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Declaration under Rule 4.17:

— of inventorship (Rule 4.17(iv))

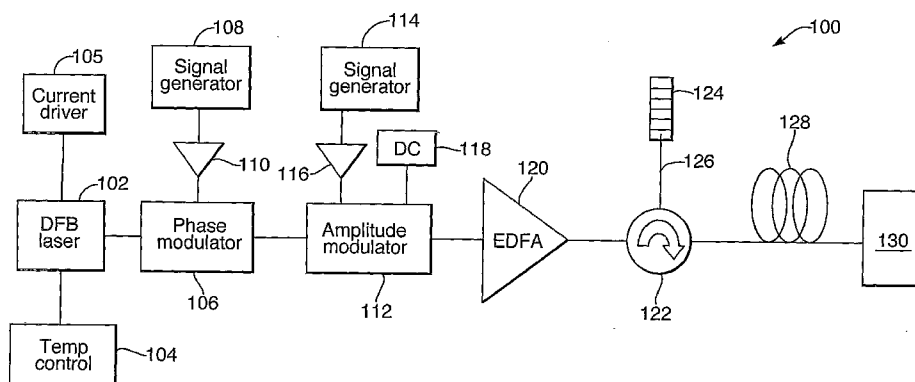
Published:

— with international search report

— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

[Continued on next page]

(54) Title: OPTICAL CLOCK



(57) Abstract: An optical clock (100) comprises a laser oscillator (102) and modulating means (106, 108, 110, 112, 114, 116, 118, 112) arranged to cooperate with the laser oscillator to produce a series of phase-modulated optical pulses. The optical clock further comprises an optical fibre (128) arranged to provide compression of the optical pulses, and may also comprise a step-recovery diode (130) arranged to pulse-pick pulses output from the fibre to produce a series of optical clock pulses, depending on the mode of operation of the modulating means. Phase-modulation is carried out a frequency which provides sufficient linewidth broadening to inhibit stimulated Brillouin scattering within the optical fibre. An optical clock of the invention provides a robust and reliable alternative to clocks based on modelocked lasers, and may be assembled from inexpensive, commonly-available components. The repetition rate of a clock of the invention may easily be adjusted by electronic means. Unlike many modelocked lasers, a clock of the invention does not require precise optical alignment.

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INTERNATIONAL SEARCH REPORT

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| <b>A. CLASSIFICATION OF SUBJECT MATTER</b><br>INV. H01S3/10 H04B10/18 H04L7/00<br>ADD. H01S3/00 H01S3/067 H01S3/16 H01S3/23                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                |                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                |                                                                      |
| <b>B. FIELDS SEARCHED</b><br>Minimum documentation searched (classification system followed by classification symbols)<br>H01S H04B H04L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                |                                                                      |
| 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)<br>EPO-Internal, WPI Data, INSPEC, COMPENDEX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                |                                                                      |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                |                                                                      |
| Category*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Citation of document, with indication, where appropriate, of the relevant passages                                                                             | Relevant to claim No.                                                |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | EP 0 504 834 A (NIPPON ELECTRIC CO [JP])<br>23 September 1992 (1992-09-23)                                                                                     | 1,2,4-6,<br>9-12,14,<br>15,17,<br>18,21                              |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | page 4, lines 22-56; figure 1<br><br>page 5, lines 26,27                                                                                                       | 3,7,8,<br>13,16,<br>19,20                                            |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | US 2004/240037 A1 (HARTER DONALD J [US])<br>2 December 2004 (2004-12-02)<br><br>paragraphs [0035], [0038], [0041],<br>[0042]; figures 2,3<br><br>-----<br>-/-- | 1,2,4,5,<br>9-15,17,<br>21                                           |
| <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 :<br>*A* document defining the general state of the art which is not considered to be of particular relevance<br>*E* earlier document but published on or after the international filing date<br>*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)<br>*O* document referring to an oral disclosure, use, exhibition or other means<br>*P* document published prior to the international filing date but later than the priority date claimed<br>*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<br>*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<br>*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.<br>*&* document member of the same patent family |                                                                                                                                                                |                                                                      |
| Date of the actual completion of the international search<br><br>22 February 2008                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                | Date of mailing of the international search report<br><br>03/03/2008 |
| Name and mailing address of the ISA/<br>European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,<br>Fax: (+31-70) 340-3016                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                | Authorized officer<br><br>Marani, Roberta                            |

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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.       |
| Y                                                    | EP 0 595 536 A (AMERICAN TELEPHONE & TELEGRAPH [US] AT & T CORP [US])<br>4 May 1994 (1994-05-04)<br>abstract; figure 1<br>----- | 1,2,4,5,<br>9-15,17,<br>21  |
| Y                                                    | US 2005/036525 A1 (LIU JIAN [US])<br>17 February 2005 (2005-02-17)                                                              | 13                          |
| A                                                    | paragraph [0048]; figure 9<br>-----                                                                                             | 1,14                        |
| Y                                                    | US 2005/265407 A1 (BRAUN ALAN M [US] ET AL)<br>1 December 2005 (2005-12-01)                                                     | 8,20                        |
| A                                                    | abstract; figure 1<br>-----                                                                                                     | 1,14                        |
| Y                                                    | EP 0 503 579 A (GEN INSTRUMENT CORP [US])<br>16 September 1992 (1992-09-16)                                                     | 3,7,16,<br>19               |
| A                                                    | column 8, line 40 - column 9, line 8;<br>figures 2,3<br>-----                                                                   | 1,2,4,5,<br>12,15,<br>17,21 |
| X                                                    | US 5 930 024 A (ATLAS DOGAN [US])<br>27 July 1999 (1999-07-27)<br><br>the whole document<br>-----                               | 1-5,<br>9-12,<br>14-17,21   |

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 22,23

Rule 6.2(a) PCT:

The subject-matter of claim 22 is unclear, because the technical features of claim 22 are defined by references to the drawings, making it impossible to determine the scope of the claim.

The subject-matter of claim 23 is unclear, because the technical features of claim 23 are defined by reference to the application as a whole.

Thus, an opinion with regard to novelty, inventive step and industrial applicability was not established for these claims. According to Rule 6.2(a) PCT, claims should not rely on such references except where absolutely necessary, which is not the case here.

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 Guideline C-VI, 8.2), should the problems which led to the Article 17(2)PCT declaration be overcome.

# INTERNATIONAL SEARCH REPORT

International application No.  
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## 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.: 22, 23  
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:

1.  As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable 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.

## INTERNATIONAL SEARCH REPORT

International application No  
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| Patent document cited in search report |            | Publication date | Patent family member(s) | Publication date |
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