

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
11 May 2006 (11.05.2006)

PCT

(10) International Publication Number
WO 2006/048647 A3

- (51) International Patent Classification:
G01M 11/00 (2006.01)
- (21) International Application Number:
PCT/GB2005/004243
- (22) International Filing Date:
3 November 2005 (03.11.2005)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
0424305.1 3 November 2004 (03.11.2004) GB
- (71) Applicant (for all designated States except US): **POLARMETRIX LIMITED** [GB/GB]; Mount Manor House, 16 The Mount, Guildford, Surrey GU2 4HS (GB).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **ROGERS, Alan, John** [GB/GB]; Woodbury, Burnhams, Bookham, Surrey KT23 3BA (GB). **KANELLOPOULOS, Sotiris, Emil** [GB/GB]; 88 Fleet Road, London NW3 2QT (GB). **SHATALIN, Sergey, Vladimir** [RU/GB]; 6 Pilgrim House, Quarry Street, Guildford, Surrey GU1 3XY (GB).
- (74) Agent: **THOMPSON GRAY LLP**; Sussex Innovation Centre, Science Park Square, Falmer, Brighton BN1 9SB (GB).

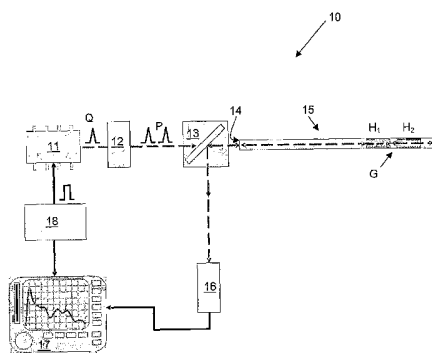
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— with international search report

(88) Date of publication of the international search report:
10 August 2006

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: DETECTING A DISTURBANCE IN THE PROPAGATION OF LIGHT IN AN OPTICAL WAVEGUIDE



(57) Abstract: An optical time domain reflectometry apparatus (10) has a laser (11) and light modulator (12) for producing coherent light pulses (P), each having two sections (H₁, H₂) of higher intensity separated by a gap (G) of lower or substantially zero intensity. As the light pulses (P) propagate along the optical fibre (15), light is continuously Rayleigh backscattered by inhomogeneities of the optical fibre (15). A photodetector (16) generates backscatter signals representing the intensity of light Rayleigh backscattered in the optical fibre (15) as each light pulse (P) travels along the optical fibre (15). The PC (17) uses these backscatter signals to derive a difference signal representing a change dI in intensity between signals generated from two successive pulses. The PC (17) then calculates the Root Mean Square (RMS) of the difference signal averaged over the interval between the two sections (H₁, H₂) of the light pulses (P). Next, the PC (17) averages the backscatter signal generated from the first of the pulses over the same interval and normalises the RMS difference signal using the averaged signal to obtain a compensated difference signal that depends only on differences in the rate of change of phase of light of the light pulses (P) as they travelled along the waveguide. This is repeated at different wavelengths to allow the compensated difference signal to be adjusted to represent the magnitude of the differences.

WO 2006/048647 A3

INTERNATIONAL SEARCH REPORT

PCT/GB2005/004243

| | | |
|---|---|-----------------------------|
| A. CLASSIFICATION OF SUBJECT MATTER INV. GO1M11/00 | | |
| 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) GO1M | | |
| 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, WPI Data, PAJ | | |
| C. DOCUMENTS CONSIDERED TO BE RELEVANT | | |
| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| X A | GB 2 212 651 A (* STC PLC) 26 July 1989 (1989-07-26) page 2, lines 28-30 page 3, lines 4-8 page 3, lines 21-25 figure 1 | 17,34 7-16, 24-33 |
| X A | ----- US 4 960 989 A (LIEBENROOD ET AL) 2 October 1990 (1990-10-02) column 1, lines 33-35 column 2, lines 27-29 column 3, lines 37,38 column 3, lines 40,41 | 35 1-34,37, 38 |
| Y | column 3, lines 49-60 ----- -/-- | 36 |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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 document 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 | Date of mailing of the international search report | |
| 11 April 2006 | 25/04/2006 | |
| 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 | Authorized officer Dogueri, A. K. | |

INTERNATIONAL SEARCH REPORT

PCT/GB2005/004243

| C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT | | |
|--|---|---|
| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| X | GB 2 190 186 A (DR JEREMY KENNETH ARTHUR * EVERARD; * NATIONAL RESEARCH DEVELOPMENT CO) 11 November 1987 (1987-11-11) | 1-4, 6, 14, 18-21, 23, 31, 37, 38 |
| Y | page 1, line 5 page 1, lines 11-13 page 1, lines 16-19 page 1, lines 48-50 page 2, lines 1-3 figures 1,4 | 15, 32 |
| X | ----- PATENT ABSTRACTS OF JAPAN vol. 007, no. 249 (P-234), 5 November 1983 (1983-11-05) -& JP 58 132674 A (NIPPON DENSHIN DENWA KOSHA; others: 01), 8 August 1983 (1983-08-08) abstract; figure 4 | 1-4, 18-21 |
| Y | ----- HEALEY, P.: "Review of Long Wavelength Single-Mode Optical Fiber Reflectometry Techniques" JOURNAL OF LIGHTWAVE TECHNOLOGY, vol. LT-3, no. 4, August 1985 (1985-08), pages 876-886, XP002376590 page 881, left-hand column, line 19 - page 882, left-hand column, line 22 | 36 |
| Y | ----- EP 0 685 722 A (CSELT CENTRO STUDI E LABORATORI TELECOMUNICAZIONI S.P.A.) 6 December 1995 (1995-12-06) abstract | 15, 32 |
| | ----- | |

INTERNATIONAL SEARCH REPORT

Information on patent family members

PCT/GB2005/004243

| Patent document cited in search report | | Publication date | Patent family member(s) | Publication date |
|---|---|---------------------|--|--|
| GB 2212651 | A | 26-07-1989 | NONE | |
| US 4960989 | A | 02-10-1990 | NONE | |
| GB 2190186 | A | 11-11-1987 | WO 8707014 A2 | 19-11-1987 |
| JP 58132674 | A | 08-08-1983 | JP 1799869 C JP 5009750 B | 12-11-1993 05-02-1993 |
| EP 0685722 | A | 06-12-1995 | CA 2150418 A1 IT 1266016 B1 JP 7325015 A | 01-12-1995 16-12-1996 12-12-1995 |