(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
20 March 2014 (20.03.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/043033 A1

(51) International Patent Classification:
E21B 17/043 (2006.01) *E21B 34/14* (2006.01)

(21) International Application Number:
PCT/US2013/058767

(22) International Filing Date:
9 September 2013 (09.09.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
13/618,406 14 September 2012 (14.09.2012) US

(71) Applicant: **BAKER HUGHES INCORPORATED** [US/US]; P.O. Box 4740, Houston, TX 77210 (US).

(72) Inventor: **DOANE, James, C.**; 1905 Stillwater Drive, Friendswood, TX 77546 (US).

(74) Agent: **CHANDLER, Kimberly, L.**; Baker Hughes Incorporated, Intellectual Property Counsel, P.o. Box 4740, Houston, TX 77210-4740 (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, BN, 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, 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, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, 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, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, 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, KM, ML, MR, NE, SN, TD, TG).

Published:

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

(54) Title: MULTI-PISTON HYDROSTATIC SETTING TOOL WITH LOCKING FEATURE AND PRESSURE BALANCED PISTONS

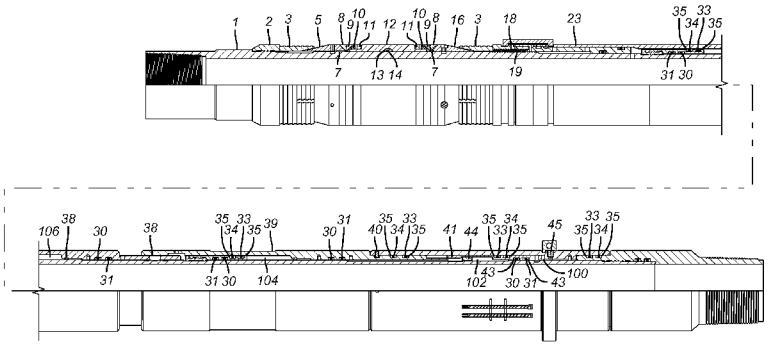

FIG. 1

(57) Abstract: [00023] A hydraulically actuated setting tool has a plurality of pistons that move in tandem when unlocked. The pistons are initially in pressure balance to take a load off a single locking mechanism that retains all the pistons. The pistons move due to admission of hydrostatic and/or applied pressure from the annulus on one side of each piston with an opposite side exposed to atmospheric pressure. The locking member is exposed to the annulus and is located away from any atmospheric chambers associated with the pistons. In this manner the components can be made thicker to resist burst and collapse pressure and the loads on the locking member reduced due to initial piston pressure balance configuration. Depths of greater than 8,000 meters can be used due to one or more of the described design features.

WO 2014/043033 A1

MULTI-PISTON HYDROSTATIC SETTING TOOL WITH LOCKING FEATURE AND PRESSURE BALANCED PISTONS

Inventor: James C. Doane

FIELD OF THE INVENTION

[0001] The field of the invention is hydrostatically operated actuators for subterranean tools and more particularly in very deep applications where space is limited and high burst and collapse resistance is required for locking and actuation components.

BACKGROUND OF THE INVENTION

[0002] Technology has evolved to allow the drilling of wells to depths approaching 8,000 meters. At those depths the tools that are deployed have to resist rupture or collapse forces that are orders of magnitude higher than the original depths for which such tools were designed. At the same time space restrictions in such applications do not allow for simply scaling up the dimensions of all components to resist the heightened burst and collapse loads that could be encountered. The new conditions dictate a new approach to the tool to meet the often conflicting parameters of higher pressure differentials and limited space. Individual components that in old designs see increased differential pressure stresses now need to be rethought as to shape and placement in the tool to make the tool function reliably in a new high depth environment. While the ultimate mission of a tool may be unchanged, such as using hydrostatic pressure with the addition of pressure from the surface into an annulus to set a tool such as a packer, the configuration of the tool has to change to handle the new parameters that come into play from ultra-deep deployments of such tools.

[0003] The present invention is illustrated using an example of an existing tool discussed below and shown in FIG. 1 with a redesigned tool for deep applications shown in FIG. 2a-2b. While the context for the illustration of the inventive concept is hydrostatically operated tool actuators, the scope of the invention will be understood by those skilled in the art to be found in the appended claims.

[0004] FIG. 1 shows a model SB-3H Hydrostatic Setting Tool/ Packer currently offered by Baker Hughes Incorporated of Houston, Texas. The

packer has slips **3** that move out radially by riding up on cones **5**, **16**. In between the cones **5**, **16** there is a seal assembly that is longitudinally compressed so that it extends radially in a well known manner. The seal assembly includes components **7** through **14** as illustrated in FIG. 1. A lock ring assembly **18**, **19** holds the set position that is not shown. A stop ring **2** acts as a backup to the assembly of shifting pistons **23** and **39**. When the pistons **23** and **39** are unlocked for movement toward the stop ring **2**, the packer is set in the known manner.

[0005] In order to actuate, pressure in the annulus either rises to a predetermined value with depth or is raised to a predetermined value from the surface to break rupture disc **45**. When that happens, the chamber between seals **33**, **34** and **35** on one side and seals **30**, **31** and **43** on the inside builds pressure on the piston **44** that initially traps the locking dog **41** to the mandrel **1**. Dog **41** extends through a window in piston **39** and into an aligned groove in the mandrel **1** so as to keep piston **39** from moving until a recess on release piston **44** aligns with dog **41** to allow dog **41** to come out radially so that the piston **39** is no longer locked. The pressure that enters the chamber between seals **33**, **34** and **35** on one side and seals **30**, **31** and **43** on the inside then propels the piston **44** against the piston **39** for tandem movement as shear pin **40** breaks. Note that the driving force for piston **44** is the annulus pressure entering chamber **100**, after the rupture disc **45** is broken, on one side and atmospheric pressure trapped in chamber **102** on the other side. Note also that the locking components for the piston **39** are in the atmospheric chamber **102**. Chamber **104** is also initially at atmospheric pressure so as to put piston **39** initially in pressure balance to annulus pressure and to the opposed atmospheric chambers **102** and **104** acting in opposing direction.

[0006] Initially, piston **39** overlays dogs **38** to prevent movement of piston **23**. Piston **23** is subjected to an unbalanced force with exposure to the annulus at its lower end near dogs **38** and exposure to atmospheric pressure from chamber **106** acting in opposition. Movement of piston **39** to liberate dogs **38** allows the unbalanced pressure on piston **23** to move uphole in tandem with piston **39** to set the packer in the manner described above.

[0007] While the above described design functioned well for moderate depth of about 5,000 meters the design incorporates features that at 8,000 meters or more would cause component failure making the device inoperable. One of the issues with the present design is the quantity of the net force that has to be retained by a lock assembly when any of the pistons is subjected to an unbalanced force before setting. The greater depths just magnify this force level causing the locking system to be more robust or to be subject to failure. However, the design also features not only a locking system for each piston but also location of at least a part of the locking system inside atmospheric chambers. At greater depths the differential pressures on atmospheric chambers are magnified forcing the components to be thicker walled structures to resist collapse or burst pressures. However, there is also the issue of lack of space in a borehole at depths of 8,000 meters and more that makes a locking system located in an atmospheric chamber problematic.

[0008] The present invention presents several unique and independent approaches to actuation tools triggered by hydrostatic or/and applied pressure in an annulus. One approach is to put multiple pistons in pressure balance to annulus pressure. Another is to move the locking mechanism from outside any atmospheric chamber. Yet another is to use a single locking mechanism for all the pistons and to reduce the loading on such a locking mechanism by using pressure balanced piston. The use of a single lock for all the pistons reduces component redundancy leaving space to make components thicker to handle the expected differential pressure loads at depths in excess of 8,000 meters. These and other features of the present invention will be more readily apparent from a review of the detailed description of the preferred embodiment and the associated drawings while recognizing that the full scope of the invention is to be found in the literal and equivalent scope of the appended claims.

SUMMARY OF THE INVENTION

[0009] A hydraulically actuated setting tool has a plurality of pistons that move in tandem when unlocked. The pistons are initially in pressure balance to take a load off a single locking mechanism that retains all the pistons. The pistons move due to admission of hydrostatic and/or applied pressure from the annulus on one side of each piston with an opposite side

exposed to atmospheric pressure. The locking member is exposed to the annulus and is located away from any atmospheric chambers associated with the pistons. In this manner the components can be made thicker to resist burst and collapse pressure and the loads on the locking member reduced due to initial piston pressure balance configuration. Depths of greater than 8,000 meters can be used due to one or more of the described design features.

BRIEF DESCRIPTION OF THE DRAWINGS

[00010] FIG. 1 is a section view of a known hydrostatic setting tool for a packer;

[00011] FIGS. 2a-2d are a section view of the tool of the present invention in the run in position;

[00012] FIGS. 3a-3d are the tool of FIGS. 2a-2d shown in the lock about to release position; and

[00013] FIGS. 4a-4d are the tool of FIGS. 2a-2d in the fully released position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[00014] Referring to FIGS 2a-2d, the tool **200** has a multi-component mandrel **202**, **204** and **206** with mandrel **202** supported by a running string that also supports a tool to be set such as a packer. These uphole devices are omitted to focus the drawings on the tool **200**, which is the focus of the present invention. A bottom sub **208** is connected to mandrel component **206** and can support other equipment or a tubular string which are also omitted. Collet housing **210** is secured at thread **212** to the bottom sub **208**. Collet fingers **214** extend from lower end **216** at collet housing **210** and further features heads **218** with external thread pattern **220** to engage a mating thread pattern **222** on piston **224**. Support piston **226** is initially fixed with one or more shear pins **228** for run in. Raised surface **230** initially supports the heads **218** so that the thread patterns **220** and **222** stay in engagement to prevent movement of piston **224**. Rupture disc **232** initially covers passage **234** that leads to chamber **236** defined by seal pairs **238** and **240**. When the rupture disc **232** is broken by hydrostatic pressure with or without added pressure from the surface, the raised pressure in chamber **236** pushes support piston **226** to the right so that thread patterns **220** and **222** can separate as the heads **218** become

unsupported. Movement of support piston **226** to the right breaks the shear pin or pins **228** and displaces floating piston **242** toward shoulder **244** while reducing the volume of chamber **246** that is initially at atmospheric pressure for the purpose of creating a pressure differential against support piston **226** when the rupture disc **232** breaks as does the shear pin or pins **228**.

[00015] Chamber **248** is initially at the same pressure as chamber **236** to put the piston **224** in pressure balance from these opposed chambers. Seal pair **250** is the same size as seal pair **240** to make this pressure balance feature take effect. The piston **224** is threaded at **252** to piston **254**. Seal **256** and seal pair **250** define a chamber 258 that is accessible to the annulus through open port **260**. Chamber **262** is initially isolated from port **260** due to the run in position of seal pair **264** and seals **256** and **266**. Comparing FIGS. 2b with FIGS. 3b and 4b it can be seen that movement of piston **254** exposes seal **256** to allow annulus pressure into chamber **262** so as to propel piston **254** against the resisting atmospheric pressure in chamber **268** defined between seal pairs **264** and **270**. Piston **254** is initially in pressure balance from opposed chambers **262** and **268**.

[00016] Piston **254** is attached to piston **272** at threads **274**. Chamber **276** is initially isolated from open ports **278** by seal pairs **280** and seals **282** and **284**. Chamber **276** is initially at the same pressure as chamber **286**. Chamber **286** is defined by seal pairs **288** and **280**. Chambers **276** and **286** maintain piston **272** in pressure balance until piston **272** moves to expose seal **282** which allows annulus pressure into chamber **276** from ports **278**. As this movement happens the volume of chamber **286** is reduced and its internal pressure rises to some extent.

[00017] Actuating sleeve **290** is secured to piston **272** at thread **292**. Movement of the sleeve **290** against a tool that is not shown in combination with mandrel **202** being held fixed such as with a running string also not shown is the relative movement that makes the unshown tool go to a set position.

[00018] The pistons **224**, **254** and **272** are secured together for tandem movement. They are in pressure balance as an assembly to annulus pressure because seal pairs **240** and **288** are the same size to present equal and opposite

piston areas on the joined pistons. Although three pistons are shown, other numbers of pistons can be used for greater or lesser actuating force as needed. Tying the pistons together allows the use of a singular lock such as the engaged threads **220** and **222** to retain all the pistons. The fact that the pistons are all in pressure balance also allows the use of a less beefy locking system. Locating the locking system in a place where there is exposure to the annulus pressure and outside the atmospheric or low pressure chambers such as **248** allows the ability to increase wall thicknesses of components that form such chambers such as the pistons or the underlying mandrel so that greater depths can be used for the setting tool **200** particularly when space restrictions present controlling design parameters.

[00019] While a locking mechanism of collet heads that become unsupported are illustrated in the preferred embodiment, other types of locking mechanisms are envisioned, such as dogs that are undermined or shear devices.

[00020] With the pistons in pressure balance during run in, the lock need only hold against contact friction of the pistons during run in because there is no net hydrostatic load during the trip to the desired location. The term "pressure balance" encompasses conditions of no net force in either direction up to and inclusive of a net force in one direction that is less than 5% of the force applied from either of the opposed chambers acting on a given piston. Thus the chamber pressures on opposed sides do not have to be the same. Alternatively, the pressures in the opposed chambers can be the same but the opposed piston areas can be different or both the chamber pressures and the piston areas can be different, all within the 5% either directional force from the opposed chambers.

[00021] The tool **200** can be a standalone setting tool or it can be integrated into the subterranean tool that it is setting and the term "setting tool" is intended to cover both configurations. Although the rupture disc **232** is shown oriented to the surrounding annulus it can alternatively be oriented to the passage within the mandrel **202**, **204** and **206** or the bottom sub **208**.

[00022] The above description is illustrative of the preferred embodiment and many modifications may be made by those skilled in the art without departing from the invention whose scope is to be determined from the literal and equivalent scope of the claims below:

I claim:

1. A hydrostatically actuated setting tool for a subterranean tool for operation at a subterranean location using hydrostatic pressure, comprising:

a mandrel;

a plurality of pistons disposed on said mandrel, said pistons formed to define a pair of opposed chambers adjacent each said piston that place each said piston initially in pressure balance;

at least one lock assembly selectively operated with hydrostatic pressure at the subterranean location to selectively release said pistons to move responsive to at least in part hydrostatic pressure in the subterranean location adjacent said mandrel to actuate the subterranean tool.

2. The setting tool of claim **1**, wherein:

said pistons are connected for tandem movement.

3. The setting tool of claim **1**, wherein:

said pistons are in initial pressure balance from hydrostatic pressure in an annulus about the setting tool.

4. The setting tool of claim **1**, wherein:

said at least one lock assembly comprises a single lock assembly located on said mandrel and outside said opposed chambers.

5. The setting tool of claim **1**, wherein:

at least one of each pair of opposed chambers selectively opened to hydrostatic pressure.

6. The setting tool of claim **5**, wherein:

an initial one of said pairs of opposed chambers is opened with hydrostatic pressure acting to open a port therein from the annulus.

7. The setting tool of claim **6**, wherein:

said port extends through one of said pistons.

8. The setting tool of claim **6**, wherein:

said port is opened with breaking of a frangible member located in said port.

9. The setting tool of claim **6**, wherein:

pressure in said opened port defeats said lock assembly.

10. The setting tool of claim **9**, wherein:

pressure in said opened port shifts a support sleeve away from a collet to allow a first of said pistons, now subjected to an unbalanced force with one chamber exposed to hydrostatic pressure from said port and an opposed chamber of the pair of opposed chambers at a lower pressure, to move.

11. The setting tool of claim **10**, wherein:

each said piston apart from said first piston has an associated port selectively opened to one of said pair of opposed chambers associated therewith;

all said associated ports being opened with initial movement of said first piston.

12. The setting tool of claim **10**, wherein:

said lock assembly initially pinned against movement by at least one shear pin that is sheared with movement of said support sleeve.

13. The setting tool of claim **1**, wherein:

movement of a first said piston unbalances the pressure on each of the remaining said pistons by opening one of said pair of opposed chambers associated with each said remaining pistons to pressure in the annulus.

14. The setting tool of claim **13**, wherein:

said pistons are attached for tandem movement.

15. The setting tool of claim **2**, wherein:

said pistons are in initial pressure balance from hydrostatic pressure in the annulus.

16. The setting tool of claim **15**, wherein:

said at least one lock assembly comprises a single lock assembly located on said mandrel and outside said opposed chambers.

17. The setting tool of claim **16**, wherein:

at least one of each pair of opposed chambers selectively opened to hydrostatic pressure.

18. The setting tool of claim **17**, wherein:

an initial one of said pairs of opposed chambers is opened with hydrostatic pressure acting to open a port therein from the annulus.

19. The setting tool of claim **1**, wherein:

said opposed chambers are configured to resist burst or collapse pressures with said mandrel disposed at depths greater than 8,000 meters.

20. The setting tool of claim **12**, wherein:

said opposed chambers are configured to resist burst or collapse pressures with said mandrel disposed at depths greater than 8,000 meters.

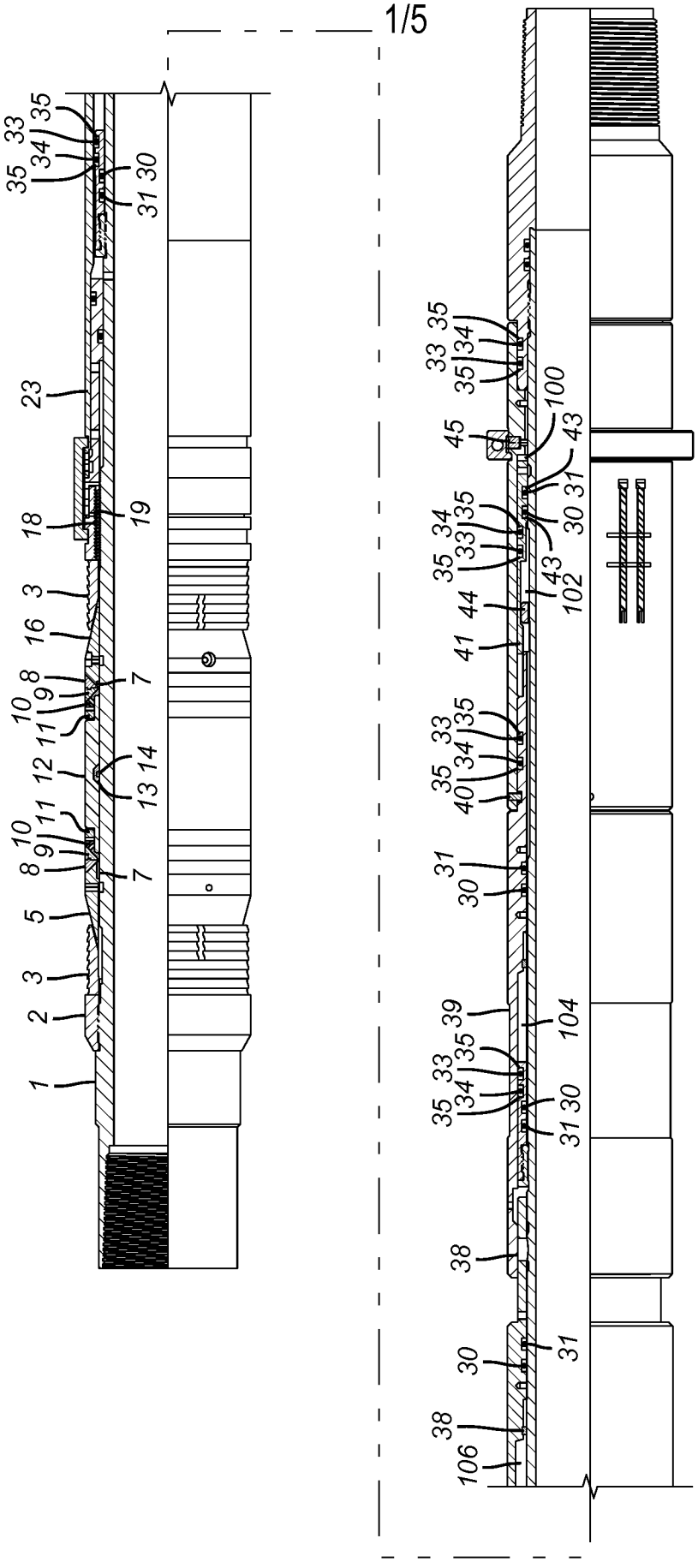
1
2
3
5
8
9
10
11
12
13
14
7
16
3
18
19
23
35
33
34
30
31
39
104
38
106
100
43
45
102
44
41
40

FIG. 1

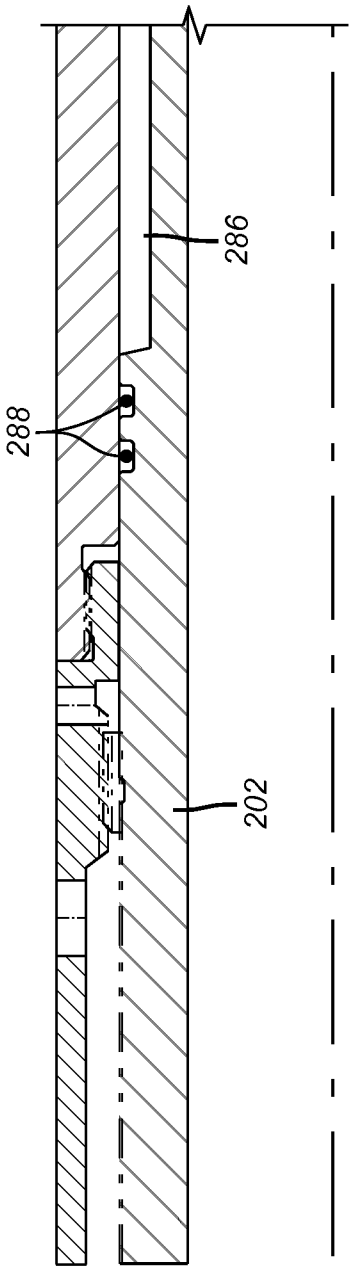

FIG. 2a

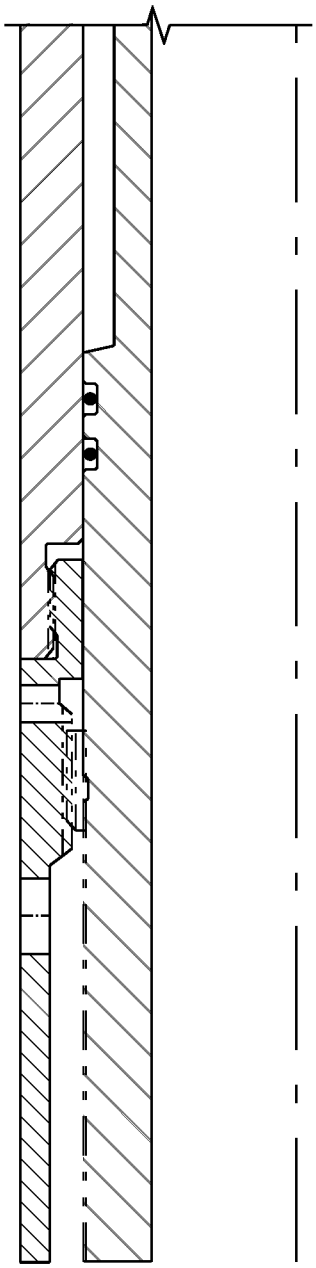

FIG. 3a

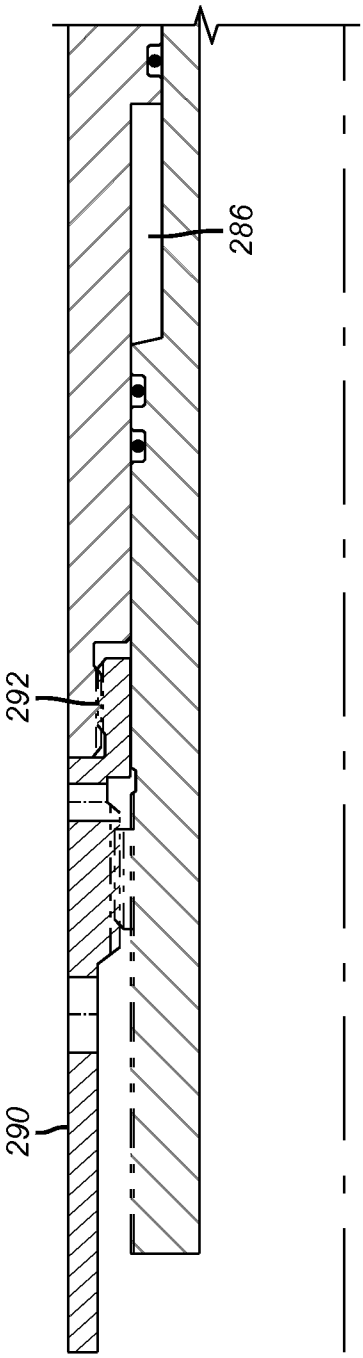

FIG. 4a

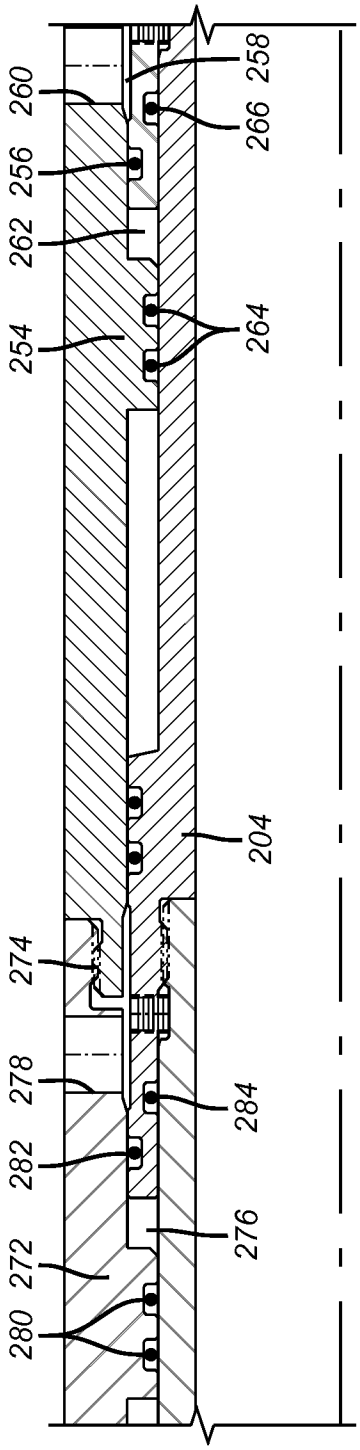

FIG. 2b

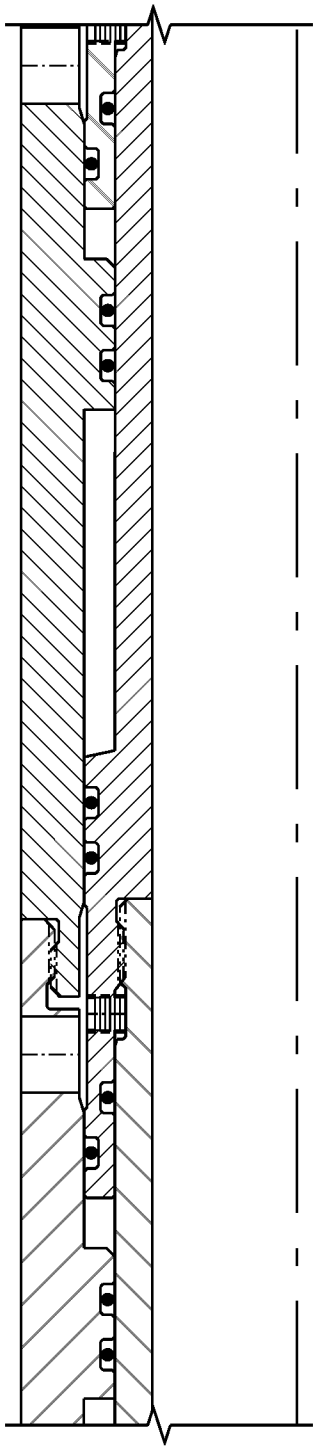

FIG. 3b

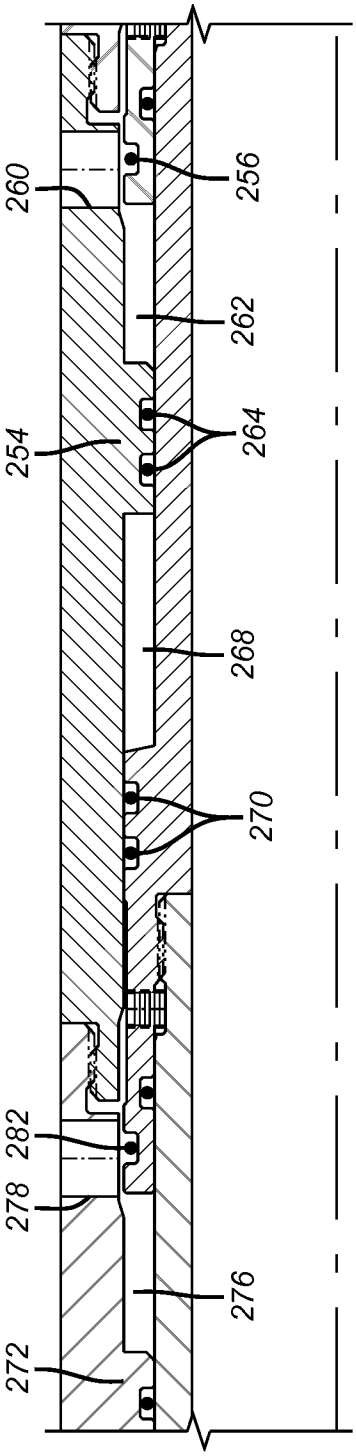

FIG. 4b

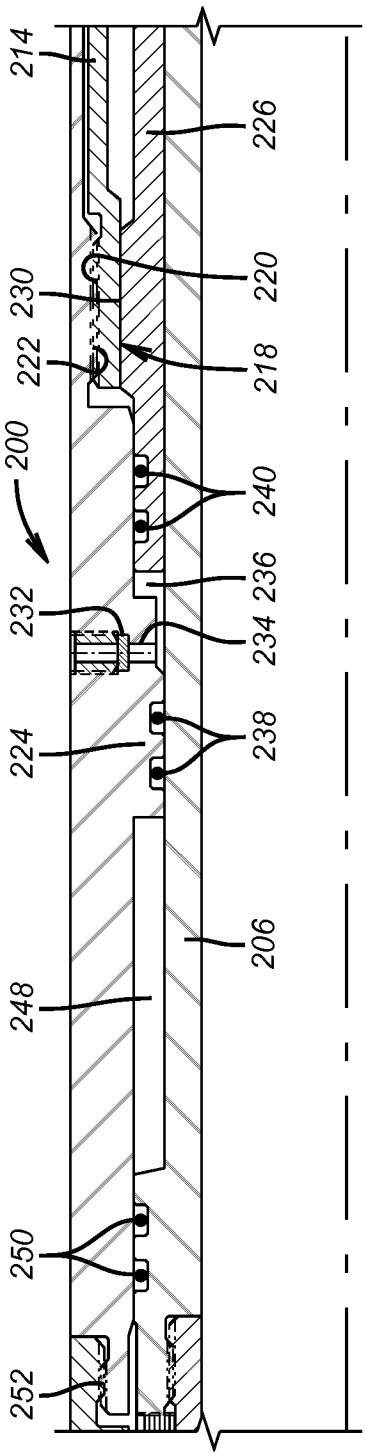

FIG. 2c

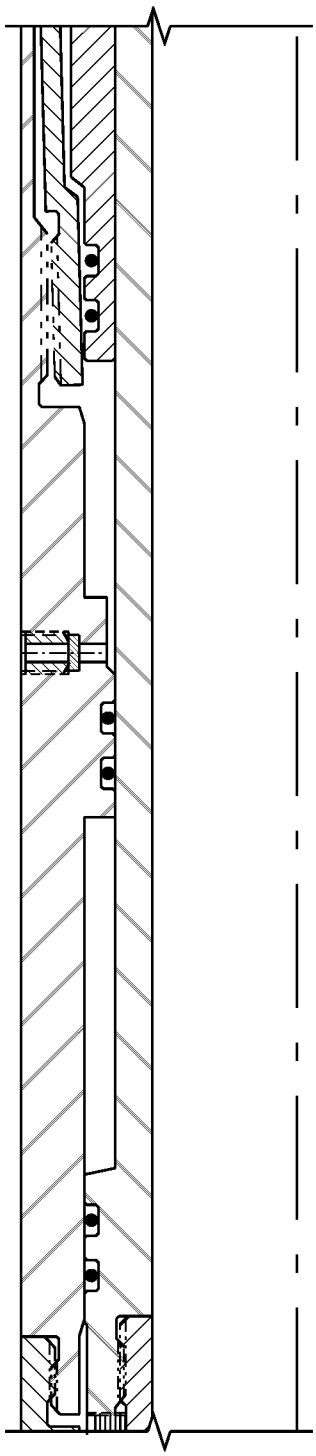

FIG. 3c

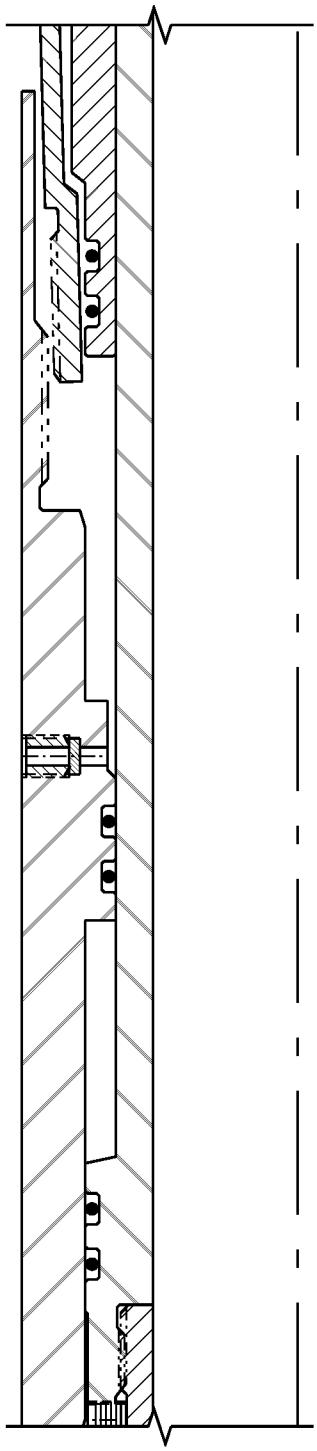

FIG. 4c

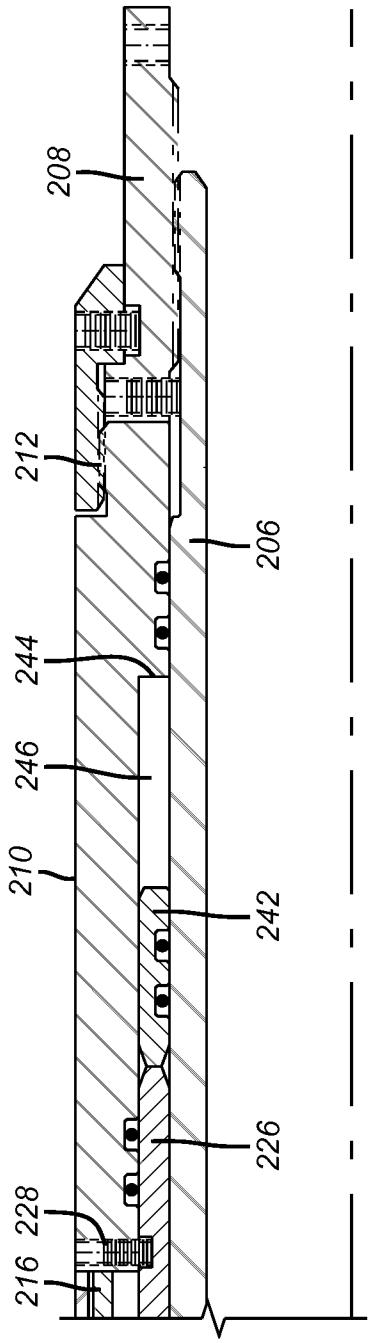

FIG. 2d

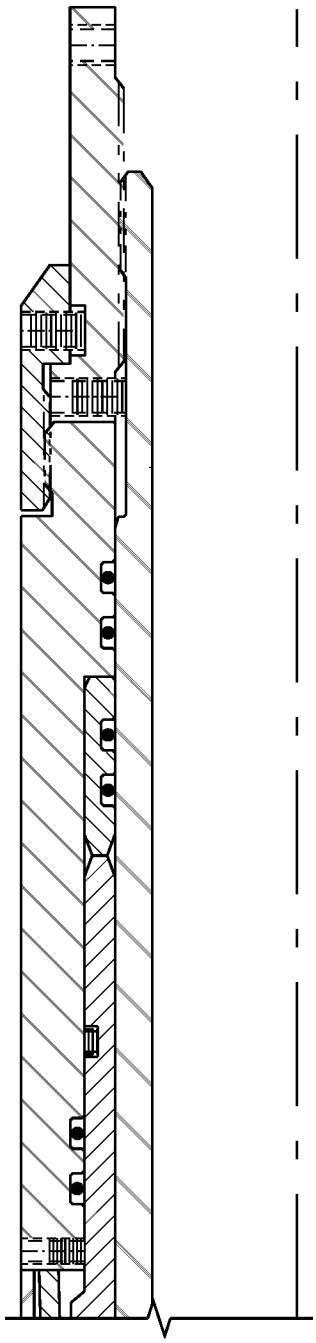

FIG. 3d

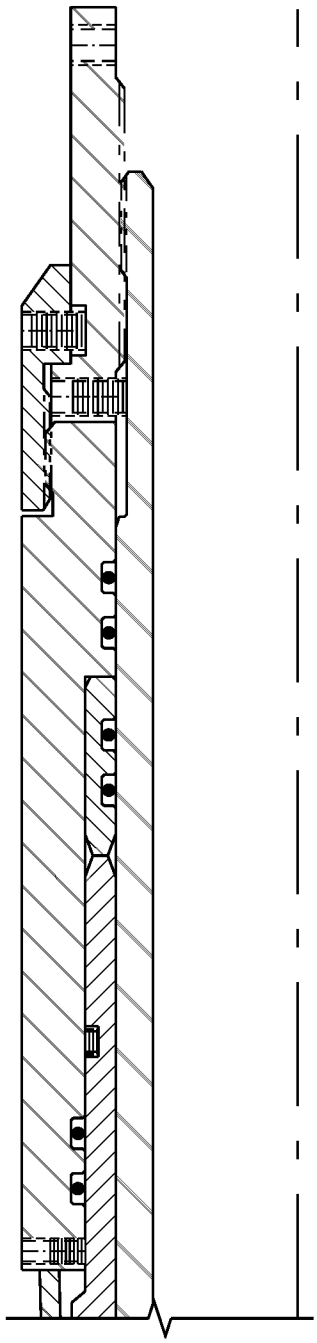

FIG. 4d

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/058767

A. CLASSIFICATION OF SUBJECT MATTER

E21B 17/043(2006.01)i, E21B 34/14(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 17/043; E21B 23/02; E21B 34/06; E21B 33/128; E21B 23/06; E21B 33/12; E21B 19/16; E21B 34/10; E21B 23/01; E21B 34/14

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: actuating tool, mandrel, multiple pistons, lock assembly, hydrostatic pressure, and port

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010-0200245 A1 (RINGGENBERG et al.) 12 August 2010 See abstract; paragraphs [0053]-[0056]; figure 6.	1-20
A	US 2007-0246227 A1 (EZELL et al.) 25 October 2007 See abstract; paragraphs [0011]-[0016]; claims 1-6.	1-20
A	US 5,810,082 A (JORDAN, JR., HENRY JOE) 22 September 1998 See abstract; claims 1-19.	1-20
A	US 2003-0019623 A1 (KING et al.) 30 January 2003 See paragraphs [0012]-[0016]; figures 1a-1e.	1-20
A	US 2005-0028989 A1 (DOANE et al.) 10 February 2005 See abstract; paragraphs [0023]-[0031].	1-20

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

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"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	Date of mailing of the international search report
16 December 2013 (16.12.2013)	**17 December 2013 (17.12.2013)**

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea
Facsimile No. +82-42-472-7140

Authorized officer
HAN, Joong Sub
Telephone No. +82-42-481-5606

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2013/058767

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010-0200245 A1	12/08/2010	BR PI1000433 A2	14/06/2011
		US 7926575 B2	19/04/2011
US 2007-0246227 A1	25/10/2007	US 7717183 B2	18/05/2010
US 5810082 A	22/09/1998	GB 2316699 A	04/03/1998
US 2003-0019623 A1	30/01/2003	CA 2454948 A1	13/02/2003
		GB 2395966 A	09/06/2004
		NO 20040344 A	26/03/2004
		US 6779600 B2	24/08/2004
		WO 03-012252 A1	13/02/2003
US 2005-0028989 A1	10/02/2005	AU 2002-357884 A1	09/07/2003
		AU 2006-242451 A1	09/11/2006
		AU 2006-242451 B2	10/03/2011
		AU 2006-285396 A1	08/03/2007
		AU 2006-285396 B2	06/01/2011
		CA 2606179 A1	09/11/2006
		CA 2606179 C	14/12/2010
		CA 2606406 A1	08/03/2007
		CA 2606406 C	15/02/2011
		EP 1963617 A1	03/09/2008
		EP 1963617 B1	13/01/2010
		GB 2400872 A	27/10/2004
		GB 2410274 A	27/07/2005
		GB 2410275 A	27/07/2005
		GB 2410276 A	27/07/2005
		GB 2440073 A	16/01/2008
		GB 2467254 A	28/07/2010
		GB 2467255 A	28/07/2010
		US 2003-0116328 A1	26/06/2003
		US 2003-0141079 A1	31/07/2003
		US 2004-0035588 A1	26/02/2004
		US 2004-0182583 A1	23/09/2004
		US 2005-0034876 A1	17/02/2005
		US 2005-0161229 A1	28/07/2005
		US 2005-0189120 A1	01/09/2005
		US 2005-0189121 A1	01/09/2005
		US 2005-0217869 A1	06/10/2005
		US 2008-0196884 A1	21/08/2008
		US 6959759 B2	01/11/2005
		US 6986390 B2	17/01/2006
		US 7044231 B2	16/05/2006
		US 7051805 B2	30/05/2006
		US 7117949 B2	10/10/2006
		US 7134504 B2	14/11/2006
		US 7341110 B2	11/03/2008
		US 7387170 B2	17/06/2008

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2013/058767

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		US 7493945 B2	24/02/2009
		US 7661470 B2	16/02/2010
		WO 03-054349 A1	03/07/2003
		WO 2006-119037 A2	09/11/2006
		WO 2006-119037 A3	22/03/2007
		WO 2006-119129 A2	09/11/2006
		WO 2006-119129 A3	28/12/2006
		WO 2007-027228 A1	08/03/2007