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(71) Applicant: **FOTECH SOLUTIONS LIMITED** [GB/GB]; Condor House, 10 St Pauls Churchyard, London, Greater London EC4M 8AL (GB).

(72) Inventor: **HANDEREK, Vincent**; 4 Richmond Road, Grays, Essex RM17 6DW (GB).

(74) Agent: **BOULT WADE TENNANT**; Verulam Gardens, 70 Grays Inn Road, London, Greater London WC1X 8BT (GB).

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Declarations under Rule 4.17:

— *as to the identity of the inventor (Rule 4.17(i))*

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

— *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))*

(88) Date of publication of the international search report:
3 March 2016

(54) Title: DISTRIBUTED OPTICAL FIBRE SENSORS

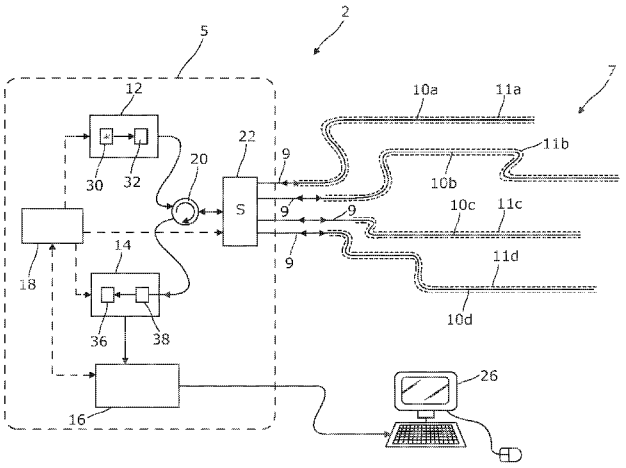


Figure 1

(57) Abstract: There is disclosed a distributed optical fibre sensor for measuring vibration, as a concurrent function of position along each of a plurality of sensing optical fibres, from properties of probe light backscattered within the sensing optical fibres. The sensor comprises a probe light source arranged to generate pulses of probe light for transmission to the sensing optical fibres, a detector arranged to receive and detect probe light backscattered within the sensing optical fibres, an optical switch arranged to switch between the sensing optical fibres, so as to direct each generated probe light pulse to a currently selected one of the sensing optical fibres, and to direct backscattered probe light from a currently selected one of the sensing optical fibres to the detector, the sensor being arranged to control the optical switch such that all of the sensing optical fibres can be used concurrently to detect acoustic vibration, and an analyser arranged to determine vibration, as a concurrent function of position along each of the sensing optical fibres, from the detected backscattered probe light.

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INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2015/052071

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01D5/353 G01H9/00
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)
G01D G01H

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	EP 2 097 880 A1 (SCHLUMBERGER HOLDINGS [VG]; PRAD RES & DEV LTD [VG]; SCHLUMBERGER SERV) 9 September 2009 (2009-09-09)	1-17, 19-27
Y	column 1, paragraph 4 - column 8, paragraph 24	18

Y	JP 2008 299238 A (NIPPON TELEGRAPH & TELEPHONE) 11 December 2008 (2008-12-11)	18
A	abstract	17,26

Y	US 6 389 191 B1 (BORREMAN ALBERT [NL] ET AL) 14 May 2002 (2002-05-14)	18
A	column 1, line 22 - column 2, line 67; figure 1	17,26

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[X] Further documents are listed in the continuation of Box C.

[X] 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

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"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

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"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
19 January 2016	28/01/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Lyons, Christopher

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

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2015/052071

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2012/076873 A2 (FOTECH SOLUTIONS LTD [GB]; HANDEREK VINCENT [GB]) 14 June 2012 (2012-06-14) the whole document	1-27
A	EP 0 585 013 A1 (LITTON SYSTEMS INC [US]) 2 March 1994 (1994-03-02) the whole document	1-27
A	DE 10 2010 049780 A1 (LIOS TECHNOLOGY GMBH [DE]) 3 May 2012 (2012-05-03) the whole document	1-27

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2015/052071

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.:
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 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.:

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: 1-17, 19-27

   A distributed optical fibre sensor for measuring vibration

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2. claims: 18-20

   An optical fibre sensor for measuring one or more parameters at one or more positions along each of a plurality of optical fibres

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2015/052071

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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