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Declarations under Rule 4.17:

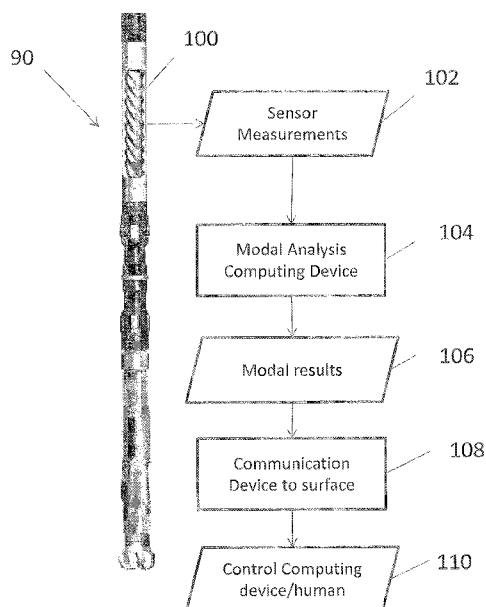
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

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- with international search report (Art. 21(3))

(54) Title: DOWNHOLE OPERATIONAL MODAL ANALYSIS

FIG. 2



(57) Abstract: A method for selecting drilling parameters for drilling a borehole penetrating the earth with a drill string. The method includes: measuring vibration-related amplitudes of the drill string during operation using one or more vibrations sensor to provide amplitude measurements; determining with a downhole processor one or more modal properties comprising one or more eigenfrequencies of the drill string using the amplitude measurements, the determination being made by including any excitation force in a white noise term of a model of the drillstring; and selecting drilling parameters that apply an excitation force at a frequency that avoids a selected range of frequencies that bound the one or more eigenfrequencies using the processor.



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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/024993**A. CLASSIFICATION OF SUBJECT MATTER****E21B 44/00(2006.01)i, E21B 41/00(2006.01)i, E21B 21/08(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 44/00; E21B 7/00; G06F 17/10; G06F 17/50; E21B 49/00; G01V 1/40; E21B 41/00; E21B 21/08

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: drilling parameters, vibration sensor, amplitude, excitation force, eigenfrequency

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2011-0077924 A1 (ERTAS et al.) 31 March 2011 See paragraphs [0002]-[0194] and figures 1-7.	1-16
Y	US 2015-0122547 A1 (HOHL et al.) 07 May 2015 See paragraphs [0001]-[0035] and figures 1-7.	1-16
A	WO 2014-186667 A1 (BAKER HUGHES INCORPORATED) 20 November 2014 See paragraphs [0002]-[0030] and figures 1-4, 5A-5C.	1-16
A	US 2012-0130693 A1 (ERTAS et al.) 24 May 2012 See paragraphs [0002]-[0252] and figures 1-9, 10A-10C.	1-16
A	US 2015-0083492 A1 (WASSELL, MARK ELLSWORTH) 26 March 2015 See paragraphs [0001]-[0112] and figures 1, 2A-2B, 3A-3B, 4-9.	1-16

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

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"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

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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 2011-0077924 A1	31/03/2011	AU 2009-260477 A1 AU 2009-260477 B2 BR PI0913218 A2 CA 2724453 A1 CA 2724453 C EA 018946 B1 EA 201170037 A1 EP 2291792 A1 EP 2291792 A4 US 8589136 B2 WO 2009-155062 A1	23/12/2009 17/07/2014 19/01/2016 23/12/2009 12/08/2014 29/11/2013 30/08/2011 09/03/2011 10/02/2016 19/11/2013 23/12/2009
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