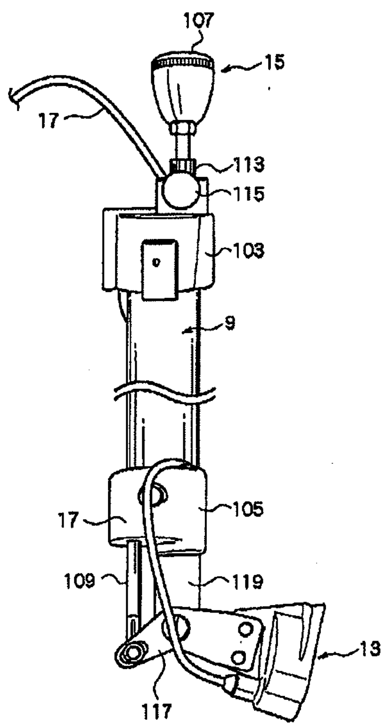

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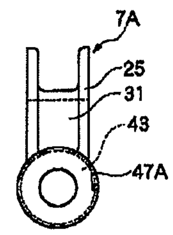
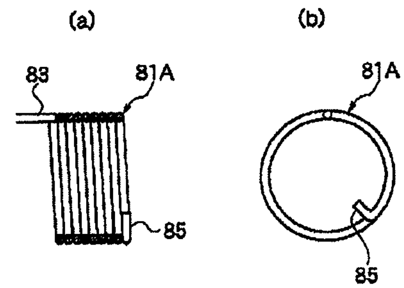


【図15】



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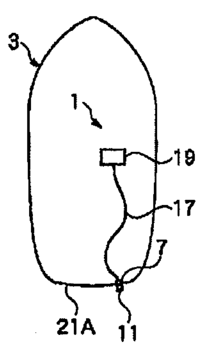
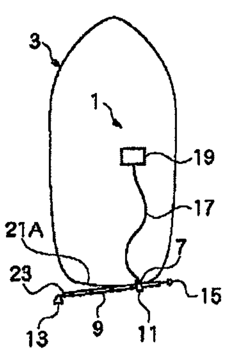


【図17】



Electronic Patent Application Fee Transmittal

Application Number:	12460139
Filing Date:	14-Jul-2009
Title of Invention:	DOWNSCAN IMAGING SONAR
First Named Inventor/Applicant Name:	Brian T. Maguire
Filer:	Michael D. McCoy/Judy Creel
Attorney Docket Number:	038495/369324

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
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($)
Miscellaneous:				
Request for continued examination	1801	1	930	930
		Total in USD ($)		**930**

Electronic Acknowledgement Receipt

EFS ID:	13081816
Application Number:	12460139
International Application Number:	
Confirmation Number:	9769
Title of Invention:	DOWNSCAN IMAGING SONAR
First Named Inventor/Applicant Name:	Brian T. Maguire
Customer Number:	826
Filer:	Michael D. McCoy/Judy Creel
Filer Authorized By:	Michael D. McCoy
Attorney Docket Number:	038495/369324
Receipt Date:	22-JUN-2012
Filing Date:	14-JUL-2009
Time Stamp:	13:02:05
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$930
RAM confirmation Number	10424
Deposit Account	160605
Authorized User	

File Listing:

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

1	Request for Continued Examination (RCE)	369324_RCE.PDF	76058 adbb93b79a678603c137faeea8755809dcde53ba	no	2

Warnings:

This is not a USPTO supplied RCE SB30 form.

Information:

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Multipart Description/PDF files in .zip description

Document Description	Start	End
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Information Disclosure Statement (IDS) Form (SB08)	2	2

Warnings:

Information:

3		369324_FOR_REFS_NPL.PDF	6155839 a3cc9dfaf899467e9071d45e2b7d87afbc08b321	yes	135

Multipart Description/PDF files in .zip description

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Foreign Reference	6	24
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Foreign Reference	50	55
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Foreign Reference	69	73
Foreign Reference	74	82
Foreign Reference	83	93
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Foreign Reference	99	113

	Non Patent Literature		114		135
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	30364 f5d6056237cc40cd95c9bcfa5671aa13f4711823	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	6377832		

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

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United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/460,139	07/14/2009	Brian T. Maguire	038495/369324

CONFIRMATION NO. 9769

POA ACCEPTANCE LETTER

OC000000053614515

826
ALSTON & BIRD LLP
BANK OF AMERICA PLAZA
101 SOUTH TRYON STREET, SUITE 4000
CHARLOTTE, NC 28280-4000

Date Mailed: 04/12/2012

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/03/2012.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/ttkim/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/460,139	07/14/2009	Brian T. Maguire	038495/369324

CONFIRMATION NO. 9769

POWER OF ATTORNEY NOTICE

OC000000053614506

826
ALSTON & BIRD LLP
BANK OF AMERICA PLAZA
101 SOUTH TRYON STREET, SUITE 4000
CHARLOTTE, NC 28280-4000

Date Mailed: 04/12/2012

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/03/2012.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

/ttkim/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

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NOTICE OF ALLOWANCE AND FEE(S) DUE

826 7590 04/11/2012

ALSTON & BIRD LLP
BANK OF AMERICA PLAZA
101 SOUTH TRYON STREET, SUITE 4000
CHARLOTTE, NC 28280-4000

EXAMINER	
HULKA, JAMES R	
ART UNIT	PAPER NUMBER
3645	

DATE MAILED: 04/11/2012

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/460,139	07/14/2009	Brian T. Maguire	038495/369324	9769

TITLE OF INVENTION: DOWNSCAN IMAGING SONAR

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1740	$300	$0	$2040	07/11/2012

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

826 7590 04/11/2012

ALSTON & BIRD LLP
BANK OF AMERICA PLAZA
101 SOUTH TRYON STREET, SUITE 4000
CHARLOTTE, NC 28280-4000

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/460,139	07/14/2009	Brian T. Maguire	038495/369324	9769

TITLE OF INVENTION: DOWNSCAN IMAGING SONAR

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1740	$300	$0	$2040	07/11/2012

EXAMINER	ART UNIT	CLASS-SUBCLASS
HULKA, JAMES R	3645	367-088000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
   - ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
   - ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
   (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
   (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
   1 ____________________
   2 ____________________
   3 ____________________

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
- ☐ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies ____________________

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ☐ A check is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number ____________ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
- ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature ______________________________ Date ______________________________

Typed or printed name ______________________________ Registration No. ______________________________

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/460,139	07/14/2009	Brian T. Maguire	038495/369324	9769

826 7590 04/11/2012

ALSTON & BIRD LLP
BANK OF AMERICA PLAZA
101 SOUTH TRYON STREET, SUITE 4000
CHARLOTTE, NC 28280-4000

EXAMINER	
HULKA, JAMES R	
ART UNIT	PAPER NUMBER
3645	

DATE MAILED: 04/11/2012

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 299 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 299 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Privacy Act Statement

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.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
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.

Notice of Allowability	**Application No.** 12/460,139	**Applicant(s)** MAGUIRE, BRIAN T.	
	Examiner JAMES HULKA	**Art Unit** 3645	

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

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 5 March 2012.
2. ☐ 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.
3. ☒ The allowed claim(s) is/are 57-84,86,88-125,127-131 and 134.
4. ☐ 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 the:
   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)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE “MAILING DATE” of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER’S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as “replacement sheets”) must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson’s Patent Drawing Review (PTO-948) attached
   1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner’s Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner’s comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 20120221
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

/J. H./ Examiner, Art Unit 3645	/JACK W KEITH/ Supervisory Patent Examiner, Art Unit 3646

RAY-1002
250 of 737

Index of Claims	Application/Control No. 12460139	Applicant(s)/Patent Under Reexamination MAGUIRE, BRIAN T.
	Examiner JAMES HULKA	Art Unit 3662

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/26/2011	09/13/2011	12/08/2011	03/07/2012					
	1	÷	N	-	-					
	2	÷	N	-	-					
	3	÷	N	-	-					
	4	÷	N	-	-					
	5	÷	N	-	-					
	6	÷	N	-	-					
	7	÷	N	-	-					
	8	÷	N	-	-					
	9	÷	N	-	-					
	10	÷	N	-	-					
	11	÷	N	-	-					
	12	÷	N	-	-					
	13	÷	N	-	-					
	14	÷	N	-	-					
	15	÷	N	-	-					
	16	÷	N	-	-					
	17	÷	N	-	-					
	18	÷	N	-	-					
	19	÷	N	-	-					
	20	÷	N	-	-					
	21	÷	N	-	-					
	22	÷	N	-	-					
	23	÷	N	-	-					
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	29	÷	N	-	-					
	30	÷	N	-	-					
	31	÷	N	-	-					
	32	÷	N	-	-					
	33	÷	N	-	-					
	34	÷	N	-	-					
	35	÷	N	-	-					
	36	÷	N	-	-					

Index of Claims	Application/Control No. 12460139	Applicant(s)/Patent Under Reexamination MAGUIRE, BRIAN T.
	Examiner JAMES HULKA	Art Unit 3662

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/26/2011	09/13/2011	12/08/2011	03/07/2012					
	37	÷	N	-	-					
	38	÷	N	-	-					
	39	÷	N	-	-					
	40	÷	N	-	-					
	41	÷	N	-	-					
	42	÷	N	-	-					
	43	÷	N	-	-					
	44	÷	N	-	-					
	45	÷	N	-	-					
	46	÷	N	-	-					
	47	÷	N	-	-					
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6	62	÷	✓	✓	=					
7	63	÷	✓	✓	=					
8	64	÷	✓	✓	=					
9	65	÷	✓	✓	=					
10	66	÷	✓	✓	=					
11	67	÷	✓	✓	=					
12	68	÷	✓	✓	=					
13	69	÷	✓	✓	=					
14	70	÷	✓	✓	=					
15	71	÷	✓	✓	=					
16	72	÷	✓	✓	=					

Index of Claims	Application/Control No. 12460139	Applicant(s)/Patent Under Reexamination MAGUIRE, BRIAN T.
	Examiner JAMES HULKA	Art Unit 3662

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/26/2011	09/13/2011	12/08/2011	03/07/2012					
17	73	÷	✓	✓	=					
18	74	÷	✓	✓	=					
19	75	÷	✓	✓	=					
23	76	÷	✓	✓	=					
24	77	÷	✓	✓	=					
25	78	÷	✓	✓	=					
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27	80	÷	✓	✓	=					
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31	84	÷	✓	✓	=					
	85	÷	✓	-	-					
32	86	÷	✓	✓	=					
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33	88	÷	✓	✓	=					
34	89	÷	✓	✓	=					
35	90	÷	✓	✓	=					
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22	103			✓	=					
46	104			✓	=					
47	105			✓	=					
48	106			✓	=					
49	107			✓	=					
50	108			✓	=					

Index of Claims	Application/Control No. 12460139	Applicant(s)/Patent Under Reexamination MAGUIRE, BRIAN T.
	Examiner JAMES HULKA	Art Unit 3662

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/26/2011	09/13/2011	12/08/2011	03/07/2012					
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52	110			✓	=					
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57	117			✓	=					
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63	123			✓	=					
66	124			✓	=					
67	125			✓	=					
	126			-	-					
68	127			✓	=					
69	128			✓	=					
70	129			✓	=					
71	130			✓	=					
72	131			✓	=					
	132			-	-					
	133			-	-					
73	134			✓	=					
	135			-	-					
	136			-	-					
	137			-	-					

Issue Classification

Application/Control No.	Applicant(s)/Patent Under Reexamination
12460139	MAGUIRE, BRIAN T.
Examiner	**Art Unit**
JAMES HULKA	3645

ORIGINAL

CLASS	SUBCLASS
367	88

INTERNATIONAL CLASSIFICATION

CLAIMED					NON-CLAIMED				
G	0	1	S	15 / 00 (2006.0)					

CROSS REFERENCE(S)

CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	57	17	73	34	89	47	105	61	121		137						
2	58	18	74	35	90	48	106	62	122								
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6	62	25	78	39	94	52	110		126								
7	63	26	79	42	95	64	111	68	127								
8	64	27	80	40	96	65	112	69	128								
9	65	28	81	41	97	53	113	70	129								
10	66	29	82	43	98	54	114	71	130								
11	67	30	83	44	99	55	115	72	131								
12	68	31	84	20	100	56	116		132								
13	69		85	45	101	57	117		133								
14	70	32	86	21	102	58	118	73	134								
15	71		87	22	103	59	119		135								
16	72	33	88	46	104	60	120		136								

/J.H./ Examiner.Art Unit 3645 (Assistant Examiner)	03/07/2012 (Date)	**Total Claims Allowed:** 73
/JACK W KEITH/ Supervisory Patent Examiner, Art Unit 3646 (Primary Examiner)	 (Date)	O.G. Print Claim(s): 76 O.G. Print Figure: 5

Substitute for form 1449/PTO (Revised 07/2007)	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(Use as many sheets as necessary)*	Application Number	12/460,139
	Filing Date	July 14, 2009
	First Named Inventor	Brian T. Maguire
	Art Unit	3662
	Examiner Name	HULKA, James R.
Sheet 1 of 1	Attorney Docket Number	038495/369324

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.	Document Number Number - Kind Code (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages of Relevant Figures Appear
	274	US-5,297,109	03-22-1994	Barksdale, Jr., et al.	
	275	US-5,525,081	06-11-1996	Mardesich, et al.	
	276	US-6,273,771	08-14-2001	Buckley, et al.	
	277	US RE 31,026	09-07-1982	Shatto	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.	Foreign Patent Document Country Code - Number Kind Code (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	English Language Translation Attached

OTHER 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, page(s), volume-issue number(s), publisher, city and/or country where published.	English Language Translation Attached

Examiner Signature	/James Hulka/	Date Considered	03/27/2012

*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.

SUBMITTED: MARCH 23, 2012

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

Substitute for form 1449/PTO (Revised 07/2007)	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application Number	12/460,139
(Use as many sheets as necessary)	Filing Date	July 14, 2009
	First Named Inventor	Brian T. Maguire
	Art Unit	3662
	Examiner Name	HULKA, James R.
Sheet 1 of 1	Attorney Docket Number	038495/369324

OTHER 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, page(s), volume-issue number(s), publisher, city and/or country where published.	English Language Translation Attached
	267	BALLANTYNE, J.; "Find and Catch More Fish, Quickly and Easily, with the FISHIN' BUDDY 2255"; [Online]; [Retrieved on 12-7-2011]; Retrieved from the Internet <URL:http://www.articleslash.net/Recreation-and-Sports/Fishing/67018__Find-and-Catch-More-Fish-Quickly-and-Easily-with-the-FISHIN-BUDDY-2255.html>; 4 pages	
	268	Deep Vision Side Scan Sonar Systems; [Online]; [Retrieved on 12-2-2011]; Retrieved from the Internet <URL:http://www.deepvision.se/products.htm>; 5 pages	
	269	Fishin' Buddy 4200™ Operations Manual; Dated 12/21/2005; 16 pages	
	270	Fishing Tool Reviews - Bottom Line Fishin Buddy 1200 Fishfinder; [Online]; [Retrieved on 12-7-2011]; Retrieved from the Internet <URL:http://www.tackletour.com/reviewbottomline1200.html>; 4 pages	
	271	HUMMINBIRD 100 Series™ Fishin' Buddy®; 110, 120, 130 and 140c Product Manual; © 2007; 2 pages	
	272	Sidefinder – Reviews & Brand Information – Techsonic Industries, Inc.; [Online]; [Retrieved on 12-7-2011]; Retrieved from the Internet <URL: http://www.trademarkia.com/sidefinder-74113182.html>; 4 pages	
	273	Trademark Electronic Search System (TESS); Word Mark: Sidefinder; [Online]; [Retrieved on 12-7-2011]; Retrieved from the Internet <URL: http://tess2.uspto.gov/bin/showfield?f=doc&state=4009:qi4jkj.2.1>; 2 pages	

Examiner Signature	/James Hulka/	Date Considered	03/07/2012

*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.

SUBMITTED: FEBRUARY 21, 2012

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

EAST Search History

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	0	((linear$2 or rectang$4) same ((down$2 near4 scan$3) or downscan$3) same (fan$5 near6 beam$2) same sonar same (conic$3 or circul$3)).clm.	US-PGPUB; USPAT; UPAD	OR	OFF	2012/03/07 12:22
L2	0	((linear$2 or rectang$4) same ((down$2 near4 scan$3) or downscan$3) same (fan$5 near6 beam$2) same sonar same transducer$2).clm.	US-PGPUB; USPAT; UPAD	OR	OFF	2012/03/07 12:23

3/7/2012 12:23:48 PM
H:\12-400\12460139b.wsp

Search Notes	Application/Control No. 12460139	Applicant(s)/Patent Under Reexamination MAGUIRE, BRIAN T.
	Examiner JAMES HULKA	Art Unit 3645

SEARCHED

Class	Subclass	Date	Examiner
367	88	9/13/2011	JH

SEARCH NOTES

Search Notes	Date	Examiner
EAST (Keyword and Class Limited)	9/13/2011	JH
PALM (Inventor Name)	9/13/2011	JH
Google (Keyword)	9/13/2011	JH
Consulted Primary Examiner (D. Pihulic)	4/2/2012	JH

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner
367	Searched Claim Language	3/7/2012	JH

/J.H./
Examiner.Art Unit 3645

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby appoint:

☒ Practitioners associated with the Customer Number: **00826**

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

as attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) and are authorized to act on behalf of the Assignee in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b).

Assignee Name and Address:

NAVICO, INC.

12000 East Skelly Drive

Tulsa, OK 74128-2486

A copy of this form, together with a statement under 37 CFR 3.73(b) (Form PTO/SB/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the practitioners appointed in this form if the appointed practitioner is authorized to act on behalf of the assignee, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Name	M/CRINCE		
Signature	[signature]	Date	3/28/2012
Title	CFO	Telephone	

Electronic Acknowledgement Receipt

EFS ID:	12455663
Application Number:	12460139
International Application Number:	
Confirmation Number:	9769
Title of Invention:	Downscan imaging sonar
First Named Inventor/Applicant Name:	Brian T. Maguire
Customer Number:	826
Filer:	Guy Randall Gosnell/Kim Shaul
Filer Authorized By:	Guy Randall Gosnell
Attorney Docket Number:	038495/369324
Receipt Date:	03-APR-2012
Filing Date:	14-JUL-2009
Time Stamp:	12:25:32
Application Type:	Utility under 35 USC 111(a)

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	Assignee showing of ownership per 37 CFR 3.73(b).	Statement369324.pdf	52306 6da63a2d0d920f19178de8c4594efc6535497d8d	no	1

Warnings:

Information:

2	Power of Attorney	NavicoPOA.pdf	52885 0a3305a75130fe0ff82377714fa15471cb78b1b0	no	1
Warnings:					
Information:					
		Total Files Size (in bytes):	105191		

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's Docket No. 038495/369324 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re:	Brian T. Maguire		
Appl No.:	12/460,139	Confirmation No.:	9769
Filed:	July 14, 2009	Group Art Unit:	3645
For:	DOWNSCAN IMAGING SONAR		

STATEMENT UNDER 37 CFR 3.73(b)

NAVICO, INC. is:

1. ☒ the assignee of the entire right, title and interest; or
2. ☐ an assignee of less than the entire right, title and interest
   (The extent (by percentage) of its ownership interest is _____%)

in the patent application/patent identified above by virtue of either:

A. ☒ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the Patent and Trademark Office at Reel 023181, Frame 0828, or a true copy of the original assignment is attached.

OR

B. ☐ A chain of title from the inventor(s) of the patent application/patent identified above, to the current assignee as follows:

1. From: To:
   The document was recorded in the Patent and Trademark Office at
   Reel , Frame , or for which a copy thereof is attached.

2. From: To:
   The document was recorded in the Patent and Trademark Office at
   Reel , Frame , or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet.

As required by 37 CFR 3.73(b)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11

The undersigned is empowered to sign this statement on behalf of the assignee.

Apr. 3, 2012
Date

Michael D. McCoy, Registration No. 28,098

Correspondence Address is Customer No. 00826 (Alston & Bird LLP)

Substitute for form 1449/PTO (Revised 07/2007)	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(Use as many sheets as necessary)*	Application Number	12/460,139
	Filing Date	July 14, 2009
	First Named Inventor	Brian T. Maguire
	Art Unit	3662
	Examiner Name	HULKA, James R.
Sheet 1 of 1	Attorney Docket Number	038495/369324

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.	Document Number Number - Kind Code (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages of Relevant Figures Appear
	274	US-5,297,109	03-22-1994	Barksdale, Jr., et al.	
	275	US-5,525,081	06-11-1996	Mardesich, et al.	
	276	US-6,273,771	08-14-2001	Buckley, et al.	
	277	US RE 31,026	09-07-1982	Shatto	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.	Foreign Patent Document Country Code - Number Kind Code (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	English Language Translation Attached

OTHER 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, page(s), volume-issue number(s), publisher, city and/or country where published.	English Language Translation Attached

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.

SUBMITTED: MARCH 23, 2012

Electronic Acknowledgement Receipt

EFS ID:	12375680
Application Number:	12460139
International Application Number:	
Confirmation Number:	9769
Title of Invention:	Downscan imaging sonar
First Named Inventor/Applicant Name:	Brian T. Maguire
Customer Number:	826
Filer:	Michael D. McCoy/Judy Creel
Filer Authorized By:	Michael D. McCoy
Attorney Docket Number:	038495/369324
Receipt Date:	23-MAR-2012
Filing Date:	14-JUL-2009
Time Stamp:	08:53:47
Application Type:	Utility under 35 USC 111(a)

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		369324_IDS.PDF	101147 abeadb1da8a52adfa7709aca753f90af4f119c16	yes	2

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal Letter	1	1
	Information Disclosure Statement (IDS) Form (SB08)	2	2

Warnings:	
Information:	
Total Files Size (in bytes):	101147

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.

Attorney's Docket No. 038495/369324 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re:	Brian T. Maguire	Confirmation No.:	9769
Appl. No.:	12/460,139	Art Unit:	3662
Filed:	July 14, 2009	Examiner:	HULKA, James R.
For:	DOWNSCAN IMAGING SONAR		

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT CITATION UNDER 37 C.F.R. § 1.97

Attached is a list of documents on form PTO-1449 along with a copy of any cited foreign patent documents and non-patent literature documents in accordance with 37 CFR § 1.98(a)(2).

It is requested that the Examiner consider these documents and officially make them of record in accordance with the provisions of 37 C.F.R. § 1.97 and Section 609 of the MPEP. By identifying the listed documents, Applicant in no way makes any admission as to the prior art status of the listed documents, but is instead identifying the listed documents for the sake of full disclosure.

Respectfully submitted,

Patrick L. Kartes
Registration No. 64,678

Customer No. 00826
ALSTON & BIRD LLP
Bank of America Plaza
101 South Tryon Street, Suite 4000
Charlotte, NC 28280-4000
Tel Charlotte Office (704) 444-1000
Fax Charlotte Office (704) 444-1111

ELECTRONICALLY FILED USING THE EFS-WEB ELECTRONIC FILING SYSTEM OF THE UNITED STATES PATENT & TRADEMARK OFFICE ON MARCH 23, 2012.

REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	12460139	Filing Date	2009-07-14	Docket Number (if applicable)	038495/369324	Art Unit	3662
First Named Inventor	Maguire			Examiner Name	James R. Hulka		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☒ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on ______
- ☒ Other Amendment After Final Filed 02-21-2012

☐ Enclosed

- ☐ Amendment/Reply
- ☐ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other ______

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months ______
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other ______

FEES

☒ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 160605

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature
☐ Applicant Signature

Signature of Registered U.S. Patent Practitioner			
Signature	/Donald M. Hill, Jr./	Date (YYYY-MM-DD)	2012-03-05
Name	Donald M. Hill, Jr.	Registration Number	40646

Privacy Act Statement

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.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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 inspections 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.

Electronic Patent Application Fee Transmittal

Application Number:	12460139
Filing Date:	14-Jul-2009
Title of Invention:	Downscan imaging sonar
First Named Inventor/Applicant Name:	Brian T. Maguire
Filer:	Donald Merton Hill/Grace Rippy
Attorney Docket Number:	038495/369324

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
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($)
Miscellaneous:				
Request for continued examination	1801	1	930	930
		Total in USD ($)		**930**

Electronic Acknowledgement Receipt

EFS ID:	12225307
Application Number:	12460139
International Application Number:	
Confirmation Number:	9769
Title of Invention:	Downscan imaging sonar
First Named Inventor/Applicant Name:	Brian T. Maguire
Customer Number:	826
Filer:	Donald Merton Hill/Grace Rippy
Filer Authorized By:	Donald Merton Hill
Attorney Docket Number:	038495/369324
Receipt Date:	05-MAR-2012
Filing Date:	14-JUL-2009
Time Stamp:	15:43:54
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$930
RAM confirmation Number	2214
Deposit Account	160605
Authorized User	

File Listing:

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

1	Request for Continued Examination (RCE)	369324_RCETransmittal.pdf	697813 7f3a2d6d33513d475e64bdec35d546e10729b908	no	3
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30035 a0f77a22be07310ef4f9ed5f43cbce4b926145ea	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	727848	

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
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New International Application Filed with the USPTO as a Receiving Office
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PATENT APPLICATION FEE DETERMINATION RECORD
Substitute for Form PTO-875

Application or Docket Number	Filing Date	
12/460,139	07/14/2009	☐ To be Mailed

APPLICATION AS FILED – PART I

FOR	NUMBER FILED (Column 1)	NUMBER EXTRA (Column 2)	SMALL ENTITY ☐ RATE ($)	SMALL ENTITY FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
			TOTAL			TOTAL	

* If the difference in column 1 is less than zero, enter "0" in column 2.

APPLICATION AS AMENDED – PART II

AMENDMENT 03/05/2012	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 79	Minus	** 99	= 0	X $ =		OR	X $60=	0
Independent (37 CFR 1.16(h))	* 3	Minus	***4	= 0	X $ =		OR	X $250=	0
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	**0**

AMENDMENT	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/MARY HOLMES/

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.
12/460,139	07/14/2009	Brian T. Maguire	038495/369324	9769

826 7590 02/27/2012
ALSTON & BIRD LLP
BANK OF AMERICA PLAZA
101 SOUTH TRYON STREET, SUITE 4000
CHARLOTTE, NC 28280-4000

EXAMINER	
HULKA, JAMES R	

ART UNIT	PAPER NUMBER
3662	

MAIL DATE	DELIVERY MODE
02/27/2012	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)

Advisory Action Before the Filing of an Appeal Brief	Application No. 12/460,139	Applicant(s) MAGUIRE, BRIAN T.
	Examiner JAMES HULKA	Art Unit 3662

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

THE REPLY FILED 21 February 2012 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

1. ☐ The reply was filed after a final rejection, but prior to or on the same day as filing a Notice of Appeal. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance; (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114. The reply must be filed within one of the following time periods:
   a) ☐ The period for reply expires _____months from the mailing date of the final rejection.
   b) ☐ The period for reply expires on: (1) the mailing date of this Advisory Action, or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.
   Examiner Note: If box 1 is checked, check either box (a) or (b). ONLY CHECK BOX (b) WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. ☐ The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37 CFR 41.37(a).

AMENDMENTS

3. ☒ The proposed amendment(s) filed after a final rejection, but prior to the date of filing a brief, will not be entered because
   (a) ☒ They raise new issues that would require further consideration and/or search (see NOTE below);
   (b) ☐ They raise the issue of new matter (see NOTE below);
   (c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
   (d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims.
   NOTE: *The claims have been amended to introduce new limitations (images of fan-shaped regions arranged in a progressive order) that require new search for patentability*. (See 37 CFR 1.116 and 41.33(a)).
4. ☐ The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).
5. ☐ Applicant's reply has overcome the following rejection(s): _____.
6. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).
7. ☐ For purposes of appeal, the proposed amendment(s): a) ☐ will not be entered, or b) ☐ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended.
   The status of the claim(s) is (or will be) as follows:
   Claim(s) allowed: _____.
   Claim(s) objected to: _____.
   Claim(s) rejected: _____.
   Claim(s) withdrawn from consideration: _____.

AFFIDAVIT OR OTHER EVIDENCE

8. ☐ The affidavit or other evidence filed after a final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).
9. ☐ The affidavit or other evidence filed after the date of filing a Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing a good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).
10. ☐ The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

REQUEST FOR RECONSIDERATION/OTHER

11. ☐ The request for reconsideration has been considered but does NOT place the application in condition for allowance because: _____.
12. ☐ Note the attached Information *Disclosure Statement*(s). (PTO/SB/08) Paper No(s). _____
13. ☐ Other: _____.

/Thomas H. Tarcza/ Supervisory Patent Examiner, Art Unit 3662	/J. H./ Examiner, Art Unit 3662

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
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/460,139	07/14/2009	Brian T. Maguire	038495/369324	9769

826 7590 02/21/2012

ALSTON & BIRD LLP
BANK OF AMERICA PLAZA
101 SOUTH TRYON STREET, SUITE 4000
CHARLOTTE, NC 28280-4000

EXAMINER	
HULKA, JAMES R	

ART UNIT	PAPER NUMBER
3662	

MAIL DATE	DELIVERY MODE
02/21/2012	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)

Applicant-Initiated Interview Summary	**Application No.** 12/460,139	**Applicant(s)** MAGUIRE, BRIAN T.	
	Examiner JAMES HULKA	**Art Unit** 3662	

All participants (applicant, applicant's representative, PTO personnel):

(1) JAMES HULKA. (3) Donald Hill (Reg. No. 40,646).

(2) Aaron Coleman (applicant). (4) _____.

Date of Interview: 16 February 2012.

Type: ☐ Telephonic ☐ Video Conference
☒ Personal [copy given to: ☒ applicant ☒ applicant's representative]

Exhibit shown or demonstration conducted: ☒ Yes ☐ No.
If Yes, brief description: Printed Sonar Images.

Issues Discussed ☐101 ☐112 ☐102 ☒103 ☐Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: 57,76 and 134.

Identification of prior art discussed: Hamada.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

Representative and applicant discussed teachings of prior art. Examiner clarified interpretation of references discussed in rejection. Possible amendments were discussed. Procedures going forward regarding after-final amendments, advisory actions and filing of RCE were quickly reviewed. No formal agreement was reached..

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☐ Attachment

/JAMES HULKA/
Examiner, Art Unit 3662

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record
A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews
Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.
All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:
- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:
1) A brief description of the nature of any exhibit shown or any demonstration conducted,
2) an identification of the claims discussed,
3) an identification of the specific prior art discussed,
4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
5) a brief identification of the general thrust of the principal arguments presented to the examiner,
   (The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
6) a general indication of any other pertinent matters discussed, and
7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

PATENT

Response Under 37 C.F.R. 1.116 – Expedited Procedure – Examining Group 3662

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.:	12/460,139	Confirmation No.: 9769
Applicant(s):	Hebert et al.	
Filed:	07/14/2009	
Art Unit:	3662	
Examiner:	James R. Hulka	
Title:	DOWNSCAN IMAGING SONAR	

Docket No.: 038495/369324
Customer No.: 00826

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AFTER FINAL UNDER 37 C.F.R. § 1.116

Sir:

In response to the final Office Action dated December 20, 2011, please reconsider the above-identified application in light of the following amendments and remarks:

Amendments to the Claims are reflected on the listing of claims that begins on page 2 of this paper.

Remarks begin on page 15 of this paper.

Amendments to the Claims:

1-56. (Canceled)

57. (Currently Amended) A ~~transducer~~ sonar assembly for imaging an underwater environment beneath a watercraft traveling on a surface of a body of water, the sonar assembly comprising:

a housing mountable to ~~a~~ the watercraft ~~capable of traversing a surface of a body of water~~; ~~and~~

a single linear downscan transducer element positioned within the housing, the linear downscan transducer element having a substantially rectangular shape configured to produce a fan-shaped sonar beam having a relatively narrow beamwidth in a direction parallel to a longitudinal length of the linear downscan transducer element and a relatively wide beamwidth in a direction perpendicular to the longitudinal length of the transducer element, the linear downscan transducer element being positioned with the longitudinal length thereof extending in a fore-to-aft direction of the housing;

wherein the linear downscan transducer element is positioned within the housing to project fan-shaped sonar ~~pulses~~ beams in a direction substantially perpendicular to a plane corresponding to the surface of the body of water, said sonar beams being repeatedly emitted so as to sequentially insonify different fan-shaped regions of the underwater environment as the watercraft travels; and

a sonar signal processor receiving signals representative of sonar returns resulting from each of the fan-shaped sonar beams and processing the signals to produce sonar image data for each fan-shaped region and to create an image of the underwater environment as a composite of images of the fan-shaped regions arranged in a progressive order corresponding to the travel of the watercraft.

58. (Currently Amended) The ~~transducer~~ sonar assembly of claim 57, wherein the linear downscan transducer element is configured to operate at a selected one of at least two selectable operating frequencies.

59. (Currently Amended) The ~~transducer~~ sonar assembly of claim 57, wherein the selectable operating frequencies include about 455 kHz and 800 kHz.

60. (Currently Amended) The ~~transducer~~ sonar assembly of claim 57, wherein the beamwidth of the linear downscan transducer element is about 0.8 degrees by about 32 degrees or about 1.4 degrees by about 56 degrees.

61. (Currently Amended) The ~~transducer~~ sonar assembly of claim 57, wherein the linear downscan transducer ~~assembly~~ element is configured to communicate with a single transceiver.

62. (Currently Amended) The ~~transducer~~ sonar assembly of claim 57, wherein a length of a rectangular face of the linear downscan transducer element is about 120 mm and a width of the rectangular face of the linear downscan transducer element is about 3 mm.

63. (Previously Presented) The ~~transducer~~ sonar assembly of claim 57, wherein the housing is mountable to the watercraft such that the fan-shaped beam extends from one side of the watercraft to an opposite side of the watercraft.

64. (Currently Amended) The ~~transducer~~ sonar assembly of claim 57, wherein the housing has a streamlined shape.

65. (Currently Amended) The ~~transducer~~ sonar assembly of claim 57, wherein the beamwidth in the direction parallel to a longitudinal length of the linear downscan transducer element is less than about five percent as large as the beamwidth of the sonar beam in the direction perpendicular to the longitudinal length of the linear downscan transducer element.

66. (Currently Amended) The ~~transducer~~ sonar assembly of claim 57, wherein the linear downscan transducer element is configured to provide data displayable as sonar data images in which images corresponding to data received via the linear downscan transducer element provide data regarding bottom features over less than fifty percent of a display screen when displayed.

67. (Currently Amended) The ~~transducer~~ sonar assembly of claim 57, wherein the linear downscan transducer element is configured to provide data displayable as sonar data images in which images corresponding to data received via the linear downscan transducer element provide data regarding bottom features over less than twenty percent of a display screen when displayed.

68. (Currently Amended) The ~~transducer~~ sonar assembly of claim 57, wherein the linear downscan transducer element is configured to provide data displayable as sonar data images in which images corresponding to data received via the linear downscan transducer element provide data indicative of bottom depth.

69. (Currently Amended) The ~~transducer~~ sonar assembly of claim 57, wherein the linear downscan transducer element is configured to provide data displayable as sonar data images in which images corresponding to data received via the linear downscan transducer element provide data indicative of water column features.

70. (Currently Amended) The ~~transducer~~ sonar assembly of claim 57, wherein the linear downscan transducer element is configured to provide data displayable as sonar data images indicative of bottom data.

71. (Currently Amended) The ~~transducer~~ sonar assembly of claim 57, wherein the linear downscan transducer element is configured to provide data displayable as sonar data images indicative of two or more of depth data water column data and bottom data.

72. (Currently Amended) The ~~transducer~~ sonar assembly of claim 57, further comprising a circular transducer element positioned to project conical sonar pulses in a direction substantially perpendicular to the plane corresponding to the surface.

73. (Currently Amended) The ~~transducer~~ sonar assembly of claim 72, wherein the linear downscan and circular transducer elements are in the same housing.

74. (Currently Amended) The ~~transducer~~ sonar assembly of claim 72, wherein the linear downscan transducer and circular transducer elements are positioned to project fan-shaped and conical sonar beams that at least partially overlap.

75. (Currently Amended) The ~~transducer~~ sonar assembly of claim 72, wherein the sonar signal returns from the circular transducer element and linear downscan transducer element provide generally simultaneous data.

76. (Currently Amended) A sonar system for imaging an underwater environment beneath a watercraft traveling on a surface of a body of water, the sonar system comprising:

a single linear downscan transducer element positioned within a housing that is mountable to ~~a~~ the watercraft ~~that traverses a surface of a body of water~~, the linear downscan transducer element having a substantially rectangular shape configured to produce a fan-shaped sonar beam having a relatively narrow beamwidth in a direction parallel to longitudinal length of the linear downscan transducer element and a relatively wide beamwidth in a direction perpendicular to the longitudinal length of the transducer element, the linear downscan transducer element being positioned with the longitudinal length thereof extending in a fore-to-aft direction of the housing;

wherein the linear downscan transducer element is positioned to project fan-shaped sonar ~~pulses~~ beams in a direction substantially perpendicular to a plane corresponding to the surface of the body of water, said sonar beams being repeatedly emitted so as to sequentially insonify different fan-shaped regions of the underwater environment as the watercraft travels;

a sonar module configured to enable operable communication with the linear downscan transducer element, the sonar module including:

a sonar signal processor to process sonar return signals, and

at least one transceiver configured to provide communication between the linear downscan transducer element and the sonar signal processor,

the sonar signal processor receiving signals representative of sonar returns resulting from each of the fan-shaped sonar beams and processing the signals to produce sonar image data for each fan-shaped region and to create an image of the underwater environment as a composite of images of the fan-shaped regions arranged in a progressive order corresponding to the travel of the watercraft.

77. (Original) The sonar system of claim 76, wherein the sonar module further comprises an Ethernet hub in communication with the signal processor.

78. (Original) The sonar system of claim 76, wherein the sonar module is provided within a separate housing.

79. (Currently Amended) The sonar system of claim 76, further comprising at least one visual display presenting ~~an~~ the image ~~representing the processed sonar return signals~~.

80. (Original) The sonar system of claim 79, wherein the display and the sonar module are in the same housing.

81. (Original) The sonar system of claim 79, wherein at least one display of the plurality of displays is enabled to simultaneously provide different images representing different information from the processed sonar return signals.

82. (Original) The sonar system of claim 76, wherein the sonar module further comprises configuration settings defining a predefined set of display images that may be presented.

83. (Currently Amended) The sonar system of claim 76, wherein the linear downscan transducer element is configured to operate at a selected one of at least two selectable operating frequencies.

84. (Original) The sonar system of claim 76, wherein the selectable operating frequencies include about 455 kHz and 800 kHz.

85. (Canceled)

86. (Previously Presented) The sonar system of claim 76, wherein the housing is mountable to the watercraft such that the fan-shaped beam extends from one side of the watercraft to an opposite side of the watercraft.

87. (Canceled)

88. (Currently Amended) The sonar system of claim 76, wherein the sonar signal processor is configured to display images of sonar data in which images corresponding to data received via the linear downscan transducer element provide data regarding bottom features over less than fifty percent of a display screen when displayed.

89. (Currently Amended) The sonar system of claim 76, wherein the sonar signal processor is configured to display images of sonar data corresponding to data received via the linear downscan transducer element representing bottom data.

90. (Currently Amended) The sonar system of claim 76, wherein the sonar signal processor is configured to display images of sonar data corresponding to data received via the linear downscan transducer element representing water column data.

91. (Currently Amended) The sonar system of claim 76, wherein the sonar signal processor is configured to display images of sonar data corresponding to data received via the linear downscan transducer element representing depth data.

92. (Currently Amended) The sonar system of claim 76, wherein the sonar signal processor is configured to display images of sonar data corresponding to data received via the linear downscan transducer element representing two or more of depth data, water column data and bottom data.

93. (Currently Amended) The sonar system of claim 76, wherein the sonar signal processor is configured to display images of sonar data corresponding to data received via the linear downscan transducer element representing data vertically below the linear transducer element.

94. (Original) The sonar system of claim 76, further comprising a circular transducer element producing a conical downscan beam.

95. (Original) The sonar system of claim 76, further comprising a circular transducer element producing a conical downscan beam from within the housing.

96. (Currently Amended) The sonar system of claim 94, wherein the fan-shaped sonar ~~pulses~~ beams from the linear downscan transducer element and the sonar pulses from the circular transducer element insonify areas of the bottom that at least partially overlap.

97. (Currently Amended) The sonar system of claim 94, wherein the sonar signal returns from the circular transducer element and linear downscan downscan element provide generally simultaneous data.

98. (Original) The sonar system of claim 76, further comprising sources of data from at least one of the group of radar, GPS, digital mapping, time and temperature.

99. (Original) The sonar system of claim 98, wherein a display format for display of the data is in a user selectable format.

100. (Currently Amended) The sonar assembly of claim 57, wherein the linear downscan transducer element is configured to emit fan-shaped sonar ~~pulses~~ beams as well to receive echo returns and convert sound energy of the echo returns into electrical signals.

101. (Currently Amended) The sonar system of claim 76, wherein the linear downscan transducer element is configured to emit fan-shaped sonar ~~pulses~~ beams as well to receive echo returns and convert sound energy of the echo returns into electrical signals.

102. (Previously Presented) The sonar assembly of claim 57, wherein the housing is mounted to the watercraft.

103. (Currently Amended) The sonar assembly of claim 57, wherein the linear downscan transducer element is configured to produce a generally planar fan-shaped beam.

104. (Previously Presented) The sonar system of claim 76, further comprising a display in communication with the sonar module.

105. (Previously Presented) The sonar system of claim 104, wherein the sonar module and display communicate with each other via a network.

106. (Previously Presented) The sonar system of claim 104, further comprising at least one additional display in communication with the sonar module.

107. (Previously Presented) The sonar system of claim 104, further comprising a user interface in communication with the sonar module and configured to receive an input from a user.

108. (Previously Presented) The sonar system of claim 107, wherein the display, the sonar signal processor, and the user interface are all contained in a single housing.

109. (Previously Presented) The sonar system of claim 107, wherein the user interface is part of the display.

110. (Currently Amended) The sonar system of claim 104, wherein the linear downscan transducer element, the transceiver, and the display respectively comprise at least two separate modules.

111. (Currently Amended) The sonar system of claim 76, wherein the housing containing the linear downscan transducer element is mounted to the watercraft.

112. (Currently Amended) The sonar system of claim 76, wherein the housing containing the linear downscan transducer element is mounted on an intermediate structure that in turn is mounted to the watercraft.

113. (Previously Presented) The sonar system of claim 104, wherein the sonar signal processor is further configured to implement signal processing or enhancement to improve display characteristics.

114. (Previously Presented) The sonar system of claim 104, wherein the sonar signal processor is further configured to process GPS information.

115. (Previously Presented) The sonar system of claim 104, wherein the sonar signal processor is further configured to process waypoint designations.

116. (Previously Presented) The sonar system of claim 104, wherein the sonar signal processor is further configured to process time data.

117. (Previously Presented) The sonar system of claim 104, wherein the sonar signal processor is further configured to process temperature data.

118. (Previously Presented) The sonar system of claim 104, wherein the sonar signal processor is further configured to implement a notice or alarm regarding depth.

119. (Previously Presented) The sonar system of claim 104, wherein the sonar signal processor is further configured to implement a notice or alarm regarding presence of fish.

120. (Previously Presented) The sonar system of claim 104, wherein the sonar signal processor is further configured to implement a notice or alarm regarding proximity of other watercraft.

121. (Previously Presented) The sonar system of claim 104, wherein the processor, in combination with a memory, stores incoming transducer data or screen images for future playback or transfer.

122. (Previously Presented) The sonar system of claim 104, wherein the sonar signal processor is further configured to perform additional processing to implement zoom.

123. (Previously Presented) The sonar system of claim 104, wherein the sonar signal processor is further configured to perform additional processing to correlate sonar data to a GPS position.

124. (Currently Amended) The sonar system of claim 76, wherein the housing containing the linear downscan transducer element has a streamlined profile.

125. (Currently Amended) The sonar system of claim 76, wherein the housing containing the linear downscan transducer element is mounted on an accessory on the watercraft enabling the fan-shaped beam to assume various orientations with respect to the watercraft.

126. (Withdrawn, Currently Amended) The sonar system of claim 76, further comprising a linear side scan transducer element positioned and configured to produce a fan-shaped beam

aimed downwardly and outwardly to one side of the watercraft, wherein dimensions and operating frequencies of the linear downscan transducer element and the linear side scan transducer element are selected to minimize or eliminate any gap between the respective fan-shaped beams.

127. (Previously Presented) The sonar system of claim 76, further comprising a display in communication with the sonar module, and wherein the system is configured to indicate a position of the watercraft on the display.

128. (Previously Presented) The sonar system of claim 76, further comprising a display in communication with the sonar module, and wherein the system is configured to indicate water depth on the display.

129. (Previously Presented) The sonar system of claim 76, further comprising a second transducer positioned and configured to produce a conical sonar beam directed downwardly from the watercraft, wherein the system further includes a display in communication with the sonar module, and wherein the system is configured to indicate on the display an intensity of a return echo received from the conical sonar beam.

130. (Currently Amended) The sonar system of claim 129, wherein the linear downscan transducer element and the second transducer are both contained in the housing.

131. (Currently Amended) The sonar system of claim 129, wherein the linear downscan transducer element and the second transducer operate at different respective frequencies.

132. (Withdrawn, Currently Amended) The sonar system of claim 76, further comprising a linear side scan transducer element positioned and configured to produce a fan-shaped beam aimed downwardly and outwardly to one side of the watercraft, wherein the linear downscan transducer element and the linear side scan transducer element are both contained in the housing.

133. (Withdrawn, Currently Amended) The sonar system of claim 132, further comprising a second linear side scan transducer element positioned and configured to produce a

fan-shaped beam aimed downwardly and outwardly to an opposite side of the watercraft, wherein the linear downscan transducer element and the linear side scan transducer elements are all contained in the housing.

134. (Currently Amended) A sonar imaging apparatus comprising:

a housing mountable to a watercraft that traverses a surface of a body of water, the watercraft defining a center plane that extends from fore to aft and that is perpendicular to the surface of the body of water; ~~and~~

a linear transducer element positioned within the housing, the linear transducer element being configured to produce a fan-shaped sonar beam having a longitudinal beamwidth in a direction parallel to a longitudinal length of the linear transducer element that is significantly less than a transverse beamwidth of the sonar beam in a direction perpendicular to the longitudinal length of the transducer element;

wherein the housing is configured for mounting to the watercraft such that the longitudinal length of the linear transducer element is parallel to said center plane, and

wherein the transverse beamwidth of the sonar beam is sufficiently wide in relation to a direction in which the linear transducer element is aimed such that the transverse beamwidth spans from a port side of said center plane to a starboard side of said center plane, said fan-shaped sonar beam being repeatedly emitted so as to sequentially insonify different fan-shaped regions of an underwater environment beneath the watercraft as the watercraft travels across the surface of the water; and

a sonar signal processor receiving signals representative of sonar returns resulting from each of the fan-shaped sonar beams and processing the signals to produce sonar image data for each fan-shaped region and to create an image of the underwater environment as a composite of images of the fan-shaped regions arranged in a progressive order corresponding to the travel of the watercraft.

135. (Withdrawn) The sonar imaging apparatus of claim 134, further comprising:

a second linear transducer element positioned within the housing, the second linear transducer element being configured to produce a second sonar beam having a longitudinal beamwidth in a direction parallel to a longitudinal length of the second linear transducer element that is significantly less than a transverse beamwidth of the second sonar beam in a direction perpendicular to the longitudinal length of the second linear transducer element.

136. (Withdrawn) The sonar imaging apparatus of claim 135, wherein the housing is configured for mounting to the watercraft such that the longitudinal length of the second linear transducer element is parallel to said center plane, and wherein the second linear transducer element is arranged such that the second sonar beam extends primarily in a direction different from the sonar beam of the first linear transducer element.

137. (Withdrawn) The sonar imaging apparatus of claim 136, wherein the transverse beam width of the second sonar beam spans generally to a port side or a starboard side of said center plane.

REMARKS

Claims 57-84, 86, and 88-125, 127-131, and 134 are pending in the present application. Claims 126, 132-133, and 135-137 have been withdrawn from consideration by the Examiner.

In the Office Action, Claims 57, 60-61, 63, 65, 68-71, 76, 78-80, 86, 89-93, 100-104, 107-108, 110-113, 119, 121, 125, 127-128, and 134 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,805,528 to Hamada ("Hamada") in view of Imagenex – Sonar Theory and Applications – Model 855 ("Imagenex"). Claim 62 was rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada and Imagenex, in further view of U.S. Patent 5,850,372 to Blue and U.S. Patent 4,774,837 to Bird. Claims 64, 77, 105, and 124 were rejected as unpatentable over Hamada and Imagenex, in further view of U.S. Patent 7,542,376 to Thompson. Claims 58, 66-67, 81, 83, and 88 were rejected as unpatentable over Hamada and Imagenex, in further view of U.S. Patent Application Publication 2007/0025183 to Zimmerman. Claims 98-99, 106, 109, 114-118, 120, and 122-123 were rejected as unpatentable over Hamada and Imagenex, in further view of Matrix 97 GPS Trackplotter – Operations Manual. Claims 59 and 84 were rejected as unpatentable over Hamada and Imagenex, in further view of U.S. Patent 4,538,249 to Richard and U.S. Patent 5,184,330 to Adams. Claim 82 was rejected as unpatentable over Hamada and Imagenex, in further view of U.S. Patent 5,142,502 to Thompson. Claims 72, 75, 94, 97, 129-131 were rejected as unpatentable over Hamada and Imagenex, in further view of U.S. Patent Application Publication 2006/0023570 to Betts. Claims 73-74 and 95-96 were rejected as unpatentable over Hamada and Imagenex, in further view of U.S. Patent 5,991,239 to Fatemi-Booshehri.

Information Disclosure Statement

The Office Action noted that the previously filed information disclosure statement is being considered by the Examiner. However, the Office Action also stated that "due to the excessive number of references, they have only been given a cursory review to gather relevance to the claimed inventions." Applicant requests that these references be given full review and consideration for proper placement on the record.

Election of Claims

In addition to withdrawing Claims 126, 132-133, and 135-137 from consideration, the Office Action also required election between two species. Species I encompasses a downscan linear transducer element with or without an optional conical downscan transducer element. Species II encompasses a downscan linear transducer element with an additional linear side scan transducer element. The Office Action indicated that Claims 57-84, 86, and 88-99 are generic to both species. Additionally, the Office Action indicated that Applicant constructively elected an invention that does not include a side scan transducer element. Thus, it appears that the Office Action takes the position that Species I has been constructively elected. In any event, Applicant hereby elects Species I for examination. The claims that read, either generically or specifically, on Species I are: Claims 57-84, 86, 88-125, 127-131, and 134.

Summary of Interview

Applicant thanks the Examiner for his courtesy in conducting a personal interview on February 16, 2012, with the undersigned as well as Aaron Coleman, Applicant's employee. In the interview, the Examiner explained his interpretation of the claims and the cited references. Applicant's representatives explained the differences between the claimed invention and the references, particularly with respect to Hamada's failure to teach any linear downscan transducer element producing a fan-shaped sonar beam, as further elaborated on below. A number of possible claim amendments were discussed, but no formal agreement was reached.

Summary of Claim Amendments

Applicant has amended each of independent Claims 57, 76, and 134 in generally similar fashion. Specifically, these claims now recite that the fan-shaped sonar beams are repeatedly emitted so as to sequentially insonify different fan-shaped regions of the underwater environment beneath the watercraft as the watercraft travels. The claims now further include a sonar signal processor to process sonar return signals, the sonar signal processor receiving the sonar return signals representative of each of the fan-shaped sonar beams and processing the signals to produce sonar image data for each fan-shaped region and to create an image of the underwater environment as a composite of images of the fan-shaped regions arranged in a progressive order corresponding to the travel of the watercraft. Support for these amendments is provided in the application as filed (see, e.g., Figures 5 and 12B-12F, paragraphs 0051-0056, and paragraph 0068), such that no new matter has been added.

Claims 57 and 76 additionally have been amended, for clarity, to refer to a linear downscan transducer element (to distinguish from a linear side scan transducer element, for example), and to recite that there is a single such linear downscan transducer element (to distinguish over an array-type transducer having multiple elements arranged in some type of array for use in phased-array beam steering). Support for this amendment is present throughout the application as filed, such that no new matter has been added. It will be understood, of course, that the recitation of a "single linear downscan transducer element" does not require the single element to be a monolithic structure formed of a single crystal of material. It is well known in the transducer field that a plurality of such crystals can be arranged (e.g., end-to-end) and can be electrically connected to circuitry such that the plurality of crystals act together as if they were a single crystal or element. Claims 57 and 76 encompass any "single downscan transducer element" (whether monolithic or not) as distinct from a multi-element phased array-type transducer.

Response to Rejections under 35 U.S.C. 103(a)

Claims 57, 60-61, 63, 65, 68-71, 76, 78-80, 86, 89-93, 100-104, 107-108, 110-113, 119, 121, 125, 127-128, and 134 were rejected under 35 U.S.C. §103(a) as being unpatentable over Hamada in view of Imagenex.

The present application currently includes independent Claims 57 and 76 directed to a transducer assembly and sonar system, respectively. Independent Claim 57 currently recites:

57. A sonar assembly for imaging an underwater environment beneath a watercraft traveling on a surface of a body of water, the sonar assembly comprising:

a housing mountable to the watercraft;

a single linear downscan transducer element positioned within the housing, the linear downscan transducer element having a substantially rectangular shape configured to produce a fan-shaped sonar beam having a relatively narrow beamwidth in a direction parallel to a longitudinal length of the linear downscan transducer element and a relatively wide beamwidth in a direction perpendicular to the longitudinal length of the transducer element, the linear downscan transducer element being positioned with the longitudinal length thereof extending in a fore-to-aft direction of the housing;

wherein the linear downscan transducer element is positioned within the housing to project fan-shaped sonar beams in a direction substantially perpendicular to a plane corresponding to the surface of the body of water, said fan-shaped sonar beams being repeatedly emitted so as to sequentially insonify different fan-shaped regions of the underwater environment as the watercraft travels; and

a sonar signal processor receiving signals representative of sonar returns resulting from each of the fan-shaped sonar beams and processing the signals to produce sonar image data for each fan-shaped region and to create an image of the underwater environment as a composite of images of the fan-shaped regions arranged in a progressive order corresponding to the travel of the watercraft.

Independent Claim 76 includes similar recitations in the context of a sonar system.

With regard to independent Claims 57 and 76 as examined, the final Office Action asserted that Hamada and Imagenex render the claimed invention unpatentable. The Office Action asserted that Hamada teaches a transducer assembly with a linear transducer element configured to produce a fan-shaped beam in a direction substantially perpendicular to a plane corresponding to the surface. The Office Action referred to the Abstract, FIGS. 9 and 10, and col. 8, lines 10-20 of Hamada as support for this assertion. Additionally, the Office Action asserted that Imagenex teaches a linear transducer element being positioned with the longitudinal length extending in a fore-to-aft direction of a housing. Finally, the Office Action asserted that it would have been obvious to position the transducer assembly taught by Hamada in the fore-to-aft direction, as allegedly taught by Imagenex.

Applicant respectfully disagrees with the rejections. Applicant submits that an erroneous interpretation of Hamada has led to the conclusion that Hamada teaches "a linear transducer element...having a rectangular shape configured to produce a fan-shaped sonar beam" and positioned to project these fan-shaped sonar beams "in a direction substantially perpendicular to a plane corresponding to the surface of the body of water" as recited by independent Claim 57. The Final Office Action pointed to the Abstract, FIGS. 9 and 10, and col. 8, lines 10-20 of Hamada and alleged, in relevant part, that Hamada teaches a linear transducer element configured to project a fan-shaped beam in a direction perpendicular to the surface of the water (e.g., a linear downscan transducer element). When Hamada is evaluated for all of what it teaches, however, it becomes apparent that no "linear transducer element" producing a "fan-shaped sonar beam" is taught or suggested.

Applicant particularly notes that the Office Action's reliance on FIGS. 9 and 10 is misplaced, and an incorrect conclusion has been drawn based primarily on those two figures. Hamada discloses an underwater detection system with the purpose of mapping the bottom sea floor in a circle underneath the boat (shown in FIGS. 9-11). Hamada describes that a transducer in the form of a *multi-element* ***array*** (see FIGS. 18-19) is used in connection with the conceptual drawing of FIG. 9. The transducer **1** consists of multiple transducer elements **1A** arranged in a linear array. Hamada's transducer transmits sonar pulses in a "wide area" underneath the boat (col. 7, lines 46-50). Hamada's apparatus then uses a phase-shifting beam forming technique to receive the sonar returns (see, e.g., the arrow directly below the boat in FIG. 9) from a "narrow" area (col. 8, lines 16-19). Clearly the "wide" area into which the sonar pulse is transmitted must be different from the "narrow" area scanned by the receiver, or else Hamada would not have used the term "wide" to describe the transmission, while describing the fan-like area as "narrow."

It is important to recognize the difference between a transmitted (or produced) sonar beam, and a so-called "receiving beam". In particular, Hamada states that "the transducer **1** transmits ultrasonic waves into a wide area" and then "the receiving beam is caused to scan a fan-like area passing through a vertical line extended exactly downward from the ship Q" (col. 7, lines 47-50). Thus, transmission of the wide-area sonar pulses in Hamada is not from a "linear transducer element" producing a "fan-shaped beam" in a "direction substantially perpendicular to a plane corresponding to the surface of the body of water" as recited in the present claims.

While FIG. 9 appears to show a "fan-shaped" insonified area S1 below the boat, this area is conceptual in nature and misleading. In particular, Hamada describes that a "receiving beam is steered in the direction of the array of transducer elements (arrow A in FIG. 9) to *scan* a narrow strip of bottom area S1 beneath the ship" (col. 3, lines 3-6, italics added). Additionally, with reference to FIGS. 18 and 19, Hamada states that "[w]hen receiving echo signals, adjacent transducer elements 1A of the array are successively given constant time delays or phase differences so that received signal phases of the individual transducer elements 1A align each other with regard to echoes from a particular direction. This means that the transducer 1 as a whole forms a receiving beam pointing in that particular direction." See col. 6, lines 25-33. Therefore, Hamada requires the use of multiple transducer elements that are physically distributed in an array, as distinct from a single linear transducer element. Moreover, only by imposing time delays or phase differences is the receiving beam of Hamada steered or scanned underneath the boat to capture sonar data.

Thus, the "receiving beam" of Hamada represents the window that is "listened to" by the multi-element transducer array as it receives sonar returns from the "wide area" insonified by the transmitted sonar pulse. This "receiving beam" (like a lighthouse beam) is steered or scanned in a line from one side of the boat to the other side, thus covering one narrow strip per sweep. It is then necessary for Hamada's transducer to transmit another "wide area" pulse, but this time the "receiving beam" is incrementally rotated a small amount (by mechanically rotating the transducer array) relative to the previous receiving beam. Ultimately, by repeating this process, the full circular area underneath the boat is covered, as shown for example in FIG. 11. Note that the locations sea floor objects/features, with respect to port and starboard sides of the boat, are indicated.

In contrast, a linear downscan transducer element as used in Applicant's claimed invention produces a narrow, single transmission of a non-steered fan-shaped beam. The sonar returns based on the fan-shaped beam are received in a single receipt, which provides the sonar data for the narrow fan-shaped region. These sonar returns, while they provide rather high-quality detail of a narrow strip extending transversely with respect to the boat, are not able to distinguish between port and starboard sides in terms of location of an object.

It can thus be seen that Hamada describes a complex phased-array sonar device and process employing a multi-element array and requiring electronic beam steering of a receiving beam. Only wide-area sonar pulses are employed. In contrast, Applicant's claimed invention uses a single linear transducer element to produce a single-transmission fan-shaped beam directed beneath the boat, and sonar returns from the narrow region insonified by the fan-shaped beam are received with no phased-array beam steering required.

Applicant believes the above detailed explanation brings to light the many differences between the multi-element phased array insonifying a wide area as disclosed in Hamada, and the claimed linear transducer element producing a fan-shaped beam in a direction substantially perpendicular to the plane of the surface of the water. Neither Hamada nor any other reference of record in this application discloses a linear transducer element that directs a fan-shaped sonar beam downwardly as set forth in Claim 57.

Additionally, Applicant submits that Imagenex fails to remedy the deficiency of Hamada. In particular, Imagenex likewise fails to teach or suggest "a linear transducer element...configured to produce a fan-shaped sonar beam...in a direction substantially perpendicular to a plane corresponding to the surface of the body of water" as recited by independent Claim 57. FIG. 1 of Imagenex shows a transducer element emitting a fan-shaped beam to the side, not substantially perpendicular to the plane of the water surface. Thus, this element does not insonify an area beneath the boat.

Therefore, neither Hamada nor Imagenex, whether taken alone or in combination, teaches or suggests "a linear transducer element...configured to produce a fan-shaped sonar beam...in a direction substantially perpendicular to a plane corresponding to the surface of the body of water," as recited by independent Claim 57. Independent Claim 76 includes similar recitations, as does independent Claim 134. As such, Applicant submits that for at least the above-noted reasons, independent Claims 57, 76, and 134 are patentable over the cited references.

Moreover, these independent claims have been amended to recite that the fan-shaped sonar beams are repeatedly emitted so as to sequentially insonify different fan-shaped regions of the underwater environment as the watercraft travels, and a sonar signal processor receives signals representative of sonar returns resulting from each of the fan-shaped sonar beams and processes the signals to produce sonar image data for each fan-shaped region and to create an image of the underwater environment as a composite of images of the fan-shaped regions arranged in a progressive order corresponding to the travel of the watercraft. There is no suggestion in Hamada of creating such an image. Imagenex also fails to suggest creating such an image from linear downscan sonar data.

For at least the above-noted reasons, Claims 57, 76, and 134 are patentable over the cited references.

The claims dependent on these independent claims are patentable at least because they include all of the features of their respective independent claim, and further because the cited references fail to teach or suggest the combination of such features with the additional limitations recited in each of the dependent claims.

As such, all pending claims (including the withdrawn claims, and those claims that read specifically on non-elected Species II) are patentable.

* * *

CONCLUSION

Based on the above amendments and remarks, it is respectfully submitted that all pending claims are patentable and the application is in condition for allowance.

It is not believed that extensions of time or fees for net addition of claims are required, beyond those that may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 CFR § 1.136(a), and any fee required therefor (including fees for net addition of claims) is hereby authorized to be charged to Deposit Account No. 16-0605.

Respectfully submitted,

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ELECTRONICALLY FILED USING THE EFS-WEB ELECTRONIC FILING SYSTEM OF THE UNITED STATES PATENT & TRADEMARK OFFICE ON February 21, 2012.

Electronic Acknowledgement Receipt

EFS ID:	12121753
Application Number:	12460139
International Application Number:	
Confirmation Number:	9769
Title of Invention:	Downscan imaging sonar
First Named Inventor/Applicant Name:	Brian T. Maguire
Customer Number:	826
Filer:	Donald Merton Hill/Grace Rippy
Filer Authorized By:	Donald Merton Hill
Attorney Docket Number:	038495/369324
Receipt Date:	21-FEB-2012
Filing Date:	14-JUL-2009
Time Stamp:	15:32:30
Application Type:	Utility under 35 USC 111(a)

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		369324_AmendAfterFinal02212012.pdf	1209076 b0f50463fa5cd427ec7ef70245e883a1e6af0f2a	yes	23

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment After Final	1	1
	Claims	2	14
	Applicant Arguments/Remarks Made in an Amendment	15	23

Warnings:

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Total Files Size (in bytes):	1209076

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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.

Substitute for form 1449/PTO (Revised 07/2007)				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(Use as many sheets as necessary)*				Application Number	12/460,139
				Filing Date	July 14, 2009
				First Named Inventor	Brian T. Maguire
				Art Unit	3662
				Examiner Name	HULKA, James R.
Sheet	1	of	1	Attorney Docket Number	038495/369324

OTHER 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, page(s) , volume-issue number(s), publisher, city and/or country where published.	English Language Translation Attached
	267	BALLANTYNE, J.; "Find and Catch More Fish, Quickly and Easily, with the FISHIN' BUDDY 2255"; [Online]; [Retrieved on 12-7-2011]; Retrieved from the Internet <URL:http://www.articleslash.net/Recreation-and-Sports/Fishing/67018__Find-and-Catch-More-Fish-Quickly-and-Easily-with-the-FISHIN-BUDDY-2255.html>; 4 pages	
	268	Deep Vision Side Scan Sonar Systems; [Online]; [Retrieved on 12-2-2011]; Retrieved from the Internet <URL:http://www.deepvision.se/products.htm>; 5 pages	
	269	Fishin' Buddy 4200™ Operations Manual; Dated 12/21/2005; 16 pages	
	270	Fishing Tool Reviews - Bottom Line Fishin Buddy 1200 Fishfinder; [Online]; [Retrieved on 12-7-2011]; Retrieved from the Internet <URL:http://www.tackletour.com/reviewbottomline1200.html>; 4 pages	
	271	HUMMINBIRD 100 Series™ Fishin' Buddy®; 110, 120, 130 and 140c Product Manual; © 2007; 2 pages	
	272	Sidefinder – Reviews & Brand Information – Techsonic Industries, Inc.; [Online]; [Retrieved on 12-7-2011]; Retrieved from the Internet <URL: http://www.trademarkia.com/sidefinder-74113182.html>; 4 pages	
	273	Trademark Electronic Search System (TESS); Word Mark: Sidefinder; [Online]; [Retrieved on 12-7-2011]; Retrieved from the Internet <URL: http://tess2.uspto.gov/bin/showfield?f=doc&state=4009:qi4jkj.2.1>; 2 pages	

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.

SUBMITTED: FEBRUARY 21, 2012

Electronic Acknowledgement Receipt

EFS ID:	12124677
Application Number:	12460139
International Application Number:	
Confirmation Number:	9769
Title of Invention:	Downscan imaging sonar
First Named Inventor/Applicant Name:	Brian T. Maguire
Customer Number:	826
Filer:	Michael D. McCoy/Judy Creel
Filer Authorized By:	Michael D. McCoy
Attorney Docket Number:	038495/369324
Receipt Date:	21-FEB-2012
Filing Date:	14-JUL-2009
Time Stamp:	17:27:36
Application Type:	Utility under 35 USC 111(a)

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		369324_IDS.PDF	142330 fbd637dfce61d738583bb1f8bf6ce64263dec024	yes	3

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal Letter	1	2
	Information Disclosure Statement (IDS) Form (SB08)	3	3

Warnings:

Information:

2		369324_NPL.PDF	3944482 87e0ce6f20c1fefa7426d5c06eb1f2f1bf2e1a8c	yes	36

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Non Patent Literature	1	4
	Non Patent Literature	5	9
	Non Patent Literature	10	25
	Non Patent Literature	26	29
	Non Patent Literature	30	31
	Non Patent Literature	32	34
	Non Patent Literature	35	36

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Information:

Total Files Size (in bytes):	4086812

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's Docket No. 038495/369324

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re:	Brian T. Maguire	Confirmation No.:	9769
Appl. No.:	12/460,139	Art Unit:	3662
Filed:	July 14, 2009	Examiner:	HULKA, James R.
For:	DOWNSCAN IMAGING SONAR		

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT CITATION UNDER 37 C.F.R. § 1.97

Attached is a list of documents on form PTO-1449 along with a copy of any cited foreign patent documents and non-patent literature document in accordance with 37 CFR 1.98(a)(2). Also enclosed is a translation or a concise explanation of each non-English language document.

It is requested that the Examiner consider these documents and officially make them of record in accordance with the provisions of 37 C.F.R. § 1.97 and Section 609 of the MPEP. By identifying the listed documents, Applicant in no way makes any admission as to the prior art status of the listed documents, but is instead identifying the listed documents for the sake of full disclosure.

This Information Disclosure Statement is submitted in accordance with 37 C.F.R. § 1.97(c), before final Office Action or Allowance, whichever is earlier.

In re: Brian T. Maguire
Appl. No.: 12/460,139
Filed: July 14, 2009

In accordance with the requirements of 37 C.F.R. § 1.97(c), the following statement as specified in 37 C.F.R. § 1.97(e) is made:

No item of information contained in this statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing this document after making reasonable inquiry, no item of information contained in this statement was known to any individual designated in 37 C.F.R. § 1.56(c) more than three (3) months prior to the filing of this information disclosure statement.

Respectfully submitted,

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ELECTRONICALLY FILED USING THE EFS-WEB ELECTRONIC FILING SYSTEM OF THE UNITED STATES PATENT & TRADEMARK OFFICE ON FEBRUARY 21, 2012.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/460,139	Filing Date 07/14/2009	☐ To be Mailed

APPLICATION AS FILED – PART I

FOR	NUMBER FILED (Column 1)	NUMBER EXTRA (Column 2)	SMALL ENTITY ☐ RATE ($)	SMALL ENTITY FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
			TOTAL			TOTAL	

* If the difference in column 1 is less than zero, enter "0" in column 2.

APPLICATION AS AMENDED – PART II

AMENDMENT	02/21/2012	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 79	Minus	** 99	= 0	X $ =		OR	X $60=	0
	Independent (37 CFR 1.16(h))	* 3	Minus	***4	= 0	X $ =		OR	X $250=	0
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	**0**

AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/ERIC DANTZLER/

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PTOL-413A (08-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Doc Code: M865 or FAI.REQ.INTV

Applicant Initiated Interview Request Form

Application No.: 12/460,139
First Named Applicant: Maguire
Examiner: James R. Hulka
Art Unit: 3662
Status of Application: under final rejection

Tentative Participants:
(1) James Hulka
(2) Donald M. Hill, Jr.
(3) Aaron Coleman
(4) ______

Proposed Date of Interview: February 16, 2012
Proposed Time: 1:00 PM (AM/PM)

Type of Interview Requested:
(1) [ ] Telephonic (2) [✓] Personal (3) [ ] Video Conference

Exhibit To Be Shown or Demonstrated: [ ] YES [✓] NO
If yes, provide brief description: ______

Issues To Be Discussed

Issues (Rej., Obj., etc)	Claims/ Fig. #s	Prior Art	Discussed	Agreed	Not Agreed
(1) 103 Rej.	Cls. 57, 76	Hamada	[ ]	[ ]	[ ]
(2)			[ ]	[ ]	[ ]
(3)			[ ]	[ ]	[ ]
(4)			[ ]	[ ]	[ ]

[ ] Continuation Sheet Attached [ ] Proposed Amendment or Arguments Attached

Brief Description of Arguments to be Presented: Applicant proposes to explain why the Office Action has erroneously concluded that Hamada teaches a linear downscan transducer as claimed in Applicant's claims, and thus why the claims are patentable over the combination of references.

An interview was conducted on the above-identified application on ______

NOTE: This form should be completed and filed by applicant in advance of the interview (see MPEP § 713.01). If this form is signed by a registered practitioner not of record, the Office will accept this as an indication that he or she is authorized to conduct an interview on behalf of the principal (37 CFR 1.32(a)(3)) pursuant to 37 CFR 1.34. This is not a power of attorney to any above named practitioner. See the Instruction Sheet for this form, which is incorporated by reference. By signing this form, applicant or practitioner is certifying that he or she has read the Instruction Sheet. After the interview is conducted, applicant is advised to file a statement of the substance of this interview (37 CFR 1.133(b)) as soon as possible. This application will not be delayed from issue because of applicant's failure to submit a written record of this interview.

Applicant/Applicant's Representative Signature

Examiner/SPE Signature

Donald M. Hill, Jr.
Typed/Printed Name of Applicant or Representative

40,646
Registration Number, if applicable

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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Date:
February 10, 2012

Recipient:
Examiner James Hulka

Company:
U.S. Patent & Trademark Office

Fax Number:
(571) 273-8300

Voice Number:

Sender:
Don Hill

Message:

Applicant Initiated Interview Request

Appln. No. 12/460,139
Group Art No: 3662

Number of Pages: (including cover page) 1

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USER CODE:	HILLD	REQUESTED BY:	Grace Rippy
CLIENT/MATTER:	038495/369324	OPERATOR:	

LEGAL02/33122534v1

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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.
12/460,139	07/14/2009	Brian T. Maguire	038495/369324	9769

826 7590 12/20/2011

ALSTON & BIRD LLP
BANK OF AMERICA PLAZA
101 SOUTH TRYON STREET, SUITE 4000
CHARLOTTE, NC 28280-4000

EXAMINER	
HULKA, JAMES R	

ART UNIT	PAPER NUMBER
3662	

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.

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No.	Applicant(s)	
	12/460,139	MAGUIRE, BRIAN T.	
	Examiner	**Art Unit**	
	JAMES HULKA	3662	

-- 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 *30 November 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) *57-84,86 and 88-137* is/are pending in the application.

5a) Of the above claim(s) *126,132,133 and 135-137* is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *57-84,86,88-125,127-131 and 134* 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 _____ 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 *20111115*.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

Claims 1-56, 85, 87 have been cancelled.

Claims 57-76, 86, 88, and 96 have been amended.

Claims 100-137 are new. Claims 57-84, 86, and 88-137 are pending.

Information Disclosure Statement

The information disclosure statement (IDS) submitted on 15 November 2011 was filed after the mailing date of the Non-final rejection on 22 September 2011. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner. However, due to the excessive number of references, they have only been given a cursory review to gather relevance to the claimed inventions.

Election/Restrictions

1. Claim(s) 57-84, 86, and 88-99 is/are generic to the following disclosed patentably distinct species: Species I describes a singular downscan linear transducer element with optional conical downscan transducer element. The species are independent or distinct because Species II discloses an additional linear side scan transducer element. In addition, these species are not obvious variants of each other based on the current record.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species, or a single grouping of patentably indistinct species, for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable.

There is a search and/or examination burden for the patentably distinct species as set forth above because at least the following reason(s) apply:

Species I and II require different fields of search based on the additional linear transducer element described in new claims for purposes of sidescanning.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species or a grouping of patentably indistinct species to be examined even though the requirement may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected species or grouping of patentably indistinct species**, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

The election may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the election of species requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected species or grouping of patentably indistinct species.

Should applicant traverse on the ground that the species, or groupings of patentably indistinct species from which election is required, are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing them to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the species unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other species.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which depend from or otherwise require all the limitations of an allowable generic claim as provided by 37 CFR 1.141.

2. Newly submitted claims 126, 132-133, and 135-137 are directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: The new species describes an additional linear transducer element for purposes of sidescanning

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, **claims 126, 132-133, and 135-137 are withdrawn from consideration** as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 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.

4. Claims 57, 60-61, 63, 65, 68-71, 76, 78-80, 86, 89-93, 100-104, 107-108, 110-113, 119, 121, 125, 127-128, and 134 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada (5,805,528) in view of Imagenex (Sonar Theory and Applications – Model 855).

5. Regarding Claim 57, Hamada teaches a transducer assembly comprising: a housing mountable to a watercraft … [Abstract] a linear transducer element positioned within the housing, the linear transducer element having a substantially rectangular shape configured to produce a fan-shaped sonar beam having a relatively narrow beam width in a direction parallel to longitudinal length of the linear transducer element … [Fig. 9 & 10] wherein the linear transducer element is positioned within the housing to project sonar pulses in a direction substantially perpendicular to a plane corresponding to the surface [Col. 8 Lines 10-20]. Hamada does not explicitly teach a linear transducer element being positioned with the longitudinal length thereof extending in a fore-to-aft direction in the housing. Imagenex teaches a linear transducer element being positioned with the longitudinal length thereof extending in a fore-to-aft direction in the housing [Fig. 1a]. It would have been obvious to modify the assembly of Hamada with a housing

mountable to a watercraft aligned longitudinally fore-to-aft in order to get a clear image of the area below and to each side of the watercraft.

Regarding Claim 76, Hamada teaches a sonar system comprising: a linear transducer element positioned within a housing that is mountable to a watercraft … [Abstract] the linear transducer element having a substantially rectangular shape configured to produce a fan-shaped sonar beam having a relatively narrow beam width in a direction parallel to longitudinal length of the linear transducer element … [Fig. 9 & 10] wherein the linear transducer element is positioned within the housing to project sonar pulses in a direction substantially perpendicular to a plane corresponding to the surface of a body of water [Col. 8 Lines 10-20], a sonar module configured to enable operable communication … [Fig. 17] including a sonar signal processor … and at least one transceiver… [5 of Fig. 17]. Hamada does not explicitly teach a linear transducer element being positioned with the longitudinal length thereof extending in a fore-to-aft direction in the housing. Imagenex teaches a linear transducer element being positioned with the longitudinal length thereof extending in a fore-to-aft direction in the housing [Fig. 1a]. It would have been obvious to modify the system of Hamada with a housing mountable to a watercraft aligned longitudinally fore-to-aft in order to get a clear image of the area below and to each side of the watercraft.

Regarding Claim 134, Hamada teaches a sonar imaging apparatus comprising: a housing mountable to a watercraft … [Abstract], a linear transducer element positioned within the housing, the linear transducer element being configured to produce a sonar beam having a longitudinal beamwidth in a direction parallel to a longitudinal length …

[Fig. 9], wherein the transverse beamwidth of the sonar beam is sufficiently wide in relation to a direction in which the linear transducer element is aimed such that the transverse beamwidth spans from a port side [Fig. 10, Col 8 Lines 10-20]. Hamada does not explicitly teach a longitudinal length of the linear transducer element is parallel to said center plane. Imagenex teaches teach a longitudinal length of the linear transducer element is parallel to said center plane [Fig. 1a]. It would have been obvious to modify the apparatus of Hamada with a housing mountable to a watercraft aligned longitudinally parallel to a center plane in order to get a clear image of the area below and to each side of the watercraft.

Regarding Claim 60, Hamada does not teach a beam width of a linear transducer element is about 0.8 degrees by about 32 degrees or about 1.4 degrees by about 56 degrees. Imagenex teaches a beam width of a linear transducer element is about 0.8 degrees by about 32 degrees or about 1.4 degrees by about 56 degrees [Fig. 1a]. It would have been obvious to modify the assembly of Hamada to produce a wide, thin beam to cover a large area while also producing higher resolution sonar images.

Regarding Claim 61, Hamada also teaches communicating with a single transceiver [5 of Fig. 17].

Regarding Claims 63 and 86, Hamada also teaches a fan-shaped beam extending from one side of the watercraft to an opposite side of the watercraft [Fig. 9 & 10].

Regarding Claim 65, Hamada does not explicitly teach a beam width in the direction parallel to a longitudinal length of the linear transducer element is less than about five percent as large as the beam width of the sonar beam in the direction perpendicular to the longitudinal length of the linear transducer element. Imagenex teaches a beam width in the direction parallel to a longitudinal length of the linear transducer element is less than about five percent as large … [Fig. 1a]. It would have been obvious to modify the system of Nishimori to include a narrow beam in one direction to increase resolution of successive 2-D images.

Regarding Claims 68-70, 89-91 and 93, Hamada also teaches images of sonar data corresponding to data received via the linear transducer element representing bottom data, depth, data water column data, or data below the linear transducer element [Col. 8, Lines 10-20, 45-60].

Regarding Claims 71 and 92, Hamada also teaches sonar data images of two or more of ... [Col. 8, Lines 10-20, 45-60].

Regarding Claim 78, Hamada inherently teaches a sonar module is provided within a separate housing [Fig. 17, Col. 3, Lines 1-15]. Putting a sonar module (processor and communications link) in a separate housing is common in the art of sonar imaging as the sensors are submerged in the water, while the processor is above water and is being used by an operator.

Regarding Claim 79, Hamada also teaches at least one visual display … [19 of Fig. 17].

Regarding Claim 80, Hamada inherently teaches a display and the sonar module are in the same housing [Fig. 17, Col. 3 Lines 1-15]. It is common in the art to combine the sonar module (processor and communications) and display in the same housing as to make the system portable, with a wired or wireless link between the sonar module and submerged sensors so the user can operate the system in real-time.

Regarding Claims 100 and 101, Hamada also teaches a linear transducer element is configured to emit sonar pulses as well to receive echo returns ... [3, 4, 5 of Fig. 17].

Regarding Claims 102, 111, and 112, Hamada inherently teaches a housing (containing the linear transducer element) is mounted to a watercraft, or on an intermediate structure mounted to a water craft [Abstract, Fig. 9]. It is common in the art to mount a sonar receiver on the side or underneath a watercraft directly or indirectly as the beams need to be created in the water for correct use and data collection. An intermediate structure might reduce damage to the watercraft, sensor, or make attachment and removal of the sensor element easier.

Regarding Claim 103, Hamada also teaches a linear transducer element is configured to produce a generally planar fan-shaped beam [Fig. 9 & 10].

Regarding Claim 104, Hamada also teaches a display in communication with the sonar module [19 of Fig. 17].

Regarding Claim 107, Hamada also teaches a user interface in communication … [Col. 7 Lines 40-50].

Regarding Claim 108, Hamada inherently teaches a display, sonar signal processor and user interface are all contained in a single housing [Abstract, Fig. 17]. It is common in the art to provide a personal computer or laptop with all three features that can easily be connected to the sonar sensors for easier operator use.

Regarding Claim 110, Hamada inherently teaches a linear transducer element, transceiver, and display respectively comprise at least two separate modules [Abstract, Col. 3 Lines 1-15]. It is common in the art to have at least one separate housing for non-submerged electronics (display, transceiver) to allow the operator easier use without having to worry about water damage to certain electronic elements.

Regarding Claim 113, Hamada also teaches a sonar signal processor is further configured to implement signal processing or enhancement to improve display characteristics [Col. 8 Lines 30-40].

Regarding Claim 119, Hamada also teaches a sonar signal processor is configured to implement a notice or alarm … [Col. 8 Lines 45-55].

Regarding Claim 121, Hamada also teaches a processor, in combination with a memory, stores incoming transducer data … [Col. 8 Lines 45-60].

Regarding Claim 125, Hamada inherently teaches a housing containing the linear transducer element is mounted on an accessory on the watercraft enabling the fan-shaped beam to assume various orientations [Fig. 9 & 10].

Regarding Claim 127, Hamada teaches indicating a position of the watercraft on the display [Col. 8 Lines 20-30].

Regarding Claim 128, Hamada also teaches indicating water depth on the display [Col. 8 Lines 10-20].

6. Claim 62 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada (5,805,528) in view of Imagenex (Sonar Theory and Applications – Model

855) as applied to claim 57 above, and further in view of Blue (5,850,372) and Bird (4,774,837).

7. Regarding Claim 62, Hamada does not teach a length of a rectangular face of the linear transducer element is about 120 mm and a width of the rectangular face of the linear transducer element is about 3 mm. Blue [Col 6, Lines 1-5] and Bird [Col 2. Lines 40-60] teach a length of a rectangular face of the linear transducer element is about 120 mm and a width of the rectangular face of the linear transducer element is about 3 mm. It would have been obvious to modify the system of Hamada to make a specific size transducer to produce a beam for desired applications and also to eliminate unnecessary costs.

8. Claims 64, 77 and 105 and 124 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada (5,805,528) in view of Imagenex (Sonar Theory and Applications – Model 855) as applied to claims 57, 76 and 104 above, and further in view of Thompson (7,542,376).

9. Regarding Claims 64 and 124, Hamada does not teach a housing (containing the linear transducer element) has a streamlined shape(profile). Thompson teaches a housing has a streamlined shape [Col. 2, Lines 35-55]. It would have been obvious to modify the system of Hamada to include a streamlined housing in order to protect the sensors from being damaged.

Regarding Claims 77 and 105, Hamada does not explicitly teach an Ethernet hub … or communication via a network. Thompson teaches an Ethernet Hub … or communication via a network [Col. 6, Lines 10-15]. It would have been obvious to modify the system of Hamada to include an Ethernet hub to allow multiple users to analyze the sonar data and images, or to increase the speed of data transfer.

10. Claims 58, 66-67, 81, 83 and 88 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada (5,805,528) in view of Imagenex (Sonar Theory and Applications – Model 855) as applied to claims 57 and 76 above, and further in view of Zimmerman (2007/0025183).

11. Regarding Claims 58 and 83, Hamada does not explicitly teach a linear transducer element is configured to operate at a selected one of at least two selectable operating frequencies. Zimmerman teaches a linear transducer element is configured to operate at a selected one of at least two selectable operating frequencies [0003]. It would have been obvious to modify the system of Hamada to be able to detect different types of objects effectively.

Regarding Claims 66, 67 and 88, Hamada does not explicitly teach images corresponding to data received via the linear transducer provide data regarding bottom features over less than fifty (or twenty) percent of a display screen when displayed. Zimmerman teaches images corresponding to data received via the linear transducer provide data regarding bottom features over less than fifty (or twenty) percent of a display screen when displayed [Claim 9]. It would have been obvious to modify the system of Hamada to include display of images on less than fifty or twenty percent of a display screen to be able to see multiple images at one time, or to analyze a time series of data.

Regarding Claim 81, Hamada does not explicitly teach at least one display of the plurality of displays is enabled to simultaneously provide different images… Zimmerman teaches at least one display of the plurality of displays is enabled to simultaneously provide different images… [Claim 9]. It would have been obvious to modify the system of Hamada to include display of different images simultaneously to be able to see multiple images at one time, or to analyze a time series of data.

12. Claims 98-99, 106, 109, 114-118, 120, 122-123 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada (5,805,528) in view of Imagenex (Sonar Theory and Applications – Model 855) as applied to claims 76 and 104 above, and further in view of Matrix 97 GPS Trackplotter (Operations Manual).

Regarding Claims 98 and 114-117, Hamada does not explicitly teach data from at least one of the group of radar, GPS, digital mapping , time and temperature, or waypoint designations. Matrix 97 GPS teaches data from at least one of the group of radar, GPS, digital mapping, , time and temperature [Page 4]. It would have been obvious to modify the system of Hamada to include data from at least one of those resources to improve location tracking of desired underwater targets.

Regarding Claim 99, Hamada does not explicitly teach display of the data is in a user-selectable format. Matrix 97 GPS teaches display of the data is in a user-selectable format [Page 66]. It would have been obvious to modify the system of

Hamada to include a user selectable display format screen to be able to see multiple images at one time, or to analyze a time series of data.

Regarding Claim 106, Hamada does not explicitly teach at least one additional display… Matrix 97 GPS teaches at least one additional display [Page 27]. It would have been obvious to modify the system of Hamada for expansion bus options for computer electronics or sensors to include additional displays to view multiple images at the same time.

Regarding Claim 109, Hamada does not explicitly teach a user interface is part of the display. Matrix 97 GPS teaches teach a user interface is part of the display [Page 24]. It would have been obvious to modify the system of Hamada to include a combined user interface/display to reduce size and make the unit more portable.

Regarding Claims 118 and 120, Hamada does not explicitly teach a sonar signal processor is further configured to implement a notice or alarm regarding depth or proximity of other watercraft. Matrix 97 GPS teaches a sonar signal processor is further configured to implement a notice or alarm regarding depth or proximity of other watercraft [Page 46-49]. It would have been obvious to modify the system of Hamada to include notification of depth or watercraft proximity to let the user know of a possible collision for damage to the watercraft or sensor.

Regarding Claim 122, Hamada does not explicitly teach performing additional processing to implement zoom. Matrix 97 GPS teaches performing additional processing to implement zoom [Page 34]. It would have been obvious to modify the system of Hamada to include zoom in order to provide the user with more details in the image.

Regarding Claim 123, Hamada does not explicitly teach additional processing to correlate sonar to GPS data. Matrix 97 GPS teaches teach additional processing to correlate sonar to GPS data [Page 18]. It would have been obvious to modify the system of Hamada to include additional processing for sonar and GPS to provide the user with a more detailed map of routes, points, and features.

13. Claims 59 and 84 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada (5,805,528) in view of Imagenex (Sonar Theory and Applications – Model 855), and Zimmerman (2007/0025183), as applied to claims 58 and 83 above, and further in view of Richard (4,538,249) and Adams (5,184,330).

14. Regarding Claim 59, Hamada does not explicitly teach selectable operating frequencies include about 455 kHz and 800 KHz. Zimmerman [0003], Adams [Col. 5, Lines 1-5], and Richard [Col. 8, Lines 45-60] teach selectable operating frequencies include about 455 kHz and 800 KHz. It would have been obvious to modify the system of Nishimori to include specific frequencies depending on the types of objects being tracked by the sonar in the water.

15. Claim 82 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada (5,805,528) in view of Imagenex (Sonar Theory and Applications – Model 855) as applied to claim 76 above, and further in view of Wilcox (5,142,502).

16. Regarding Claim 82, Hamada does not explicitly teach configuration settings defining a predefined set of display images … Wilcox teaches configuration settings defining a predefined set of display images … [Col. 3, Lines 50-70]. It would have been obvious to modify the system of Hamada to include configuration settings to allow the user to compare different sonar images taken during different surveys.

17. Claim 72, 75, 94, 97, 129-131 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada (5,805,528) in view of Imagenex (Sonar Theory and Applications – Model 855) as applied to claims 57 and 76 above, and further in view of Betts (2006/0023570).

18. Regarding Claims 72 and 94, Hamada does not explicitly teach a circular transducer element … Betts also teaches a circular transducer element … [0031]. It would have been obvious to modify the assembly and system of Hamada to include a circular transducer element in order to display sonar images with accurate scale and depth information.

Regarding Claims 75 and 97, Hamada does not explicitly teach sonar signal returns from the circular transducer element and linear transducer element provide generally simultaneous data Betts teaches sonar signal returns from the circular transducer element and linear transducer element provide generally simultaneous data [0049-0051]. It would have been obvious to modify the system of Hamada to include generally simultaneous data display to provide the user with a complete, real-time sonar image.

Regarding Claim 129, Hamada does not explicitly teach a second transducer …wherein the system is configured to indicate on the display an intensity of a return echo received ... Betts teaches a second transducer …[72 of Fig. 1] wherein the system is configured to indicate on the display an intensity of a return echo received ... [0048]. It would have been obvious to modify the system of Hamada to include a second transducer …wherein the system is configured to indicate on the display an intensity of a return echo received ... to provide the user with a complete, real-time sonar image.

Regarding Claim 130, Hamada does not explicitly teach a linear transducer element and the second transducer are both contained in the same housing. Betts teaches a linear transducer element and the second transducer are both contained in the same housing [Fig .1]. It would have been obvious to modify the system of Hamada to include a housing for both transducers to reduce cost, save space, and prevent unnecessary damage.

Regarding Claim 131, Hamada does not explicitly teach a linear transducer element and the second transducer operate at different respective frequencies. Betts teaches a linear transducer element and the second transducer operate at different respective frequencies [0053]. It would have been obvious to modify the system of Hamada to include operation of different transducers at different frequencies to provide the user with a complete, real-time sonar image.

19. Claim 73-74 and 95-96 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hamada (5,805,528) in view of Imagenex (Sonar Theory and

Applications – Model 855) and Betts (2006/0023570) as applied to claims 72 and 94 above, and further in view of Fatemi-Booshehri (5,991,239).

20. Regarding Claims 73 and 95, Hamada does not explicitly teach linear and circular transducer elements are in the same housing or that the circular transducer element produces a conical downscan beam from within the same housing. Fatemi-Booshehri teaches … elements are in the same housing or that the circular transducer element produces a conical downscan beam from within the same housing [Col. 4, Lines 60-70]. It would have been obvious to modify the system of Hamada to include putting both transducers in the same housing to reduce material cost.

Regarding Claims 74 and 96, Hamada does not teach linear transducer and circular transducer elements are positioned to project fan-shaped and conical sonar beams … to sonify areas of the bottom that at least partially overlap. Fatemi-Booshehri teaches linear transducer and circular transducer elements are positioned to project fan-shaped and conical sonar beams … to sonify areas of the bottom that at least partially overlap [Abstract]. It would have been obvious to modify the system of Hamada to include overlapping circular and linear transducer beams to improve sonar image resolution.

Response to Arguments

21. Applicant's arguments with respect to claims 57-99 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

22. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. HUMMINBIRD – Fish Wide Open (IDS Citation #228) teaches direct and indirect mounting methods, and accessories/structures for mounting the sonar.

23. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JAMES HULKA whose telephone number is (571)270-7553. The examiner can normally be reached on Monday thru Thursday 7:30am-5pm, Every 2nd Friday, 7:30am - 4pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas Tarcza can be reached on 571-272-6979. 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.

/J. H./
Examiner, Art Unit 3662

/Thomas H. Tarcza/
Supervisory Patent Examiner, Art Unit 3662

Notice of References Cited	Application/Control No. 12/460,139	Applicant(s)/Patent Under Reexamination MAGUIRE, BRIAN T.	
	Examiner JAMES HULKA	Art Unit 3662	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2002/0071029 A1	06-2002	Zell et al.	348/97
*	B	US-2005/0216487 A1	09-2005	Fisher et al.	707/100
*	C	US-2006/0023570 A1	02-2006	Betts et al.	367/088
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Substitute for form 1449/PTO (Revised 07/2007)	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(Use as many sheets as necessary)*	Application Number	12/460,139
	Filing Date	July 14, 2009
	First Named Inventor	Brian T. Maguire
	Art Unit	3662
	Examiner Name	HULKA, James R.
Sheet 1 of 16	Attorney Docket Number	038495/369324

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.	Document Number Number - Kind Code (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages of Relevant Figures Appear
	1.	US-1,823,329	09-15-1931	Marrison	
	2.	US-2,416,338	02-25-1947	Mason	
	3.	US-3,005,973	10-24-1961	Kietz	
	4.	US-3,090,030	05-14-1963	Schuck	
	5.	US-3,142,032	07-21-1964	Jones	
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	First Named Inventor	Brian T. Maguire
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	Art Unit	3662
	Examiner Name	HULKA, James R.
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OTHER DOCUMENTS

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	183.	Detailed Sonar Transducer Product Information; Transducer Products; Side Scans; Models T36, T63, T62, and T403; 12/30/2003; Retrieved from internet: URL:http://www.neptune-sonar.com/products.as_btype=Side-Scan+Transducers&category=; 4 pages	
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	206.	HUMMINBIRD High Speed Transducer; 4 pages	
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	217.	HUMMINBIRD NS25 Operations Manual; 71 pages	
	218.	HUMMINBIRD Piranha 1 & 2 Operation Guide; 5 pages	
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	225.	HUMMINBIRD Wide 3D Vision Operations Manual; 38 pages	
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	233.	Imagenex Model 872 "Yellowfin" Sidescan Sonar; Imagenex Technology Corp.; © 2004 - 2009	
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	240.	"ITC Application Equations for Underwater Sound Transducers"; Published by International Transducer Corporation, 1995, Rev. 8/00; 3 pages	
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