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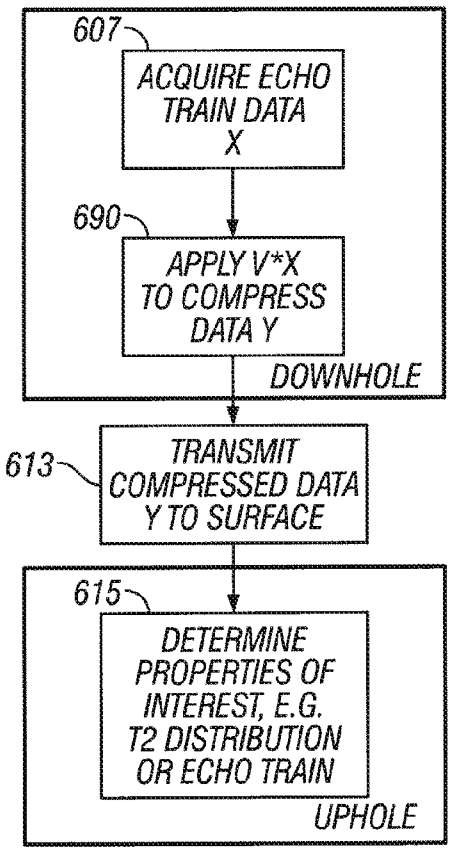
[Continued on next page]

(54) Title: JOINT COMPRESSION OF MULTIPLE ECHO TRAINS USING PRINCIPAL COMPONENT ANALYSIS AND INDEPENDENT COMPONENT ANALYSIS



F I G . 6

(57) Abstract: NMR spin echo signals are acquired downhole. Principal Component Analysis is used to represent the signals by a weighted combination of the principal components and these weights are telemetered to the surface. At the surface, the NMR spin echo signals are recovered and inverted to give formation properties.

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EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

G01V 3/14(2006.01)i, E21B 47/00(2006.01)i, G01N 24/08(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)

IPC G01V

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 since 1975

Japanese utility models and applications for utility models since 1975

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

eKOMPASS(KIPO internal)

Keywords: earth formation, NMR, eigenfunction, sensing

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 06859032 B2 (NICHOLAS J. HEATON et al.) 22 February 2005 See abstract, all claims, and all figs	1-18
A	US 06181132 B1 (DOUWE JOHANNES RUNIA) 30 January 2001 See abstract, all claims, and all figs	1-18
A	US 06040696 A (TERIZHANDUR S. RAMAKRISHNAN et al.) 21 March 2000 See abstract and all claims	1-18
A	JP 2545484 B2 (SCHLUMBERGER OVERSEAS SA) 16 October 1996 See all claims and all figs	1-18

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

☒ See patent family annex.

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"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
30 JULY 2009 (30.07.2009)	**30 JULY 2009 (30.07.2009)**

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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 06859032 B2	22.02.2005	CA 2411089 A1	18.06.2003
		CA 2411089 C	06.01.2009
		GB 2386953 A	01.10.2003
		US 2003-0128032 A1	10.07.2003
US 06181132 B1	30.01.2001	AU 1999-62002 A1	29.09.1999
		AU 1999-62002 B2	29.09.1999
		AU 752386 B2	19.09.2002
		CN 1321251 A0	07.11.2001
		CN 1321251 A	07.11.2001
		CN 1149405 C	12.05.2004
		JP 2002-526784 A	20.08.2002
US 06040696 A	21.03.2000	NONE	
JP 2545484 B2	16.10.1996	JP 04024588 A	28.01.1992