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(71) Applicant: **BAKER HUGHES INCORPORATED**
[US/US]; 3900 Essex Lane, Suite 1200, Houston, TX
77027 (US).

(72) Inventor: **MILLER, Joseph, A.**; 1 Signature Point Dr,
#907, League City, TX 77573 (US).

(74) Agents: **CARSON, Matt et al.**; 9100 Emmott Road, Hous-
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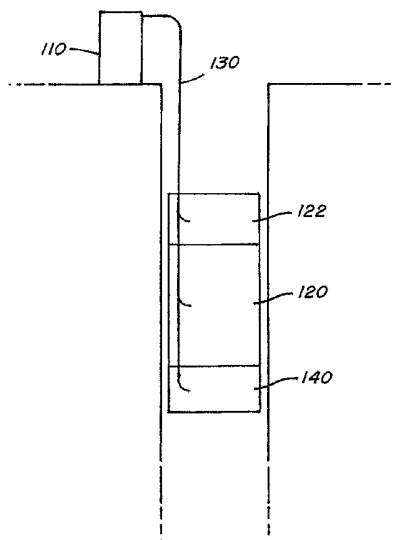
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ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.*

(54) Title: A SENSOR SYSTEM AND METHOD OF COMMUNICATING DATA BETWEEN A DOWNHOLE DEVICE ON A
REMOTE LOCATION



(57) Abstract: Disclosed herein is a sensor system having a sensor (122) and at least one communication line (130) operable with the sensor. The transmission medium is configured to convey data transmitted by the sensor to a remote location (110). The sensor transmits data on the communication line a plurality of times by at least two methods of transmission or modulation. Further disclosed herein is a method based on the foregoing. Further disclosed is a method of communicating by modifying a voltage amplitude of a signal and receiving the communication signal by employing a variable threshold detection circuit in the downhole device. Further disclosed is a system for communicating data between a downhole device and a remote location including a remote device for generating a communication signal, the remote device configured to modify a voltage amplitude of said communication signal.

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INTERNATIONAL SEARCH REPORT

International Application No

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E21B47/12

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E21B

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 991 611 A (MARSHALL III J HOWARD ET AL) 16 November 1976 (1976-11-16)	1-4,6-13
Y	column 9, line 31 - column 10, line 31; figure 1a	5
X	WO 96/23368 A (TSL TECHNOLOGY LTD ; EXPRO NORTH SEA LTD (GB); YURATICH MICHAEL ANDREW) 1 August 1996 (1996-08-01)	1-4,6-13
Y	page 17, line 1 - page 18, line 1; figures 7,8	5
Y	GB 2 369 759 A (BAKER HUGHES INC) 5 June 2002 (2002-06-05) Either of US'611, WO'368 may be combined with this document. page 11, line 7 - line 26	5
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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
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Date of the actual completion of the international search

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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

Authorized officer

Stroemmen, H.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2003/015319 A1 (GREEN ROBERT R ET AL) 23 January 2003 (2003-01-23) paragraph '0139!; figure 1 -----	1-13
A	EP 0 922 836 A (HALLIBURTON ENERGY SERV INC) 16 June 1999 (1999-06-16) paragraph '0040! - paragraph '0043!; figure 1 -----	1-13
A	US 2002/113718 A1 (WEI MICHAEL ET AL) 22 August 2002 (2002-08-22) abstract; figure 1 -----	1-13
X	US 4 583 090 A (QUILICI TIMOTHY J ET AL) 15 April 1986 (1986-04-15) column 1, line 1 - column 1, line 13 column 18, line 66 - column 19, line 25 column 15, line 7 - column 16, line 50 figure 10 -----	14-31
A	US 4 423 624 A (DOOLEY DANIEL ET AL) 3 January 1984 (1984-01-03) abstract -----	14,31

INTERNATIONAL SEARCH REPORT

International application No.
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Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

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

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

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

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

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
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: 1-13

A sensor system and corresponding method of data transmission to a remote location (downhole to topside).

2. claims: 14-31

Method and system of communication between a topside location (remote location) and a downhole device (located downhole) by means of sending a voltage amplitude based signal and receiving said signal employing a variable threshold detection circuit in the downhole device.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 3991611	A	16-11-1976	NONE	
WO 9623368	A	01-08-1996	AU 4493396 A WO 9623368 A1 GB 2310986 A NO 973448 A	14-08-1996 01-08-1996 10-09-1997 25-07-1997
GB 2369759	A	05-06-2002	US 6798338 B1 CA 2353164 A1	28-09-2004 17-01-2002
US 2003015319	A1	23-01-2003	US 2001043509 A1 US 5995449 A US 6310829 B1 GB 2348029 A ,B GB 2348030 A ,B GB 2322953 A ,B NO 981740 A WO 9714869 A1	22-11-2001 30-11-1999 30-10-2001 20-09-2000 20-09-2000 09-09-1998 17-06-1998 24-04-1997
EP 0922836	A	16-06-1999	US 6018501 A EP 0922836 A1	25-01-2000 16-06-1999
US 2002113718	A1	22-08-2002	US 6348876 B1 CA 2469168 A1 EP 1472811 A2 WO 03050376 A2 US 2004207538 A1 AU 6866301 A BR 0111829 A CA 2413984 A1 CN 1437742 T EP 1295271 A2 JP 2004501473 T WO 0198618 A2	19-02-2002 19-06-2003 03-11-2004 19-06-2003 21-10-2004 02-01-2002 01-04-2003 27-12-2001 20-08-2003 26-03-2003 15-01-2004 27-12-2001
US 4583090	A	15-04-1986	NONE	
US 4423624	A	03-01-1984	NONE	