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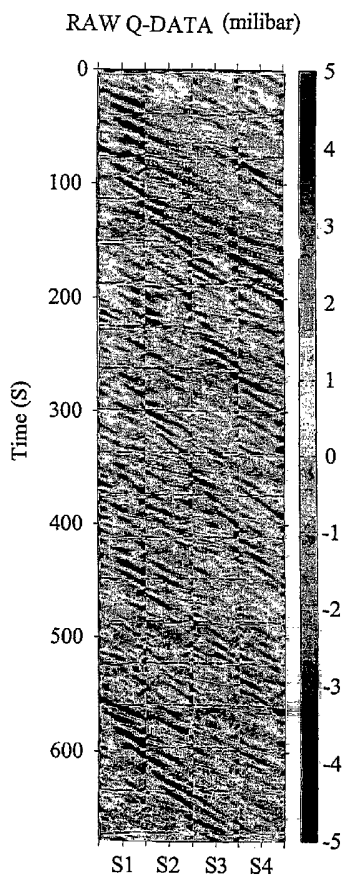
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[Continued on next page]

(54) Title: DETERMINATION OF THE HEIGHT OF THE SURFACE OF A FLUID COLUMN



(57) Abstract: The invention concerns a method for reducing the effect of a rough sea ghost reflection in marine seismic data. According to the invention, the method comprises the steps of: providing one or a plurality of pressure sensors sensitive to frequencies below about 1Hz; - using said sensor(s) to receive and acquire pressure data in a frequency band comprised between about 0.03 and about 1Hz; - recording said data; and - processing said data to provide information about the sea-height above the or each sensor. The or each sensor may be a seismic sensor that can acquire seismic data substantially simultaneously with the acquisition of the pressure data in a frequency band between about 0.03 and about 1Hz.



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INTERNATIONAL SEARCH REPORT

International Application No  
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**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 G01V1/38 G01V1/36 G01V1/20

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)  
IPC 7 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	US 4 951 264 A (YAMAMOTO TOKUO) 21 August 1990 (1990-08-21) abstract; figures 1,2,6,25	1,2, 17-21 3,7
Y	column 4, line 31 - column 5, line 32 column 6, line 50 - line 55 column 16, line 48 - line 63 -----	
Y	US 4 870 625 A (YOUNG DEWEY R ET AL) 26 September 1989 (1989-09-26) abstract; figures 3-6,8 -----	3,7
A	US 5 747 754 A (BUGTEN BJARNE ET AL) 5 May 1998 (1998-05-05) abstract; figures 1-3 -----	3,7

Further documents are listed in the continuation of box C.  Patent family members are listed in 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: 7 February 2003  
 Date of mailing of the international search report: 14.04.03

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: De Bekker, R

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB 02/04244

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 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 II Observations where unity of invention is lacking (Continuation of item 2 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.:

1,2,3,7,17-21

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: 1,2,3,7,17-21

method or system for determining wave activity by means of providing sensors for sensing pressure waves at frequencies below 1 Hz, acquiring pressure data between 0.03Hz and 1Hz and obtaining information about the height of the surface, characterised in that the sensor is comprised in an instrument cable.

2. Claims: 4,5,6

method or system for determining wave activity by means of providing sensors for sensing pressure waves at frequencies below 1 Hz, acquiring pressure data between 0.03Hz and 1Hz and obtaining information about the height of the surface, characterised in that the pressure sensor is a seismic sensor.

3. Claim : 8

method or system for determining wave activity by means of providing sensors for sensing pressure waves at frequencies below 1 Hz, acquiring pressure data between 0.03Hz and 1Hz and obtaining information about the height of the surface, characterised by the sensor being associated with a seismic source.

4. Claim : 9

method or system for determining wave activity by means of providing sensors for sensing pressure waves at frequencies below 1 Hz, acquiring pressure data between 0.03Hz and 1Hz and obtaining information about the height of the surface, characterised in that the movement of each sensor is detected to be taken into account for adjusting the acquired pressure data.

5. Claims: 10,11

method or system for determining wave activity by means of providing sensors for sensing pressure waves at frequencies below 1 Hz, acquiring pressure data between 0.03Hz and 1Hz and obtaining information about the height of the surface, characterised by correction filtering to compensate for the interference of the surface waves with each other.

6. Claim : 12

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

method or system for determining wave activity by means of providing sensors for sensing pressure waves at frequencies below 1 Hz, acquiring pressure data between 0.03Hz and 1Hz and obtaining information about the height of the surface, characterised by the generation of a profile of the sea surface.

7. Claims: 13-16,22-27

method and arrangement for processing seismic data wherein wave activity is determined by means of providing sensors for sensing pressure waves at frequencies below 1 Hz, acquiring pressure data between 0.03Hz and 1Hz and obtaining information about the height of the surface, characterised by the attenuating the effects of a rough sea ghost reflection in the seismic data based on said information about the height of the surface of the fluid column above each sensor.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 02/04244

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