

(43) International Publication Date
22 December 2011 (22.12.2011)(10) International Publication Number
WO 2011/159294 A1(51) International Patent Classification:
G01V 3/00 (2006.01)(21) International Application Number:
PCT/US2010/038844(22) International Filing Date:
16 June 2010 (16.06.2010)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant (for all designated States except US): **HAL-LIBURTON ENERGY SERVICES, INC.** [US/US]; 10200 Bellaire Boulevard, Houston, TX 77072 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **MORYS, Marian, L.** [US/US]; 835 Tremont Drive, Downingtown, PA 19335 (US). **KNIZHNIK, Sergei** [US/US]; 92 Heritage Lane, Exton, PA 19341 (US). **JACHMANN, Rebecca, C.** [US/US]; 102 Plaza Dr., Apt 2, Downingtown, PA 19335 (US). **EPSTEIN, Robert** [US/US]; 464 Creekside Drive, Downingtown, PA 19335 (US).(74) Agents: **KRUEGER, Daniel, J.** et al.; Krueger Iselin LLP, P.O. Box 1906, Cypress, TX 77410-1906 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, 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, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

Published:

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

(54) Title: NUCLEAR MAGNETIC RESONANCE LOGGING TOOL HAVING AN ARRAY OF ANTENNAS

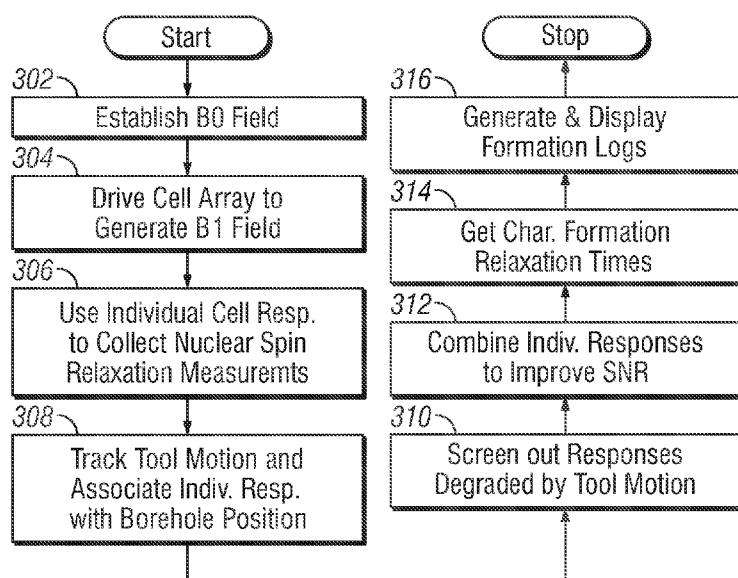


FIG. 13

(57) Abstract: Various disclosed nuclear magnetic resonance (NMR) logging systems and methods employ an array of antennas to provide increased resolution without sacrificing signal-to-noise ratio. Certain method embodiments include: establishing a static magnetic field (B0) with a tool moving along a borehole through a formation; concurrently driving a multiple antenna cells to produce a radio frequency field (B1) in said formation; measuring an individual response from each antenna cell as nuclear spins undergo precession in the formation; and determining at least one characteristic relaxation time of the formation based at least in part on the individual response. The individual responses can be associated with positions where the individual responses were measured, and the relaxation time can be determined from a combination of those responses associated with a given position. Certain responses may be excluded due to tool motion that degrades the measured response.