



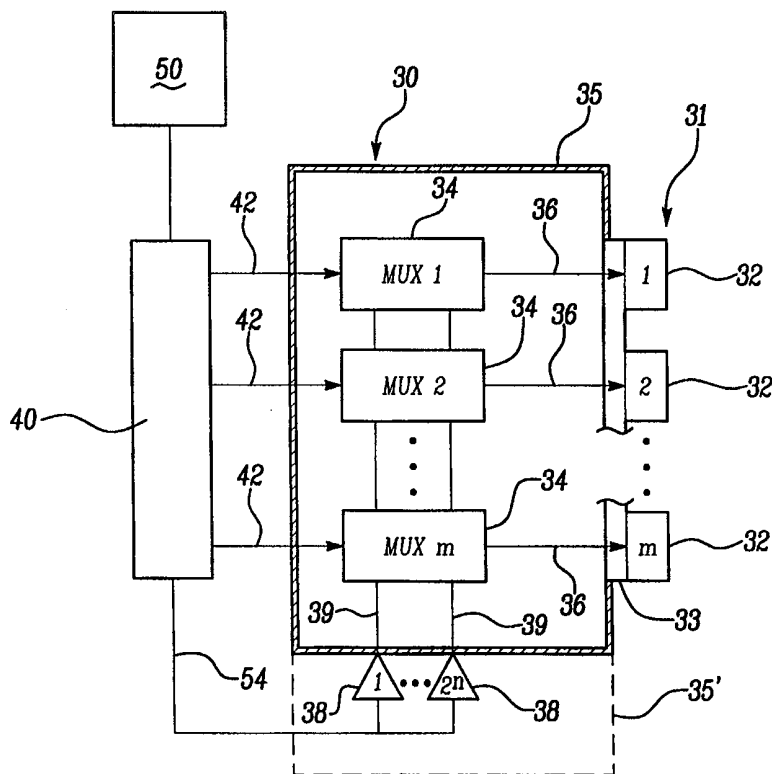
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification <sup>6</sup> : <b>G10K 11/34, G01S 15/66</b></p>	<p><b>A3</b></p>	<p>(11) International Publication Number: <b>WO 99/13452</b> (43) International Publication Date: 18 March 1999 (18.03.99)</p>
<p>(21) International Application Number: PCT/US98/18514 (22) International Filing Date: 4 September 1998 (04.09.98) (30) Priority Data: 08/927,599 11 September 1997 (11.09.97) US (71) Applicant: THE REGENTS OF THE UNIVERSITY OF MICHIGAN [US/US]; Wolverine Tower, Room 2071, 3003 S. State Street, Ann Arbor, MI 48109-1280 (US). (72) Inventor: CAIN, Charles, A.; 4801 Starak Lane, Ann Arbor, MI 48105 (US). (74) Agents: OBERHOLTZER, Steven, L. et al.; Harness, Dickey &amp; Pierce, P.L.C., P.O. Box 828, Bloomfield Hills, MI 48303 (US).</p>		<p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p> <p>(88) Date of publication of the international search report: 29 July 1999 (29.07.99)</p>

(54) Title: PHASED ARRAY SYSTEM ARCHITECTURE

(57) Abstract

Architecture for driving an ultrasound phased array. The architecture includes a series of amplifiers (38) which produce discrete driving signals. The amplifiers number less than the number of transducer elements (32) in the array (31) and an integrated circuit multiplexer chip (34) is coupled to each transducer and to all the amplifiers. A controller (40) provides first control signals to the amplifiers (38) causing the amplifiers to produce their discrete driving signals. The controller (40) further provides second control signals to each multiplexer chip (34) and these signals cause the multiplexer chips to pass a specified one of the driving signals to a selected one of the transducer elements (32). The result is that a focused ultrasonic beam is formed on a selected target volume.



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INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 98/18514

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 G10K11/34 G01S15/66

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**  
Minimum documentation searched (classification system followed by classification symbols)  
IPC 6 G10K G01S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 351 038 A (ALAIS PIERRE) 21 September 1982	1-3, 6, 11, 17-20, 23, 29
Y	see abstract; figures 1-3	12-14, 30-32
A	see column 5, line 11 - line 31  see column 6, line 23 - line 32 see the whole document	4, 5, 15, 16, 21, 22
Y	EP 0 017 382 A (GEN ELECTRIC CO PLC) 15 October 1980 see abstract; figure 3	12-14, 30-32
	-/--	

Further documents are listed in the continuation of box C.  Patent family members are listed in annex.

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Date of the actual completion of the international search: 20 May 1999

Date of mailing of the international search report: 14.06.99

Name and mailing address of the ISA: European Patent Office, P.B. 5818 Patentlaan 2, NL - 2280 HV Rijswijk, Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016

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## INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 98/18514

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	GB 2 099 582 A (STANFORD RES INST INT) 8 December 1982 see abstract; claims 1,5-7; figure 1  see page 1, line 1 - line 96 see page 2, line 10 - line 80 see page 4, line 72 - line 92 ----	1,2,6, 17,18,23 3-5,12, 15,16, 19-22,30
X	US 4 117 446 A (ALAIS PIERRE M) 26 September 1978 see abstract; claim 1; figures 1-5 ----	1,2,17, 18
A	US 4 890 267 A (RUDOLPH ARNO) 26 December 1989 see the whole document ----	1,12,17, 30
Y	EP 0 320 303 A (GEN ELECTRIC) 14 June 1989  see the whole document see page 7, line 18 - line 29 ----	7-9, 24-26
X	US 5 357 962 A (GREEN PHILIP S) 25 October 1994 see the whole document ----	1,17
Y	see abstract see column 9, line 53 - line 60 ----	7-9, 24-26 10,27,28
A	US 5 797 849 A (SMITH WAYNE ET AL) 25 August 1998 see abstract; figure 18 ----	7,24
P,A	US 5 566 675 A (LI MING ET AL) 22 October 1996 see the whole document see column 4, line 23 - line 44 see column 6, line 42 - line 44 see column 7, line 14 - line 24 -----	7,8,24, 25

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 98/ 18514

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

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

1. CLAIMS : 1-6, 11-23, 29-32

2. CLAIMS : 7-10, 24-28

FOR FURTHER INFORMATION PLEASE SEE FORM PCT/ISA/206 MAILED 02.03.99

1.  As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

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

No protest accompanied the payment of additional search fees.

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-6,11-23,29-32

This first group of claims solves the the Objective Problem of obtaining an efficient physical device which can produce the ultrasonic focused beam by means of the Special Technical Feature of the use of specific components and the way these interact with each other.

2. Claims: 7-10,24-28

This second group of claims solves the the Objective Problem of efficiently tracking a target and adjusting the focus of the beam onto this target during movement by means of the Special Technical Feature of the use of an additional phase measurement means connected to the control means and the transducer elements for feedback to optimise focussing or tracking (operating the transducer elements as receiving transducers).

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 98/18514

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Information on patent family members

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