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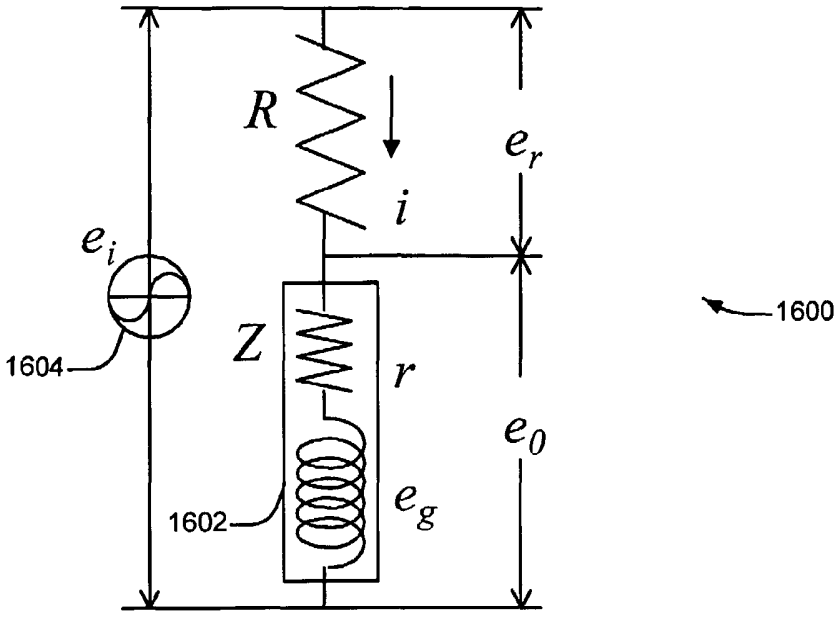
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*[Continued on next page]*

(54) Title: IMPROVED GEOPHONE CALIBRATION TECHNIQUE




(57) Abstract: Various techniques are described which may be used to facilitate and improve seismic exploration activities. For example, one aspect of the present invention is directed to a technique for enabling in-situ measurement of geophone response parameters. Another aspect of the present invention is directed to a technique for improving geophone calibration and for improving the accuracy of measurement of geophone response parameters. Yet another aspect of the present invention is directed to a technique for compensating geophone response output data in order to improve the accuracy of such data.

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# INTERNATIONAL SEARCH REPORT

Interna application No
PCT/IB2005/002597

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01V13/00

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)
G01V

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, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X,P | FRANK VAN KANN, JOHN WINTERFLOOD: "Simple method for absolute calibration of geophones, seismometers and other inertial vibration sensors" REVIEW OF SCIENTIFIC INSTRUMENTS 76, 034501, 22 February 2005 (2005-02-22), pages 034501-1-034501-8, XP009058515 American Institute of Physics pages 034501-1, right-hand column, lines 1-5 pages 034501-4, left-hand column, paragraph V - pages 034501-5, right-hand column, paragraph VI table II pages 034501-6, left-hand column, paragraph VII - pages 034501-7, right-hand column, paragraph IX figure 10 | 1-12, 40-48,73 |

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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 document 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

"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 |
|---|---|
| 8 December 2005 | 28. 03. 2006 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| 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 | Schneiderbauer, K |

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

# INTERNATIONAL SEARCH REPORT

Intern: application No
PCT/IB2005/002597

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
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| X | LIN JIN: "A reciprocity method for calibrating electro-mechanical transducers" ACTA SEISMOLOGICA SINICA, vol. 2, no. 4, November 1980 (1980-11), pages 447-452, XP001207986 China abstract | 1,4,7,73 |
| A | WO 00/55652 A (INPUT/OUTPUT, INC; RAGAN, GLEN; WILSON, DAVID; GANNON, JEFFREY, C; PHA) 21 September 2000 (2000-09-21) page 1, line 5 - line 7 page 29, paragraph 10.1-10.1.3 | 1-12, 40-48,73 |
| A | US 6 353 577 B1 (ORBAN JACQUES JOSEPH HENRI ET AL) 5 March 2002 (2002-03-05) column 2, line 7 - line 10 column 3, line 41 - line 49 | 1-12, 40-48,73 |
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| A | LIU H-P ET AL: "EFFECT OF CABLE CAPACITANCE ON IN-SITU BOREHOLE GEOPHONE CALIBRATION" January 1998 (1998-01), GEOPHYSICS, SOCIETY OF EXPLORATION GEOPHYSICISTS, TULSA, OK, US, PAGE(S) 18-24 , XP000750543 ISSN: 0016-8033 the whole document | 1-12, 40-48,73 |

# INTERNATIONAL SEARCH REPORT

Int nal application No.
PCT/IB2005/002597

## Box 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 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 fee, this Authority did not invite payment of any additional fee.

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.:

see Annex

**Remark on Protest**

☐ The additional search fees were accompanied by the applicant's protest.

☐ 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: 1-12,40-48,73

method of (system means for):
- performing a calibration test on the geophone
- determining a moving mass parameter

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2. claims: 13-23,49-58,74

method of (system means for):
- determining a second transfer function for an ideal response
- modifying the geophone response of the first geophone using the second transfer function

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3. claims: 24-39,59-72,75

mthod of (system means for):
- second portion of the seismic exploration information which includes source signal information
- determining a first portion of response parameter values associated with a first geophone
- modifying a portion of the seismic exploration information

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Interr application No
PCT/IB2005/002597

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