



(51) International Patent Classification:
E21B 7/14 (2006.01)

(21) International Application Number:
PCT/US2010/061047

(22) International Filing Date:
17 December 2010 (17.12.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
12/688,058 15 January 2010 (15.01.2010) US
12/965,859 11 December 2010 (11.12.2010) US

(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): **WRIGHT, Adam** [US/US]; 2601 Beltline Road, Carrollton, TX 75006 (US). **FRIPP, Michael, L.** [US/US]; 2601 Beltline Road,

Carrollton, TX 75006 (US). **KYLE, Donald, G.** [US/US]; 2601 Beltline Road, Carrollton, TX 75006 (US). **IRANI, Cyrus, A.** [US/US]; 3000 North Sam Houston Parkway East, Houston, TX 77032 (US).

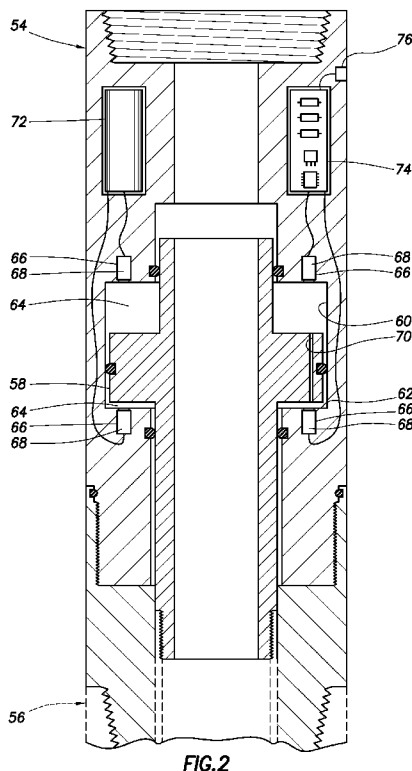
(74) Agent: **SMITH, Marlin, R.**; SMITH IP SERVICES, P.C., P.O. Box 997, Rockwall, TX 75087 (US).

(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, MZ, 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,

[Continued on next page]

(54) Title: WELL TOOLS OPERABLE VIA THERMAL EXPANSION RESULTING FROM REACTIVE MATERIALS



(57) Abstract: Methods of actuating a well tool can include releasing chemical energy from at least one portion of a reactive material, thermally expanding a substance in response to the released chemical energy, and applying pressure to a piston as a result of thermally expanding the substance, thereby actuating the well tool, with these steps being repeated for each of multiple actuations of the well tool. A well tool actuator can include a substance contained in a chamber, one or more portions of a reactive material from which chemical energy is released, and a piston to which pressure is applied due to thermal expansion of the substance in response to each release of chemical energy. A well tool actuator which can be actuated multiple times may include multiple portions of a gas generating reactive material, and a piston to which pressure is applied due to generation of the gas.



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, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

Declarations under Rule 4.17:

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