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(72) Inventor; and

(71) Applicant : **HEAD, Philip** [GB/GB]; 1 Hartdene House,
Bridge Road, Bagshot, Surrey, GU19 5AT (GB).

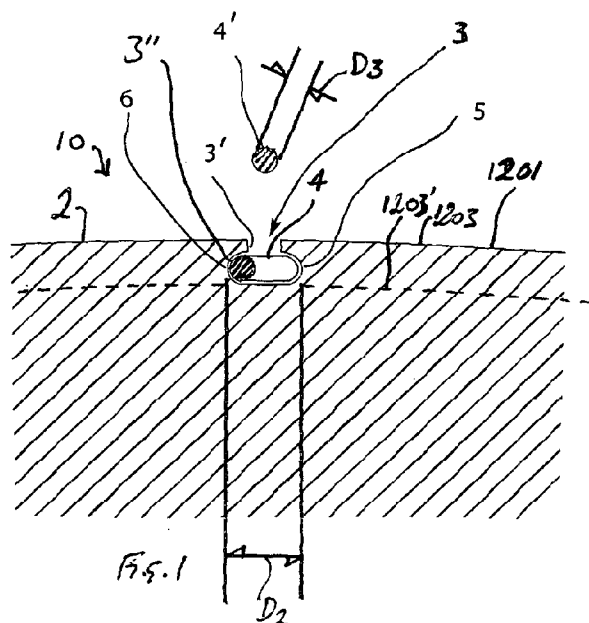
(74) Agent: **NOVAGRAAF UK**; 5th Floor, 145 Cannon Street,
London, EC4N 5BP (GB).

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[Continued on next page]

(54) Title: FIBRE OPTIC CABLE DEPLOYMENT, PARTICULARLY FOR DOWNHOLE DISTRIBUTED SENSING



(57) Abstract: A fibre optic cable is embedded in a slot or coating on the outer surface of a tubing as the tubing is deployed into a well. The cable may be mounted on a reel so as to be rotatable together with the tubing, and may be interrogated via a rotatable optical coupling while the tubing is rotated and deployed. The cable may be used to provide distributed sensing along a length of the tubing. Where the tubing comprises a drillstring, the cable may provide real-time broadband data telemetry from the drilling assembly while drilling.

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22 August 2013

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2012/000759

A. CLASSIFICATION OF SUBJECT MATTER

INV. E21B47/01 E21B47/12 E21B17/02 G02B6/50
ADD.

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)

E21B G02B

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2010/076281 A2 (SHELL INT RESEARCH [NL]; JAEAEKELAEINEN KARI-MIKKO [US]) 8 July 2010 (2010-07-08) abstract; figures page 5, lines 3-14	1,3,4, 16-18
A	----- US 4 337 969 A (ESCARON PIERRE C ET AL) 6 July 1982 (1982-07-06) column 3, line 14 - column 4, line 58; figures 1-3	8,9
X	----- WO 2009/157918 A1 (WELLDYNAMICS INC [US]; KANNAN BHARATHWAJ [US]; BOULDIN BRETT WAYNE [US]) 30 December 2009 (2009-12-30) page 1, lines 17-21; figures page 2, lines 17-26 page 5, lines 5-8	1,16,17
A	----- -/-	8,9



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 but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

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Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Riblet, Philippe

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2012/000759

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	US 2010/018697 A1 (RICHARDS WILLIAM M [US] ET AL) 28 January 2010 (2010-01-28) paragraphs [0002], [0039] - [0046], [0053]; figures 3-7,13-14 -----	1,5,6, 16,17 8,9
X A	US 7 024 941 B2 (ANDERSEN MARTIN [DK]) 11 April 2006 (2006-04-11) column 1, lines 5-11,49-60; figures column 2, lines 8-26 -----	1,2,5,7, 16,17 8,9
X A	US 2003/056947 A1 (CAMERON JOHN A M [GB]) 27 March 2003 (2003-03-27) paragraphs [0014], [0021] - [0026], [0029] - [0030]; figures -----	1,16-18, 22 8,9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2012/000759

Box No. 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.: 43, 44
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:
see FURTHER INFORMATION sheet PCT/ISA/210
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 No. 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 fees, this Authority did not invite payment of additional fees.
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.:
1-9, 16-18, 22

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ 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: 1-9, 16-18, 22

relates to an assembly including a tubing and an optical cable disposed on the outer part of the tubing.
The technical problem associated with the first invention is thus how to clamp the optical cable in an external slot of the tubing receiving the optical cable.
The technical solution is to provide the cable in the slot such that it extends sinuously along the slot so as to frictionally engage opposite sides of the slot.

2. claims: 10-15, 25-31

relates to an assembly including a tubing and an optical cable disposed on the outer part of the tubing and an installation method of the tubing.
The technical problem associated with the second invention is how to install a plurality of tubes forming the tubing while maintaining the continuity of the optical cable along the connected tubes.
The technical solution is to provide each tubes with a slot extending along the tube and in each of the joint regions and opening externally of the tubes at an opening.

3. claims: 19-21

relates to an assembly including a tubing and an optical cable disposed on the outer part of the tubing.
The technical problem associated with the third invention is how to transmit data with the cable when the tubing receiving the cable is part of a drilling assembly in rotation.
The solution is to connect the stationary upper part of the assembly with the cable in rotation via an optical slip ring.

4. claims: 23, 24

relates to an assembly including a tubing and an optical cable disposed on the outer part of the tubing. The technical problem associated with the fourth invention is how to monitor the well during manufacture. The technical solution is to provide in the assembly a sound source and design the optical cable to track the position of the sound source.

5. claims: 32-42

relates to an assembly including a tubing and an optical

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

cable disposed on the outer part of the tubing.
The technical problem associated with the fifth invention is how to provide measurements about characteristics inside the tubing using the optical cable.
The solution is to provide a hole in the tubing and insert a portion of the cable inside the bore through the hole.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 43, 44

Claims 43-44 consist of reference to the drawings and does not define any clear technical feature of the device, which does not enable these claims to be meaningfully searched.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2012/000759

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2010076281 A2	08-07-2010	AU 2009334819 A1 CA 2750905 A1 GB 2478479 A US 2011290477 A1 WO 2010076281 A2	21-07-2011 08-07-2010 07-09-2011 01-12-2011 08-07-2010
US 4337969 A	06-07-1982	NONE	
WO 2009157918 A1	30-12-2009	NONE	
US 2010018697 A1	28-01-2010	GB 2474161 A GB 2489634 A GB 2489861 A US 2010018697 A1 WO 2010011486 A1	06-04-2011 03-10-2012 10-10-2012 28-01-2010 28-01-2010
US 7024941 B2	11-04-2006	AT 456790 T AU 2002304912 A1 BR 0209213 A CA 2444511 A1 DK 200100670 A EP 1407243 A2 NO 20034818 A US 2004168521 A1 WO 02088659 A2	15-02-2010 11-11-2002 06-07-2004 07-11-2002 30-04-2001 14-04-2004 28-10-2003 02-09-2004 07-11-2002
US 2003056947 A1	27-03-2003	CA 2446115 A1 GB 2392464 A US 2003056947 A1 US 2005173109 A1 WO 03027436 A1	03-04-2003 03-03-2004 27-03-2003 11-08-2005 03-04-2003