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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
6 January 2011 (06.01.2011)

PCT

(10) International Publication Number
WO 2011/002676 A2

(51) International Patent Classification:
F16K 1/32 (2006.01) *E21B 34/06* (2006.01)
F16K 31/00 (2006.01) *F16K 1/12* (2006.01)

(21) International Application Number:
PCT/US2010/039946

(22) International Filing Date:
25 June 2010 (25.06.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
12/497,076 2 July 2009 (02.07.2009) US

(71) Applicant *(for all designated States except US)*: **BAKER HUGHES INCORPORATED** [US/US]; P.O. Box 4740, Houston, Texas 77210-4740 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **JOSEPH, Paul** [US/US]; 31 Flamingo Landing Drive, Missouri City, Texas 77459 (US). **ABARCA, John R.** [US/US]; 310 Gale Street, Houston, Texas 77009 (US). **MENDEZ, Luis E.** [US/US]; 15805 Elwood Drive, Houston, Texas 77040 (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,

[Continued on next page]

(54) Title: TUBULAR VALVE SYSTEM AND METHOD

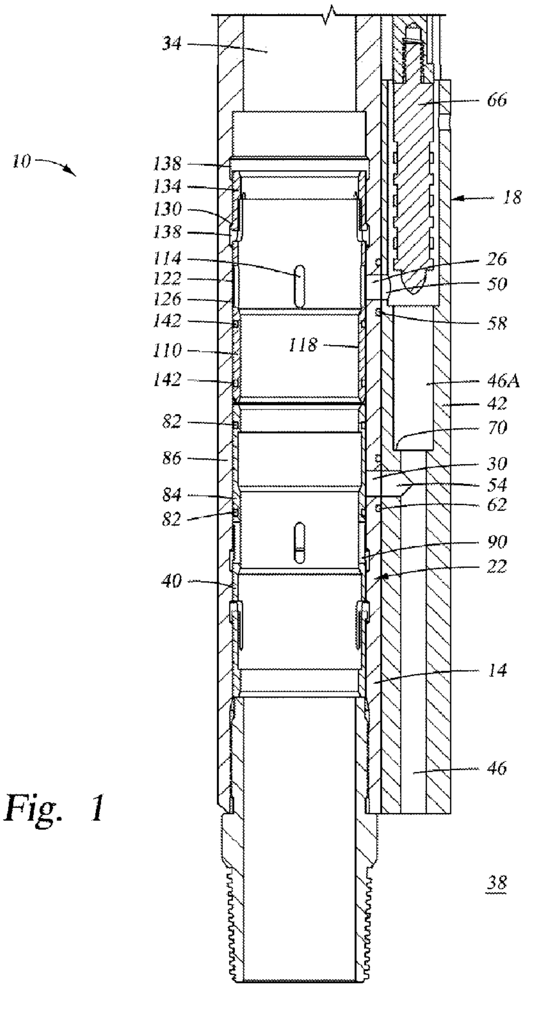

Fig. 1

(57) Abstract: A tubular valve system includes, a tubular, a primary valve actuatable to control occlusion of at least one port fluidically connecting an inner bore of the tubular with an outside of the tubular, and a contingency valve actuatable to control occlusion of at least one port fluidically connecting the inner bore with the outside of the tubular.

WO 2011/002676 A2

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, 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:

— *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))*

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

TUBULAR VALVE SYSTEM AND METHOD

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application contains subject matter related to the subject matter of co-pending applications, which are assigned to the same assignee as this application, Baker Hughes Incorporated of Houston, Texas. The below listed applications are hereby incorporated by reference in their entirety:

[0002] U.S. Patent Application Attorney Docket No. 274-49265-US, entitled MODULAR VALVE BODY AND METHOD OF MAKING; and

[0003] U.S. Patent Application Attorney Docket No. 274-49268-US, entitled TUBULAR VALVING SYSTEM AND METHOD.

BACKGROUND

[0004] Tubular valves that control occlusion of ports that fluidically connect an inner bore of a tubular with an outside of the tubular are commonly used in several industries including the downhole completion industry. Such valves are deployed in boreholes to control fluid flow in both directions, inside to outside of the tubular as well as outside to inside of the tubular, through the ports. Remote control of these valves provides advantages in operational efficiencies, in comparison to valves that require active interventive actuation, and have thus become quite popular. Remotely controlled valves, however, can malfunction. Costs associated with removal of the valves from the borehole to repair or replace the valve, in addition to the cost of lost production while the well is not producing, are a few of the concerns associated with use of these valves. Systems and methods that overcome the foregoing concerns would be well received in the art.

BRIEF DESCRIPTION

[0005] Disclosed herein is a tubular valve system. The system includes, a tubular, a primary valve actuatable to control occlusion of at least one port fluidically connecting an inner bore of the tubular with an outside of the tubular, and a contingency valve actuatable to control occlusion of at least one port fluidically connecting the inner bore with the outside of the tubular.

[0006] Further disclosed herein is a method of valving a tubular. The method includes, actively actuating a primary valve disposed at the tubular, and maintaining a contingency valve disposed at the tubular in reserve.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The following descriptions should not be considered limiting in any way. With reference to the accompanying drawings, like elements are numbered alike:

[0008] FIG. 1 depicts a partial cross sectional view of a tubular valve system disclosed herein with the primary valve open and the contingency valve closed;

[0009] FIG. 2 depicts a perspective view of the tubular valve system of FIG. 1;

[0010] FIG. 3 depicts a partial cross sectional view of the tubular valve system of FIG. 1 with the primary valve closed and the contingency valve open;

[0011] FIG. 4 depicts a partial cross sectional view of an alternate tubular valve system disclosed herein with the primary valve closed and the contingency valve closed; and

[0012] FIG. 5 depicts a partial cross sectional view of the tubular valve system of FIG. 4 with the primary valve open and the contingency valve open.

DETAILED DESCRIPTION

[0013] A detailed description of one or more embodiments of the disclosed apparatus and method are presented herein by way of exemplification and not limitation with reference to the Figures.

[0014] Referring to FIG. 1, an embodiment of a tubular valve system disclosed herein is illustrated generally at 10. The valve system 10 includes, a tubular 14 with a primary valve 18 and a contingency valve 22 disposed thereat. The tubular 14 includes at least one first port 26 and at least one second port 30 that both fluidically connect an inner bore 34 of the tubular 14 with an outside 38 of the tubular 14. The primary valve 18 is configured to control occlusion of the first port 26 while the contingency valve 22 is configured to control occlusion of at least the second port 30, with additional control of occlusion of the first port 26 by the contingency valve 22 being optional. The contingency valve 22 has a sleeve 40 that is slidably engaged with the tubular 14. In this embodiment, the sleeve 40 is positioned within the inner bore 34 of the tubular 14. The sleeve 40 is movable relative to the tubular 14 such that movement of the sleeve 40 can fully occlude the second port 30. The sleeve 40 can be passive so that it is moved by mechanical engagement therewith by a shifting tool (not shown), for example. Additionally, an alternate actuator such as an actuator that uses an atmospheric chamber that is collapsed during actuation could shift the sleeve 40.

[0015] In this embodiment, the primary valve 18 is an actively controlled valve and as such is configured to be controlled remotely as will be described in detail below. The foregoing construction allows an operator to control the primary valve 18 and directly control the contingency valve 22. As such, the primary valve 18 can be used by an operator to control flow between the inner bore 34 and the outside 38 indefinitely, while maintaining the contingency valve 22 in reserve. The contingency valve 22 can be employed to control flow between the inner bore 34 and the outside 38 at any time, including when the primary valve 18 fails to operate properly, due to jamming by contamination, for example.

[0016] The primary valve 18, in this embodiment, includes an elongated member 42 with a bore 46 that extends longitudinally therethrough. A first port 50 and a second port 54 in the elongated member 42 align with the first port 26 and the second port 30 in the tubular 14 and fluidically connect with the bore 46. As such, both ports 26 and 30 are in fluidic communication with the outside 38 through the ports 50 and 54 and the bore 46. Seals 58 and 62, illustrated herein as o-rings, seal the elongated member 42 to the tubular 14 to prevent leakage of fluid from the ports 50 and 54 to the outside 38 from between the elongated member 42 and the tubular 14. A valve stem 66 is movable within a portion 46A of the bore 46 into sealable engagement with a shoulder 70 of the bore 46, thereby occluding fluidic communication between the inner bore 34 and the outside 38 through the first ports 26 and 50. The valve stem 66 in this view is shown in a position that is not sealed to the shoulder 70 and thus the inner bore 34 is in fluidic communication with the outside 38 through the first ports 26 and 50.

[0017] Referring to FIG. 2, the valve stem 66, in this embodiment, is driven by an actuator 74, depicted herein as an electric actuator, that is controlled by electrical power supplied via a signal carrier 78, depicted herein as an electric supply line or control line. The signal carrier 78 can extend indefinitely in either or both directions along the tubular 14 from the valve system 10. For example, the signal carrier 78 may extend to a surface in applications wherein the valve system 10 is deployed within a wellbore (not shown) in an earth formation to allow remote control operation of the valve system 10 from the surface. Other embodiments can use alternate actuators 74 to actuate the primary valve 18, such as, a hydraulic actuator (not shown) that can be supplied hydraulic power through a signal carrier 78 that includes fluidic supply lines.

[0018] Referring again to FIG. 1, the sleeve 40 of the contingency valve 22 is illustrated in this view in a position that fully occludes the second ports 30 and 54. A pair of seals 82, shown herein as o-rings, slidably seal walls 84 of the sleeve 40 to walls 86 of the tubular 14 on either longitudinal side of the second port 30. At least one second port 90 through the walls 84 of the sleeve 40, in this view, is shown located longitudinally outboard of both seals 82 and is therefore fluidically isolated from the second ports 30 and 54, and therefore maintains the contingency valve 22 in a closed position.

[0019] Referring to FIG. 3, the sleeve 40, in this view, is illustrated in a position such that the second port 90 is longitudinally aligned with the second ports 30 and 54 thereby fluidically connects the inner bore 34 with the outside 38 maintaining the contingency valve 22 in an open position. A recess 92 defined by a portion of the sleeve 40 having a reduced radial dimension, is longitudinally aligned with the second port 90 to create an annular space 93 between the sleeve 40 and the tubular 14 to allow fluid to flow in the annular space 93 from between the at least one second port 90 and the second port 30 when the second port 90 is longitudinally aligned with the second port 30.

[0020] The sleeve 40, in this embodiment, also includes an optional collet 94 with collet fingers 98 that are biasingly engagable with a pair of recesses 102 formed in the walls 86 of the tubular 14. This engagement discourages unintentional movement of the sleeve 40 by positively maintaining the sleeve in one of the positions defined by the engagement of the collet fingers 98 within the recesses 102. Although the recesses 102 in this embodiment are located to maintain the sleeve 40 to either fully occlude the second port 30 with the sleeve 40 or to leave the second port 30 fully open to the second port 90. A profile 106 also formed in the walls 84 of the sleeve 40 provide a detail that is engagable with a shifting tool (not shown) to facilitated positive latching between the shifting tool and the sleeve 40 to facilitate movement of the sleeve 40.

[0021] An optional collar 110 with similar features to those of the sleeve 40 can be employed to be mechanically shifted to occlude the first port 26. Shifting the collar 110 may be desirable in the event that the valve stem 66 of the primary valve 18 ceases in an open position. Such a malfunction would present a permanent fluidic connection between the inner bore 34 and the outside 38. The collar 110 could then be used to permanently occlude the first port 26 to thereby allow control of fluid communication between the inner bore 34 and the outside 38 via mechanical shifting of the contingency valve 22 thereafter. The collar 110 is illustrated in FIG. 1 with a first port 114 through walls 118 thereof being longitudinally aligned with the first port 26, thereby providing fluid communication between the inner bore 34 and the outside 38 therethrough. A recess 122 defined by a reduced radial dimension of the walls 118 in longitudinal alignment with the first port 114 creates an annular space 126 between the collar 110 and the tubular 14 to permit fluid flow to flow therethrough between any of the first ports 114 and the first port 26.

[0022] The collar 110 is movable through contact with the sleeve 40 during movement of the sleeve 40 in a direction toward the collar 110. In alternate embodiments not illustrated herein the collar 110 could be moved by direct mechanical engagement with a shifting tool. Collet fingers 130 on a collet 134 of the collar 110 are biasingly engagable with recesses 138 in the walls 86 to discourage unintended movement of the collar 110 with respect to the tubular 14. Seals 142 slidably sealingly engage the walls 86 to the walls 118 a longitudinal dimension apart that spans at least the longitudinal dimension of the first port 26. As such, when the collar 110 is shifted to the position illustrated in FIG. 3, the seals 142 effectively fluidically deadhead the first port 26 to the walls 118 between the seals 142 thereby occluding fluid communication between the inner bore 34 and the outside 38.

[0023] Referring to Figures 4 and 5, an alternate embodiment of a tubular valve system disclosed herein is illustrated generally at 210. Due to the similarities between the valve system 210 and the valve system 10, many items are identical and, as such, are numbered alike and are not described again in detail hereunder. A primary difference between the two valve systems 210 and 10 is that the valve system 210 has only the single first port 26 and not the second port 54, as are both included in the valve system 10. The valve system 210, having only the first port 26 negates the need for both the sleeve 40 and the collar 110, as are incorporated in the valve system 10 to selectively close the second port 54 and the first port 26, respectively. The sleeve 40 in the valve system 210, therefore, is used to selectively close the first port 26 and, as such, the valve system 210 does not include the collar 54.

[0024] In Figure 4 the first port 26, as illustrated, is fully occluded by the contingency valve 222. In contrast, as illustrated in Figure 5, the second ports 90 of the sleeve 40 are aligned with the first port 26, and the contingency valve 222 provides not blockage of the first port 26.

[0025] While the invention has been described with reference to an exemplary embodiment or embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the claims. Also, in the drawings and the description, there have been disclosed exemplary embodiments of the invention and, although specific terms may have been employed, they are unless otherwise stated used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention therefore not being so limited. Moreover, the use of the terms first, second, etc. do not denote any order or importance, but rather the terms first, second, etc. are used to distinguish one element from another. Furthermore, the use of the terms a, an, etc. do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item.

CLAIMS

What is claimed is:

1. A tubular valve system, comprising:

a tubular;

a primary valve actuatable to control occlusion of at least one port fluidically connecting an inner bore of the tubular with an outside of the tubular; and

a contingency valve actuatable to control occlusion of at least one port fluidically connecting the inner bore with the outside of the tubular.

2. The tubular valve system of claim 1, wherein the primary valve is actively controlled and the contingency valve is passively controlled.

3. The tubular valve system of claim 1, wherein the tubular valve system is deployable within a wellbore.

4. The tubular valve system of claim 1, wherein the primary valve is controlled by one of electrical power and hydraulic pressure.

5. The tubular valve system of claim 1, wherein the contingency valve is controlled by mechanical actuation.

6. The tubular valve system of claim 1, wherein the contingency valve includes a sleeve that is movable relative to the tubular.

7. The tubular valve system of claim 6, wherein the sleeve has at least one contingency opening that can be aligned with the at least one port to open the at least one port or misaligned with the at least one port to occlude the at least one port.

8. The tubular valve system of claim 6, wherein the sleeve is slidably sealingly engaged with the tubular.

9. The tubular valve system of claim 6, further comprising a collet in operable communication with the sleeve and the tubular to maintain the sleeve in a position relative to the tubular when the sleeve is not being moved.

10. The tubular valve system of claim 6, wherein the sleeve includes a profile engagable with a shifting tool.

11. The tubular valve system of claim 1, further comprising a collar having at least one primary opening positionable at least between a first position aligning the primary opening with the at least one port and a second position misaligning the primary opening with the at least one port to occlude the at least one port.

12. The tubular valve system of claim 11, wherein the collar is movable from the first position to the second position by actuation of the contingency valve.

13. The tubular valve system of claim 1, further comprising a collar valve configured to defeat the primary valve upon actuation thereof.

14. The tubular valve system of claim 1, wherein the primary valve is configured to control occlusion of at least one first port and the contingency valve is configured to control occlusion of at least one second port and the at least one first port is not the at least one second port.

15. A method of valving a tubular, comprising:

actively actuating a primary valve disposed at the tubular; and

maintaining a contingency valve disposed at the tubular in reserve.

16. The method of valving a tubular of claim 15, further comprising actuating the contingency valve upon loss of performance of the primary valve.

17. The method of valving a tubular of claim 16, wherein the actuating the contingency valve is via mechanical actuation.

18. The method of valving a tubular of claim 15, further comprising engaging the contingency valve with a shifting tool.

19. The method of valving a tubular of claim 15, further comprising moving a sleeve relative to the tubular.

20. The method of valving a tubular of claim 19, further comprising moving a collar relative to the tubular.

21. The method of valving a tubular of claim 15, further comprising actuating the contingency valve to open the contingency valve.

22. The method of valving a tubular of claim 21, wherein the actuating the contingency valve includes closing the primary valve.

23. The method of valving a tubular of claim 21, further comprising defeating the primary valve with the actuating of the contingency valve.

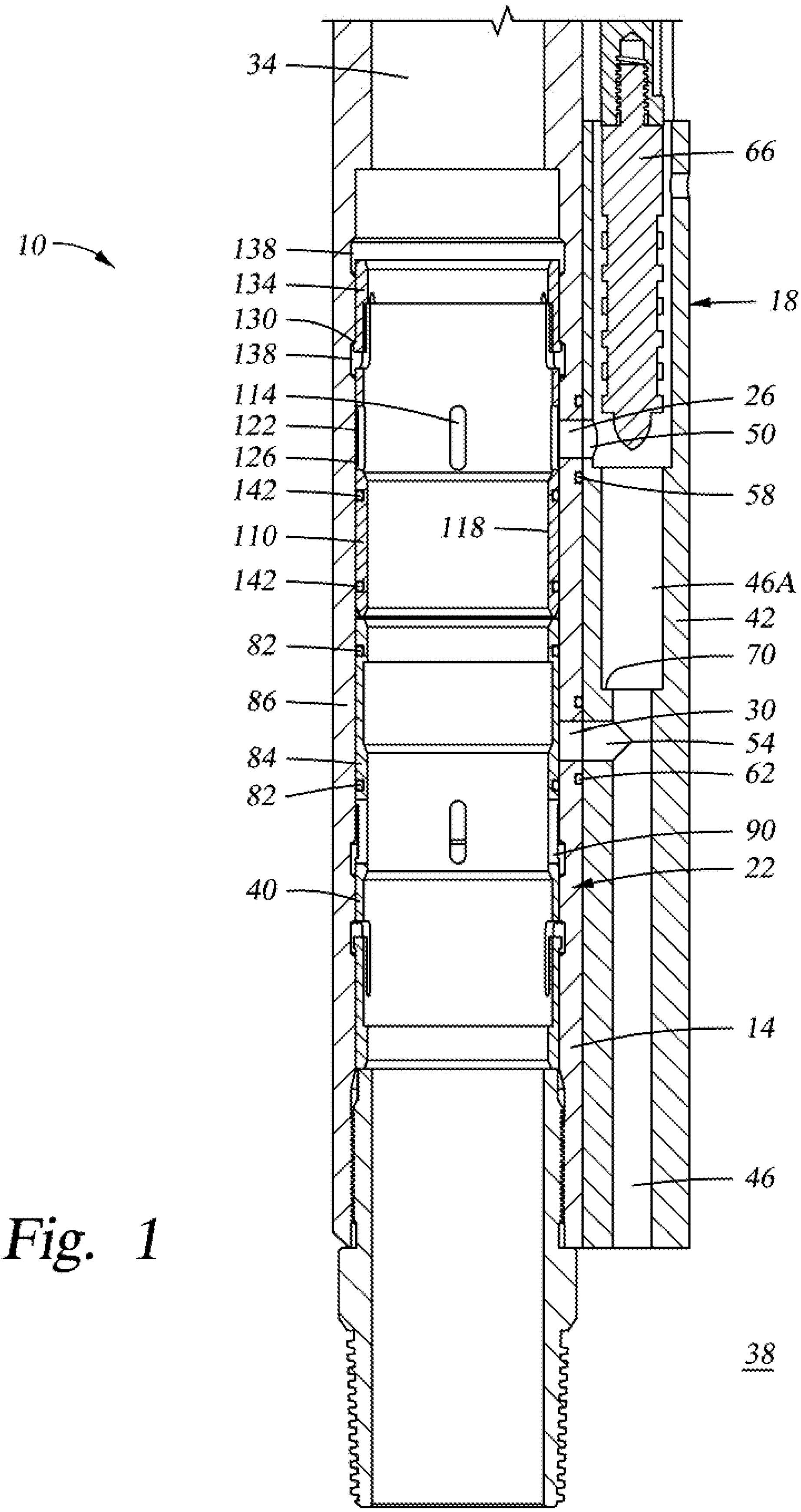
34
66
10
138
134
130
138
114
122
126
142
110
118
142
82
86
84
82
40
18
26
50
58
46A
42
70
30
54
62
90
22
14
46
38

Fig. 1

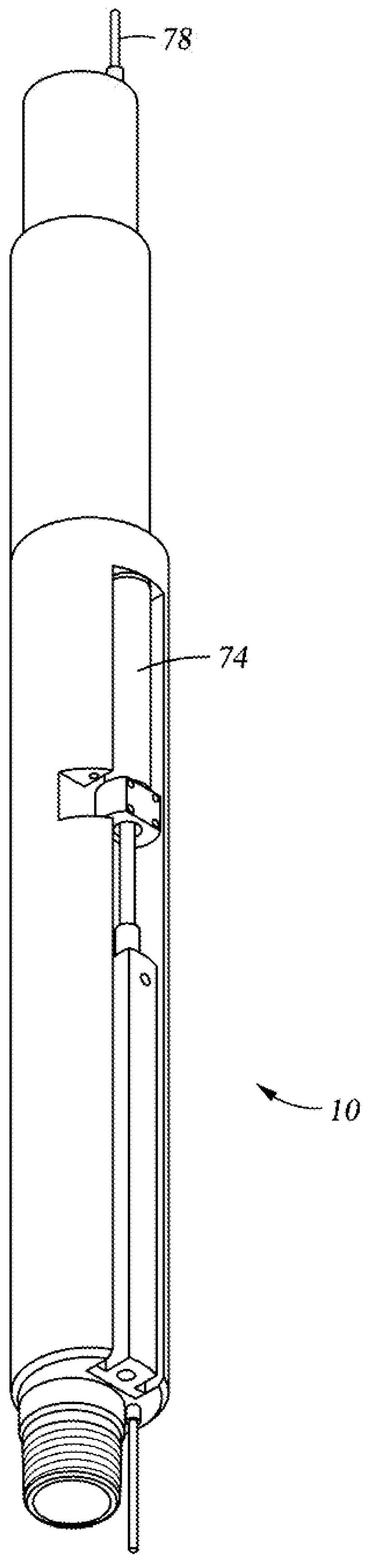

Fig. 2

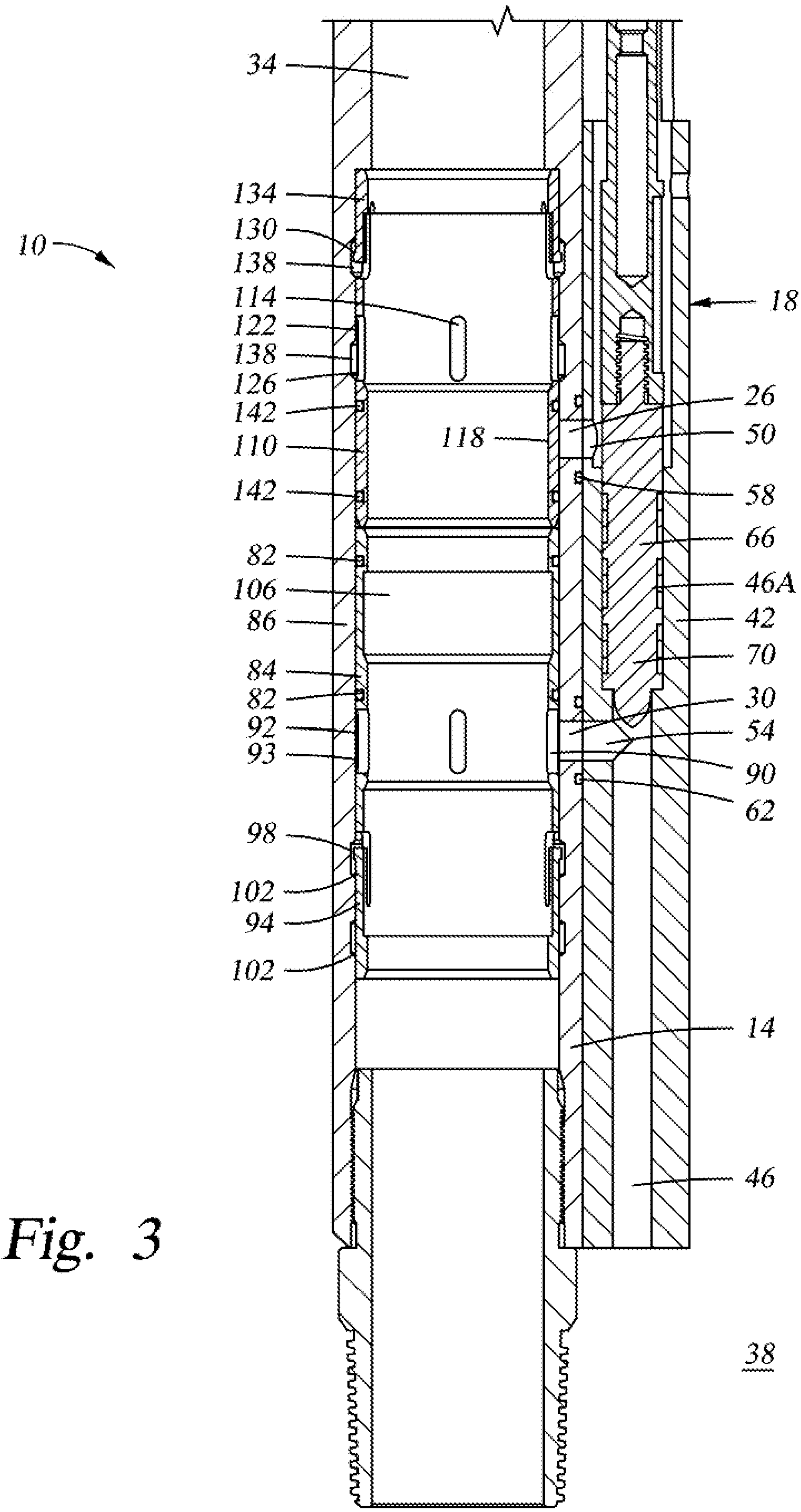
34
10
134
130
138
114
122
138
126
142
110
118
142
82
106
86
84
82
92
93
98
102
94
102
18
26
50
58
66
46A
42
70
30
54
90
62
14
46
38

Fig. 3

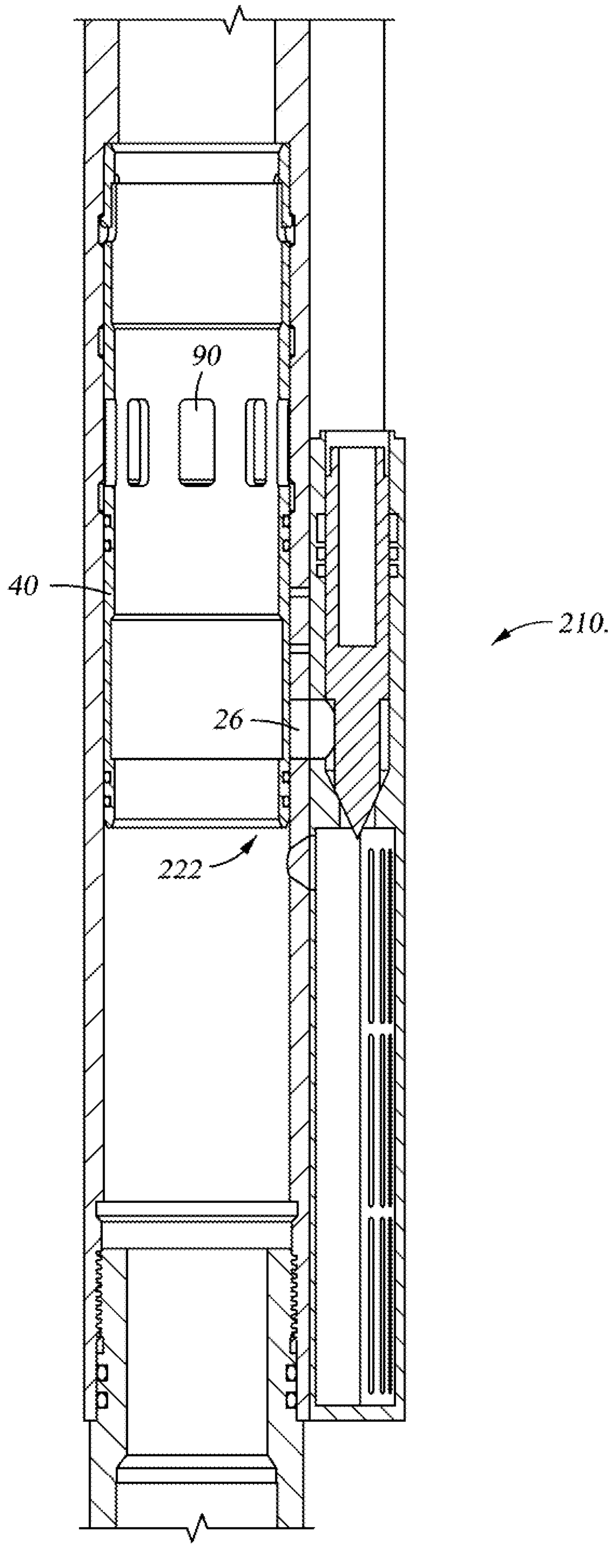

Fig. 4

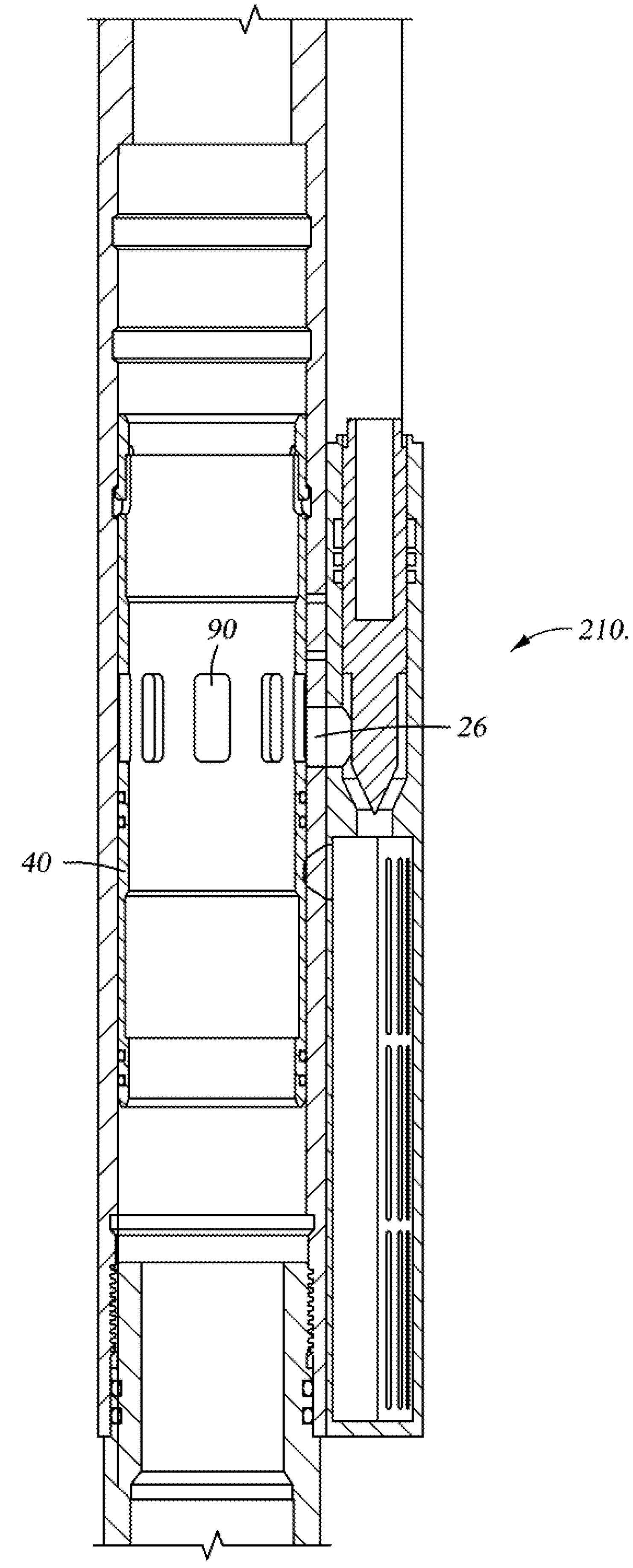

Fig. 5