

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
5 December 2002 (05.12.2002)

PCT

(10) International Publication Number
WO 02/097472 A3

(51) International Patent Classification⁷: **G01V 1/28**, 1/38

(21) International Application Number: PCT/US02/16196

(22) International Filing Date: 22 May 2002 (22.05.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/293,716 25 May 2001 (25.05.2001) US

(71) Applicant: **EXXONMOBIL UPSTREAM RESEARCH COMPANY** [US/US]; P.O. Box 2189, Houston, TX 77252-2189 (US).

(72) Inventor: **DUREN, Richard, E.**; 10 Claridge Court, Conroe, TX 77304 (US).

(74) Agents: **BELL, Keith, A.** et al.; ExxonMobil Upstream Research Company, P.O. Box 2189, Houston, TX 77252-2189 (US).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW.

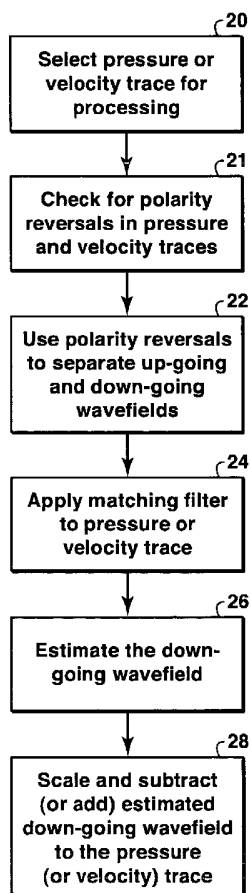
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for all designations*

[Continued on next page]

(54) Title: MULTIPLE SUPPRESSION FOR OCEAN BOTTOM SEISMIC DATA



(57) Abstract: The invention is a method for removing trapped water bottom multiples (figure 2, item 19), receiver side peg-leg multiples (13), and source side peg-leg multiples (15) from dual sensor (figure 1, item 6), OBC (7) data, where the data includes both pressure signals and velocity signals. The pressure and velocity signals are compared to determine any polarity reversals between them (figure 3, item 21). Polarity reversals are used to identify and separate up-going and down-going wavefields in the pressure and velocity signals (22). A matching filter is applied to a portion of the velocity signal where polarity reversals exist (24). The down-going wavefield is then estimated by calculating the difference between the portion of the velocity signal where polarity reversals exist and the portion of the pressure signal where polarity reversals exist and applying a scaling factor to the result (26). An attenuated up-going pressure wavefield is then determined by combining the estimated down-going wavefield and the pressure signal (28).

WO 02/097472 A3



— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations*

Published:

— *with international search report*

(88) Date of publication of the international search report:
24 December 2003

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.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US02/16196

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G01V 1/28, 1/38

US CL : 367/22, 24, 26; 181/112; 702/13, 14

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)

U.S. : 367/22, 24, 26; 181/112; 702/13, 14

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)
USPAT, EPO, JPO, DERWENT, TULSA**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,621,700 A (MOLDOVEANU) 15 APRIL 1997, COLUMNS 2, LINES 5-40	1, 18
Y	US 4,486,865 A (RUEHLE) 4 DECEMBER 1984, COLUMN 2, LINE 25 THROUGH COLUMN 3, LINE 16.	1, 18
A	US 4,752,916 A (LOWENTHL) 21 JUNE 1988, COLUMN 23, LINES 3-36	1-34
A	US 5,365,492 A (DRAGONET) 15 NOVEMBER 1994, ABSTRACT	1-34
A	US 5,999,488 A (SMITH) ABSTRACT	1-34
A	DUREN ET AL. REMOVAL OF WATER BOTTOM MULTIPLES AND EG-LEG MULTIPLES VIA WAVEFIELD RECONSTRUCTION, 67TH ANNU SEG INT. MTG., PAGES 79-82, 11 NOVEMBER 1997	1-34
A	DOWNIE ET AL, INTERACTIVE ATTENUATION OF SEISMIC MULTIPLES IN THE RADIAL DAMAIN, 11TH ASEG ET AL GEOPHYSICS CONF., VOL. 26, NO. 2-3, PAGES 486-492, 6 SEPTEMBER 1995	1-34



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 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

05 August 2002 (05.08.2002)

Date of mailing of the international search report

09 MAY 2003

Name and mailing address of the ISA/US

Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703)305-3230

Authorized officer

NELSON MOSKOWITZ

Telephone No. 703-306-4177

INTERNATIONAL SEARCH REPORT

PCT/US02/16196

Continuation of Item 4 of the first sheet:

The title of the invention fails to comply with PCT Rule 4.3 as it is longer than 7 words. The new title is "Multiple Suppression For Ocean Bottom Seismic Data".