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Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

[Continued on next page]

(54) Title: DETECTION OF LOCAL PROPERTY CHANGES IN AN OPTICAL SENSING FIBER

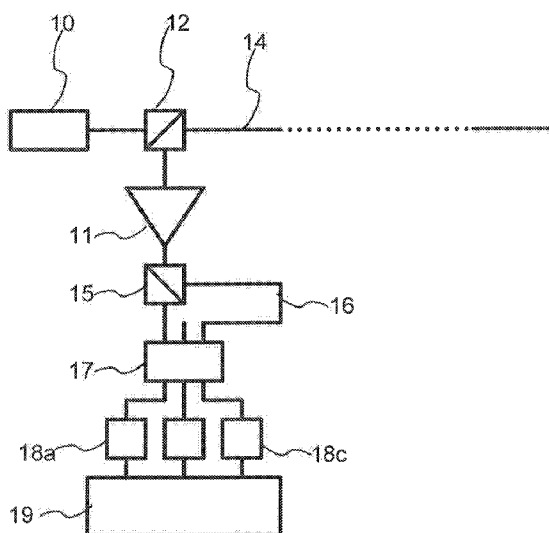


Fig. 1

(57) Abstract: Local strain and optionally other properties of an optical sensing fiber are detected as a function of position along the optical sensing fiber. A light pulse with a plurality of simultaneous laser modes at mutually different wavelengths is transmitted into the optical sensing fiber. Light produced by backscattering of the light pulse in the optical fiber is fed to a multi-way coupler, via a first and second optical path with different optical path lengths. Intensities of different phase combinations of light from the paths are detected by detectors at the outputs of the multiway coupler. A data processing system computes relative phase values of light from the first and second paths for a series to time points with time delays corresponding to scattering at different positions along the fiber. In an embodiment, inelastically scattered light such as due to Brillouin scattering and/or Raman scattered light is selective passed to the detectors and detected.



— *of inventorship (Rule 4.17(iv))*

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:
29 September 2016

INTERNATIONAL SEARCH REPORT

International application No

PCT/NL2015/050903

A. CLASSIFICATION OF SUBJECT MATTER

INV. G01D5/353

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 G01B

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.
Y	MASOUDI A ET AL: "Paper;A distributed optical fibre dynamic strain sensor based on phase-OTDR;A distributed optical fibre dynamic strain sensor based on phase-OTDR", MEASUREMENT SCIENCE AND TECHNOLOGY, IOP, BRISTOL, GB, vol. 24, no. 8, 5 July 2013 (2013-07-05), page 85204, XP020248362, ISSN: 0957-0233, DOI: 10.1088/0957-0233/24/8/085204	1-6,8-12
A	the whole document	7
Y	US 2007/165238 A1 (BOYD CLARK D [US] BOYD CLARK DAVIS [US]) 19 July 2007 (2007-07-19)	1-6,8-12
A	abstract paragraph [0003] - paragraph [0014] paragraph [0035] - paragraph [0042]	7



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

27 May 2016

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11/08/2016

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/NL2015/050903

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.:

1-12

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: 1-12

Problem to be solved:

Increasing the signal to noise ratio, enabling the use of longer sensing fibers and reducing disturbance of detection signals by signals due to inelastic scattering (see p.4, 1.3-12).

Solution:

Using a plurality of laser modes simultaneously at mutually different wavelengths according to independent claims 1 and 12.

2. claims: 13, 14

Problem:

Using backscattered light due to inelastic scattering (Brillouin, Raman) in the sensing fiber to detect local property changes (see p.4, 1.18 - p.6, 1.1).

Solution:

Providing one or more optical filters blocking light at an emission wavelength peak of the light source according to independent claims 13 and 14.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/NL2015/050903

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007165238 A1	19-07-2007	US 2007165238 A1	19-07-2007
		WO 2007087040 A2	02-08-2007
