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

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

Published:

— *with international search report (Art. 21(3))*

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14 February 2013

(54) Title: APPARATUS AND METHOD FOR DETERMINING INCLINATION AND ORIENTATION OF A DOWNHOLE TOOL USING PRESSURE MEASUREMENTS

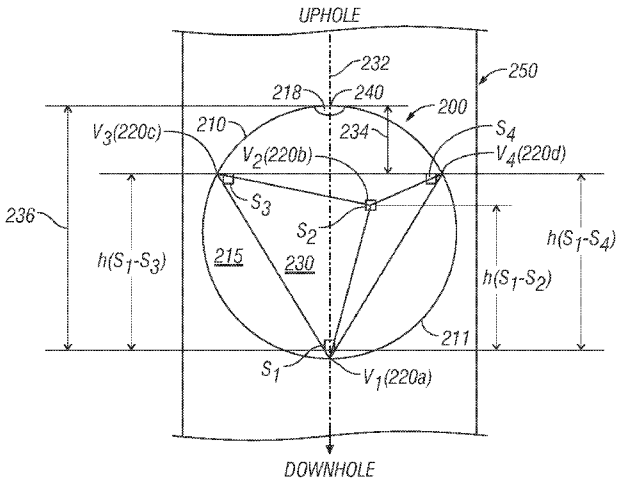

FIG. 2

(57) Abstract: In one aspect, a method of estimating one of inclination and orientation of a downhole device is provided that includes the features of taking pressure measurements at a plurality of locations on the downhole device in the wellbore, wherein at least one location in the plurality of locations is vertically displaced from at least one other location, and estimating the one of the inclination and orientation of the downhole device from the plurality of pressure measurements. In another aspect, a downhole tool is disclosed that in one configuration includes a device for estimating inclination and/or orientation of the downhole tool that further includes a body containing a liquid therein and a plurality of pressure sensors arranged in the body configured to provide pressure measurements of the liquid in the body, wherein a pressure sensor in the plurality of pressure sensors is vertically disposed from at least one other sensor in the plurality of sensors.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

E21B 47/02(2006.01)i, E21B 47/06(2006.01)i

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)

E21B 47/02; G01C 9/06; G01V 1/46; G01V 3/00; G01C 9/18

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: downhole, inclination, orientation, pressure sensor and immersion depth

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5646611 A (DAILEY, PATRICK E. et al.) 08 July 1997 See column 5, line 40 - column 6, line 63 and figures 1 - 5.	1-18
A	JP 2000-065569 A (TOKAI RIKA CO., LTD.) 03 March 2000 See the abstract, paragraphs 0015 - 0018 and figures 1, 2.	1-18
A	JP 57-190211 A (RICOH CO., LTD.) 22 November 1982 See the whole document.	1-18
A	US 2008-0316860 A1 (MUYZERT, EVERHARD JOHAN et al.) 25 December 2008 See paragraphs 0050, 0051, 0083 and figures 2, 10.	1-18

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5646611 A	08.07.1997	None	
JP 2000-065569 A	03.03.2000	None	
JP 57-190211 A	22.11.1982	None	
US 2008-0316860 A1	25.12.2008	CA 2614038 A1	11.01.2007
		CN 101258423 A0	03.09.2008
		EA011736B1	28.04.2009
		EA200800256A1	28.04.2008
		GB 0513745 D0	10.08.2005
		GB 2428089 A	17.01.2007
		GB 2428089 B	05.11.2008
		WO 2007-003886 A1	11.01.2007