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(71) Applicant (for all designated States except US): **BAKER HUGHES INCORPORATED** [US/US]; 2929 Allen Parkway, Suite 2100, Houston, TX 77019-21 18 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **HOGAN, Andrew N.** [US/US]; 1640 E. TC Jester Blvd., Apt. 838, Houston, TX 77008 (US). **BRYANT, Drayton, W.** [US/US]; 6620 Gessner Road, Apt. 7205, Houston, TX 77040 (US). **BLAIR, Steven, G.** [US/US]; 8719 Sorrell Meadows Drive, Tomball, TX 77375 (US). **WHITE, Richard, T.** [US/US]; 3206 Pine Alcove Court, Kingwood, TX 77345 (US).

(74) Agent: **PORTER, Andre, J.**; 14990 Yorktown Plaza, Houston, TX 77040 (US).

[Continued on nextpage]

(54) Title: INSTALLATION SYSTEM WITH FORCE GENERATING TOOL

(57) Abstract: Devices and methods for applying axial force for such uses as running and releasing tools or other articles within a wellbore. An installation system is described that includes a force generator used to generate axial forces. The installation system also releasably secures an article and is capable of releasing the article once it has been emplaced or installed with the force generator.

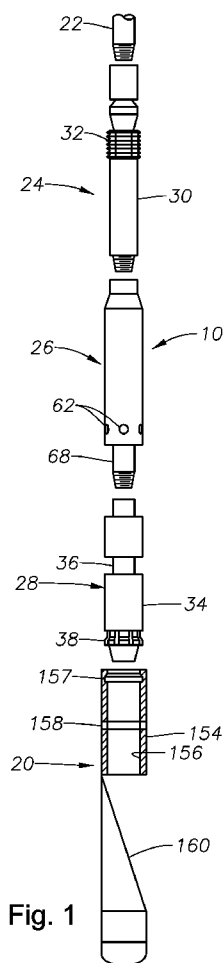


Fig. 1

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INSTALLATION SYSTEM WITH FORCE GENERATING TOOL

BACKGROUND OF THE INVENTION

1. Field of the Invention

5 [0001] The present invention generally relates to tools for use in installing articles and equipment within a wellbore. In some aspects, the invention relates to installation devices used in coiled tubing arrangements.

2. Description of the Related Art

10 [0002] When coiled tubing is used in wellbores, it is problematic to apply significant downward force on the tubing, as this might result in the collapse of or damage to the coiled tubing. This makes it difficult to perform many tasks wherein it is necessary to apply a downward force. One example of such a task is when a multilateral wellbore
15 has been drilled wherein a primary, usually vertically-oriented wellbore has one or more lateral secondary wellbores which extend radially outwardly therefrom. It is difficult to apply set-down force for certain tools that are landed within the wellbore. Conventional arrangements for generating axial forces with coiled tubing assemblies lack the ability to be reused or to enable a device below the force generator to be actuated by hydraulic
20 fluid pressure.

SUMMARY OF THE INVENTION

[0003] The invention provides exemplary devices and methods for generating and applying axial force for such uses as running and releasing tools or other articles within
25 a wellbore. An installation system is described that includes a force generator used to

generate axial forces. The installation system also releasably secures an article and is capable of releasing the article once it has been emplaced or installed with the force generator. An exemplary installation system is described that includes an anchor for securing the system in place within a wellbore and a force generator in the form of a stroker tool for installing a diverter module that is run in with coiled tubing. The stroker tool creates the axial force needed to seat the diverter module within a lateral entry module in the wellbore. The installation system also includes a release tool that is selectively released from the diverter module after seating.

[0004] The described stroker tool includes a tool body and a piston portion that is axially moveable with respect to the tool body in a telescoping fashion. The piston portion includes a mandrel with a central flowbore. A ball seat is releasably secured within the central flowbore by one or more frangible shear members that are designed to shear away at a predetermined level of fluid pressure within the central flowbore. The ball seat permits a ball or other object to be landed within the mandrel, permitting fluid pressure to urge the piston portion axially with respect to the tool body, thereby generating axial force. After the ball seat has been sheared out of the mandrel, hydraulic fluid pressure can be communicated through the stroker tool and to the release tool. The fluid pressure actuates the release tool to release from the seated diverter.

[0005] The installation system also functions to provide physical indications to operators at the surface of the status of the installation operation. The running string can be pulled up on after the setting of the anchor. The increased resistance to pull will indicate that the installation system is successfully anchored in place. A fluid pressure

drop associated with shearing out of the ball seat will provide an indication that 1) the stroker tool has become fully stroked for seating of the diverter module and 2) fluid pressure has been transmitted to the release tool in order to release from the seated diverter module.

5

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The advantages and other aspects of the invention will be readily appreciated by those of skill in the art and better understood with further reference to the accompanying drawings in which like reference characters designate like or similar
10 elements throughout the several figures of the drawings and wherein:

[0007] Figure 1 is a partial side, cross-sectional view of an exemplary tool installation system constructed in accordance with the present invention with system components being shown in an exploded manner.

[0008] Figure 2 is a side, cross-sectional view of an exemplary stroker tool used with
15 the tool installation system of Figure 1 and constructed in accordance with the present invention.

[0009] Figure 3 is a side, cross-sectional view of the tool shown in Figure 2, now in a stroked condition.

[0010] Figure 4 is a side, cross-sectional view of an exemplary piston head used in
20 the tool shown in Figures 2 and 3.

[0011] Figure 5 is a side, cross-sectional view of an exemplary insert sleeve used with the piston head shown in Figure 4.

[0012] Figure 6 is a side, cross-sectional view of an exemplary ball seat and setting ball used with the insert sleeve shown in Figure 5.

[0013] Figure 7 is a side, cross-sectional view of an exemplary release tool used with the tool installation system shown in Figure 1.

5 [0014] Figure 8 is a side, cross-sectional view of the tool installation system of Figure 1 during run-in to install a diverter module within a lateral entry module in a wellbore,

[0015] Figure 9 is a side, cross-sectional view of the tool installation system of Figure 8 during installation of the diverter module.

10 **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

[0016] Figure 1 illustrates an exemplary installation system, generally shown at 10, that has been constructed in accordance with the present invention. In the described embodiment, the installation system 10 is useful for installing an article within a wellbore wherein the article needs to be seated within a generally complimentary seating
15 arrangement by applied axial force. In the described embodiment, a diverter module is emplaced within a lateral entry module that is already positioned within a wellbore. The components of the installation system 10 are shown in side view and partially exploded. The installation system 10 is shown here in conjunction with a lateral diverter module 20 which will be installed into a wellbore in a manner which will be described in detail
20 shortly.

[0017] The system 10 and the attached diverter module 20 are run into a wellbore on the tubing string 22, which extends downwardly from the surface of a wellbore. Preferably, the tubing string 22 is a coiled tubing string of a type known in the art. The

tubing string 22 defines a central internal flowbore, as is known in the art, through which hydrocarbon production fluid can be transmitted to the surface of the wellbore 10 from the diverter module 20. In addition, fluid may be pumped downwardly through the tubing string 22 and pressure increased within the tubing string 22 using surface pumps, as is known in the art. Also, production arrangements and other tools can be passed through the flowbore of the tubing string 22. The installation system 10 generally includes an anchor device 24, a stroker tool 26, and a release tool 28. The diverter module 20 allows communication between the secondary bore 18 and the flowbore of the tubing string 22.

[0018] The anchor device 24 includes a sub body 30 with a plurality of slips 32 that are radially outwardly moveable with respect to the sub body 30. In a currently preferred embodiment, the anchor device 24 is hydraulically actuated by fluid pressure within the tubing string 22. When the anchor device 24 is actuated by increased fluid pressure, the slips 32 are moved radially outwardly and into biting engagement with a surrounding casing. One suitable anchor device for this application is the Thru-Tubing Hydraulic Set Anchor (Model H13226) which is available commercially from Baker Oil Tools of Houston, Texas.

[0019] The release tool 28 is used to convey the diverter module 20 into the wellbore and is capable of selectively releasing from the diverter module 20 after it has been latched into a pre-placed lateral entry module. The release tool 28 generally includes an outer housing 34, an inner mandrel 36, and a skirt 37 which carries engagement members in the form of latching collet fingers 38. Although collet fingers 38 are depicted, different forms of latches, locks or other engagement members, as are known

in the art, may be used. The skirt 37 and collet fingers 38 are axially moveable with respect to the outer housing 34. An exemplary release tool 28 is depicted in Figure 7 apart from the other components of the system 10, and it will be discussed in greater detail shortly.

5 [0020] The stoker tool 26 is shown in greater detail in Figure 2. As seen there, the tool 26 is a telescoping assembly that includes an outer tool body, generally indicated at 40 and a piston portion, generally shown at 42, which is axially moveable with respect to the body 40. The tool body 40 includes a top sub 44, a generally cylindrical outer housing 46, and a bottom sub 48. The top sub 44 includes an axial bore 50 with a
10 threaded portion 52 so that the stoker tool 26 can be affixed to the anchor 24. The top sub 44 is affixed by threaded connection 54 to the outer housing 46. The bottom sub 48 is affixed to the outer housing 46 by threaded connection 56. The outer housing 46 surrounds and defines a piston chamber 58, which is bounded by the top sub 44 at the top end and by the bottom sub 48 at the lower end. The bottom sub 48 contains a
15 central polished bore 60 and lateral vent channels 62. The vent channels 62 provide fluid communication between the pressure chamber 58 and the surrounding annulus 64.

[0021] The piston portion 42 of the stoker tool 26 includes a piston head 66 and an affixed mandrel 68. The components of an exemplary piston head 66 are shown in greater detail in Figures 4, 5 and 6. The piston head 66 has a piston body 70 with an
20 outer radial surface 72. The outer radial surface 72 carries a fluid o-ring seal 74 and a dynamic seal stack 76. The piston body 70 has an interior bore 78 with an enlarged insert chamber 80. The lower end of the insert chamber 80 has threads 82 so that the mandrel 68 can be affixed to the piston head 66. A portion of the insert chamber 80

also has threads 84 so that an insert sleeve 86 can be affixed within the insert chamber 80.

[0022] An exemplary insert sleeve 86 is depicted in Figure 5. The insert sleeve 86 has a sleeve body 88 that presents an outer radial surface 90 with threads 92. Annular fluid seals 94 are carried on the outer radial surface 90. Threads 96 are also formed on the outer radial surface 90 and are shaped and sized to be complimentary to the threads 84 of the piston body 70. A ball seat bore 98 is defined within the sleeve body 88. Threaded openings 100 are disposed through the sleeve body 88.

[0023] A ball seat 102 is secured within the ball seat bore 98. An exemplary ball seat 102 is shown in Figure 6. The ball seat 102 has a generally cylindrical body 104 which defines a central fluid passageway 106. A seat portion 108 is formed at one axial end of the ball seat 102 upon which ball member 109 can rest. Threaded openings 110 are disposed through the body 104. Shear screws 114 are disposed within the threaded openings 100 and 110 to releasably secure the ball seat 102 to the insert sleeve 86. The shear screws 114 are frangible members designed to break away at a particular level of axial force applied to the ball seat 102.

[0024] Referring once again to Figure 2, the mandrel 68 defines a central flowbore 112. A baffle 116 is located within the flowbore 112. In a currently preferred embodiment, the baffle 116 is a perforated plate which allows fluid to pass through, but which will capture the ball seat 102 and ball 109. It is noted that, while a spherical ball is depicted for ball 109, the ball 109 may take other shapes, such as a dart, plug or other object that will seat upon the ball seat 102 and substantially block fluid flow through the passageway 106 of the ball seat 102.

[0025] A compression spring 118 is disposed within the pressure chamber 58. The compression spring 118 abuts the underside of the piston head 66 and the upper axial end of the bottom sub 48.

[0026] In Figure 2, the stoker tool 26 has had ball 109 landed upon the ball seat 102.

5 Thereafter, fluid pressure is increased in the flowbore 50 above the ball 109. In Figure 2, the stoker tool 26 is in an axially retracted position. Figure 3 illustrates the stoker tool 26 in a stroked position wherein the piston portion 42 has been moved axially downwardly (i.e., "stroked") with respect to the tool body 40, compressing the spring 118. The stroked position shown in Figure 3 is an axially extended position. Fluid
10 within the pressure chamber 58 is expelled through the vent channels 62. It is currently preferred that the tool 26 provide a stroke with a length from about 12 to about 18 inches.

[0027] When fluid pressure within the flowbore 50 increases to the point where the shear forces exerted upon the shear screws 114 exceeds the shear capacity of those
15 screws 114, the screws 114 rupture and release the ball seat 102 from the insert sleeve 86. The ball seat 102 and ball 109 will fall downwardly through the flowbore 112 of the mandrel 68 and land upon the baffle 116. When this occurs, fluid flow is permitted through the flowbore 112 and baffle 116. Fluid pressure above the piston head 66 is reduced, and the compression spring 118 urges the piston portion 42 upwardly with
20 respect to the tool body 40 until it is again in the position shown in Figure 2.

[0028] Figure 7 illustrates an exemplary release tool 28 in greater detail. The release tool 28 includes a central axial flow passage 120 which is defined within a release tool body formed by the outer housing 34 and inner mandrel 36. An annular spring chamber

122 is defined between the outer housing 34 and the inner mandrel 36. Spring 124 resides within the spring chamber 122. The spring 124 exerts axial force upon the skirt 37, urging it axially downwardly with respect to the housing 34. An annular pressure chamber 126 is formed between the skirt 37 and the inner mandrel 36. A lateral flow path 128 extends from the central flow passage 120 to the annular chamber 126. Fluid seals 130 help enclose the pressure chamber 126. The skirt 37 and collets 38 are normally in the downward position depicted in Figure 7, with the collets 38 being biased radially outwardly by the presence of shoulder 132. When fluid pressure is increased within the flowbore 112, the pressure is transmitted through the lateral flow path 128 and into the annular pressure chamber 126 causing the skirt 37 to move axially upwardly, compressing the spring 124. When the skirt 37 is moved axially upwardly, the collets 38 are raised above the shoulder 132 and are freed to deflect radially inwardly into recessed area 134 on the mandrel 36. As a result, the release tool 28 can, in this manner, release an affixed tool from the collets 38.

[0029] Figures 8 and 9 depict the tool installation system 10 being used to install a diverter module 20 into a lateral entry module 136 which has been previously installed within a primary wellbore 138. The primary wellbore 138 has been drilled through the earth 140 and lined with casing 142. A secondary lateral wellbore 144 extends from the primary wellbore 138.

[0030] The lateral entry module 136 includes a central, generally cylindrical body 146 which defines a central bore 148 (see Figure 9). A lateral window 150 is formed in the body 146 and provides fluid communication between the bore 148 and the secondary wellbore 144. The bore 148 of the lateral entry module 136 includes a landing profile

(152 in Figure 9), of a type known in the art. One suitable lateral entry module for use as the lateral entry module 136 is the H28906 lateral entry module which is available commercially from Baker Oil Tools of Houston, Texas.

[0031] The diverter module 20 includes a diverter body 154 defining an axial bore 156 within. Collet latching recesses 157 (see Figure 1) are formed within the bore 156. A landing latch 158 is formed on the radial exterior of the body 154 and is shaped and sized to latch into the landing profile 152 of the lateral entry module 136. The diverter body 154 also presents a ramp surface 160 that permits access into the bore 156 of the diverter module 20 and attached tubing string 22.

[0032] In Figure 8, the installation system 10 is being run into the primary wellbore 138 in the direction of arrow 162. During run in, the collets 38 of the release tool 28 are secured within the collet latching recesses 157 of the diverter module 20 to secure the diverter module 20 to the tool installation system 10. The lower end of the diverter module 20 will eventually enter the upper end of the central bore 148 of the lateral entry module 136. When the landing latch 158 of the diverter module 20 encounters the landing profile 152 of the lateral entry module 136, downward progress ends, and it now becomes necessary to apply downward force upon the diverter module 20 in order to seat the landing latch 158 into the landing profile 152 of the lateral entry module 136. The end of downward progress of the tubing string 22 will indicate to operators at the surface that the application of downward force is needed.

[0033] A ball (or dart, plug or other object) 109 is now dropped into the tubing string 22 and lands upon the ball seat 102 of the stoker tool 26. Fluid pressure is now increased within the tubing string 22, and this will cause the slips 32 of the anchor

device 24 to move radially outwardly and into biting engagement with the surrounding casing 142. The tool installation system 10 is now secured axially within the primary wellbore 138. The increased fluid pressure within the tubing string 22 also causes the piston portion 42 of the stoker tool 26 to be moved downwardly with respect to the tool
5 body 40, as described previously. This downward movement will urge the diverter module 20 into seating engagement with the lateral entry module 136 as the landing latch 158 becomes seated within the landing profile 152. Proper seating can be confirmed by pulling upwardly on the tubing string 22 to ensure that latching has occurred. Thereafter, fluid pressure is increased within the tubing string 22 until the ball
10 seat 102 is sheared out of the surrounding insert sleeve 86. The release tool 28 will initially remain affixed to the diverter module 20 because the shoulder 132 prevents the collets 38 from moving radially inwardly to release the diverter module 20.

[0034] However, once the ball seat 102 is sheared out, fluid pressure can be communicated below the stoker tool 26 and to the release tool 28. Fluid pressure will
15 enter the central flow passage 120 of the release tool 28 and is transmitted via the lateral flow passage 128 into annular chamber 126. The increased pressure within the chamber 126 will urge the skirt 37 axially upwardly with respect to the outer housing 34 and inner mandrel 36 and compress the spring 124. The collets 38 can then retract into the recessed area 134 thereby disengaging the diverter module 20 from the release tool
20 28. The tubing string 22 and tool installation system 10 can now be withdrawn from the wellbore 138.

[0035] The installation system 10 provides a number of physical indicators to surface operators of the installation process for the diverter module 20. Once fluid pressure has

been increased within the coiled tubing string 22 to set the anchor device 24, the string 22 can be pulled up on at surface. Increased resistance to pull will indicate that the installation system 10 is successfully anchored in place. Also, once the ball seat 102 has sheared out of the surrounding insert sleeve 86, fluid pressure within the tubing string 22 will drop as fluid is communicated through the stroker tool 26 and to the release tool 28 below. The drop in fluid pressure provides an indication that 1) the stroker tool 26 has become fully stroked to seat the diverter module 20 and 2) fluid pressure has been transmitted to the release tool 28 in order to release the installation system 10 from the seated diverter module 20.

[0036] It is noted that the emplacement of the diverter module 20 into lateral entry module 136 is merely an example of the utility of the system 10. The installation system 10 may be used to emplace other articles within a wellbore.

[0037] Those of skill in the art will recognize that numerous modifications and changes may be made to the exemplary designs and embodiments described herein and that the invention is limited only by the claims that follow and any equivalents thereof.

CLAIMS

What is claimed is:

1. An installation system for use emplacing an article within a wellbore, the system comprising:

a release tool which releasably secures an article to the system;

an anchor for securing the system in place within the wellbore;

and

a stroker tool for creating an axial force between the anchor and the release tool, the axial force emplacing the article within the wellbore.

2. The installation system of claim 1 wherein the stroker tool comprises:

a tool body defining a piston chamber;

a piston portion that is at least partially retained within the piston chamber and which is axially moveable with respect to the tool body between an axially retracted position and an axially extended position, the piston portion comprising:

a mandrel defining a central flowbore; and

a ball seat secured within the flowbore of the mandrel upon which a ball is landed to permit fluid pressure to move the piston portion to its axially extended position.

3. The installation system of claim 2 wherein the ball seat is secured within the flowbore with a frangible shear member.

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1 4. The installation system of claim 2 further comprising a compression spring
2 disposed within the piston chamber and biasing the piston portion toward the axially
3 retracted position.

1

1 5. The installation system of claim 1 wherein the release tool comprises:
2 a release tool body;
3 an engagement member shaped and sized for releasably engaging the article to
4 be emplaced, the engagement member being axially moveable with respect to the
5 release tool body between a first position wherein the article is engaged with the release
6 tool and a second position wherein the article is disengaged from the release tool; and
7 a pressure chamber defined within the release tool body, the engagement
8 member being moved to the second position when the pressure chamber is filled with
9 fluid,

i

1 6. The installation system of claim 5 wherein the engagement member comprises a
2 collet which engages a complimentary latching recess on the article.

i

1 7. The installation system of claim 3 wherein the Howbore of the mandrel of the
2 stroker tool further includes a baffle to capture the sheared ball seat but permit fluid flow
3 through the baffle.

i

1 8. An installation system for use emplacing a diverter module within a lateral entry
2 module within a wellbore, the system comprising:

3 a release tool which releasably secures the diverter module to the system;

4 an anchor for securing the system in place within the wellbore;

5 a stoker tool for creating an axial force between the anchor and the release tool,

6 the axial force seating the diverter module within the lateral entry module, the stoker

7 tool comprising:

8 a) a tool body defining a piston chamber;

9 b) a piston portion that is at least partially retained within the piston chamber

10 and which is axially moveable with respect to the tool body between an axially

11 retracted position and an axially extended position, the piston portion comprising:

12 c) a mandrel defining a central flowbore; and

13 d) a ball seat secured within the flowbore of the mandrel upon which a ball is

14 landed to permit fluid pressure to move the piston portion to its axially extended

15 position.

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1 9. The installation system of claim 8 wherein the ball seat is secured within the
2 flowbore with a frangible shear member.

1
1 10. The installation system of claim 8 further comprising a compression spring
2 disposed within the piston chamber and biasing the piston portion toward the axially
3 retracted position.

1 11. The installation system of claim 8 wherein the flowbore of the mandrel of the
2 stroker tool further includes a baffle to capture the sheared ball seat but permit fluid flow
3 through the baffle.

I

1 12. The installation system of claim 8 wherein the release tool comprises:
2 a release tool body;
3 an engagement member shaped and sized for releasably engaging the diverter
4 module, the engagement member being axially moveable with respect to the release
5 tool body between a first position wherein the diverter module is engaged with the
6 release tool and a second position wherein the diverter module is disengaged from the
7 release tool; and

8 a pressure chamber defined within the release tool body, the engagement
9 member being moved to the second position when the pressure chamber is filled with
10 fluid.

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1 13. The installation system of claim 12 wherein the engagement member comprises
2 a collet which engages a complimentary latching recess on the diverter module.

i

l 14. A method of installing an article within a wellbore, the method comprising:
2 affixing an article to be installed to an installation system having:
3 a) a release tool which releasably secures the article to the system;
4 b) an anchor for securing the system in place within the wellbore;
5 and

6 c) a stoker tool for creating an axial force between the anchor and the
7 release tool, the axial force emplacing the article within the wellbore;
8 disposing the article and the installation system within the wellbore on a running
9 string having a flowbore;
10 setting the anchor to secure the installation system within the wellbore;
11 actuating the stoker tool to generate an axial force to seat the article within a
12 complimentary seating arrangement within the wellbore; and
13 operating the release tool to disengage the installation system from the article.

i
1 15. The method of claim 14 wherein the step of operating the release tool further
2 comprises communicating fluid pressure through the stoker tool and to the release tool
3 to cause the release tool to disengage from the article.

i
1 16. The method of claim 14 wherein the stoker tool further comprises a telescoping
2 assembly that is moveable between an axially retracted position and an axially
3 extended position, and wherein the step of actuating the stoker tool to generate an
4 axial force further comprises:

5 landing a ball on a ball seat within the stoker tool; and
6 increasing fluid pressure within the flowbore of the running string against the
7 landed ball to move the stoker tool from the axially retracted position to the axially
8 extended position.

1 17. The method of claim 16 wherein the step of operating the release tool further
2 comprises:

3 increasing fluid pressure within the flowbore of the running string to a point
4 wherein the ball seat is sheared out of the flowbore; and

5 communicating fluid pressure from the running string through the stroker tool to
6 the release tool to cause the release tool to disengage from the article.

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1 18. The method of claim 17 wherein fluid pressure causes the release tool to
2 disengage from the article by filling a release chamber within the release tool with fluid
3 to release an engagement member from the article.

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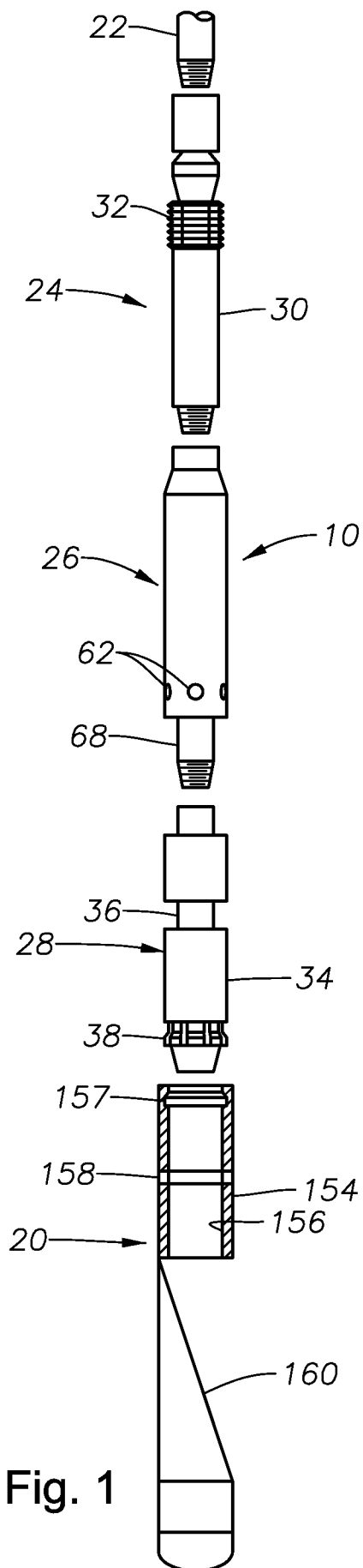


Fig. 1

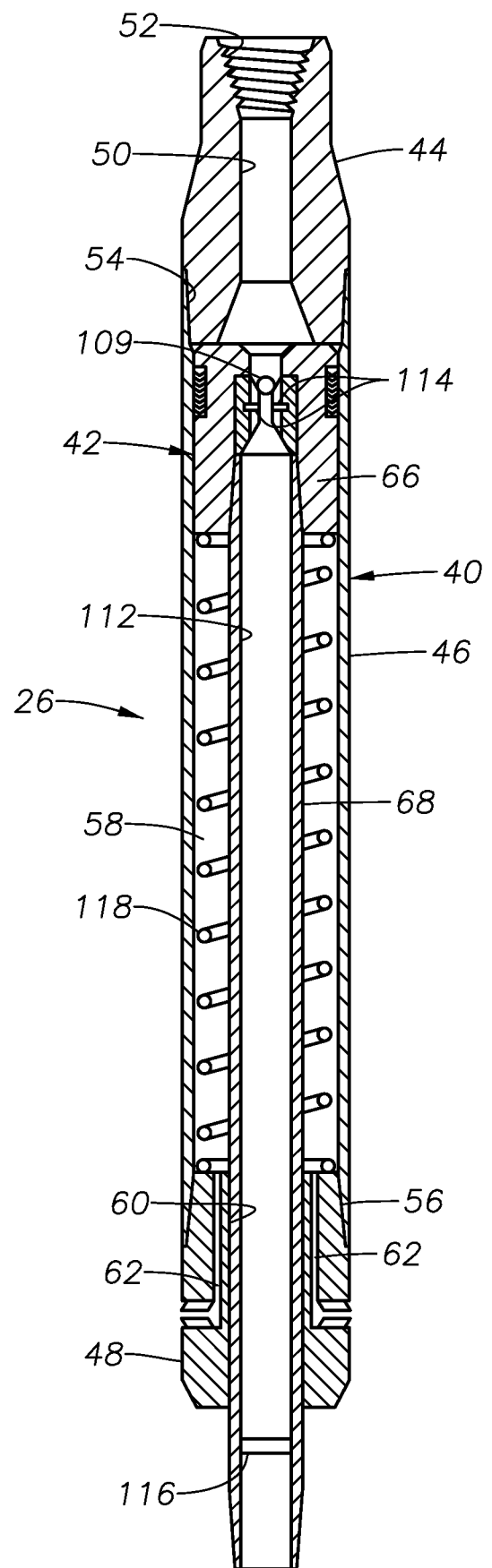
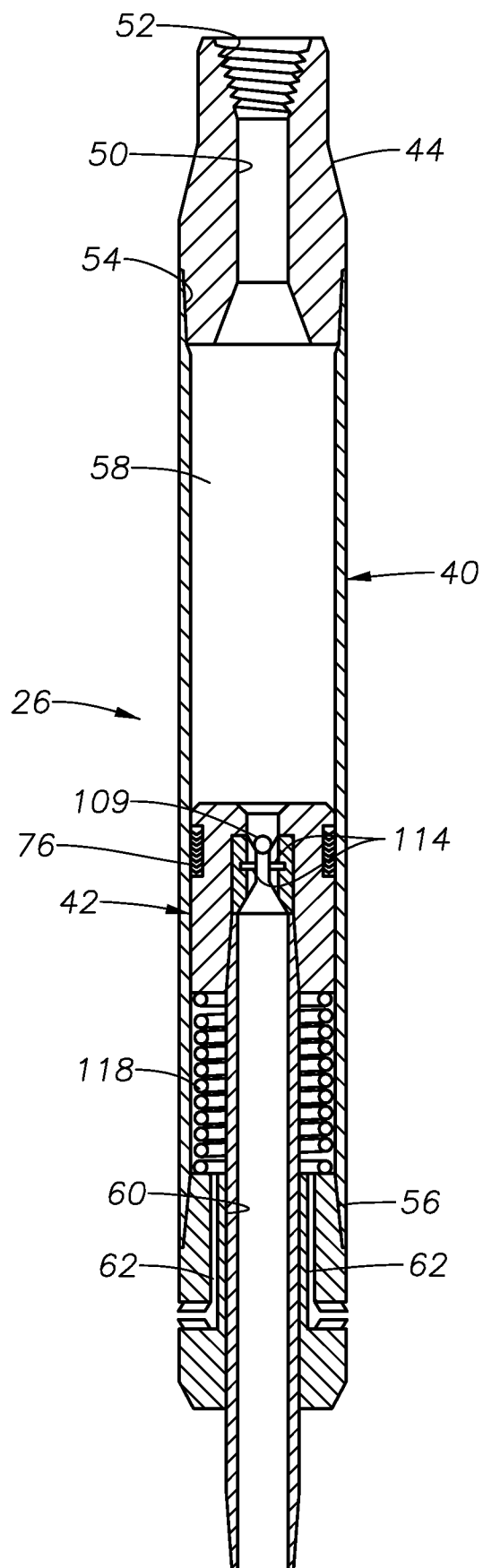


Fig. 2

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Fig. 3



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Fig. 4

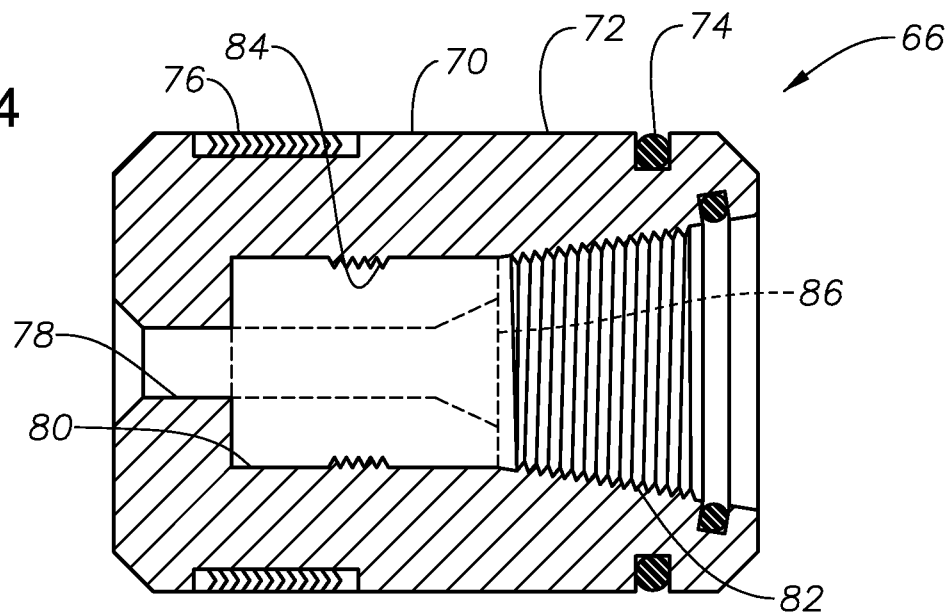


Fig. 5

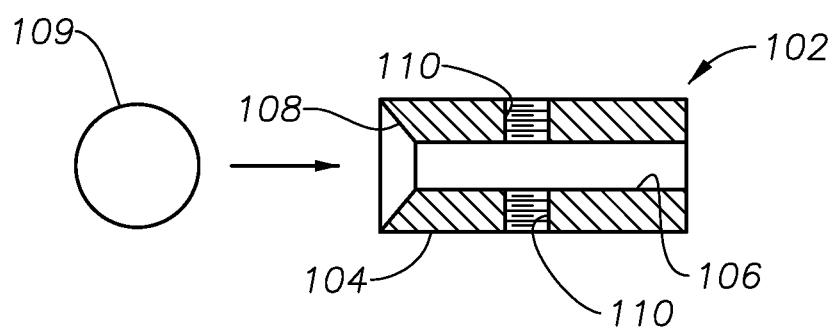
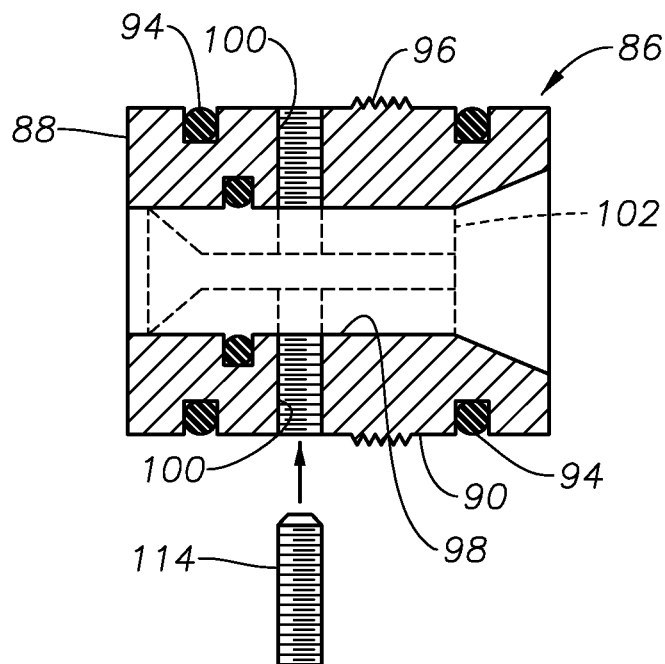
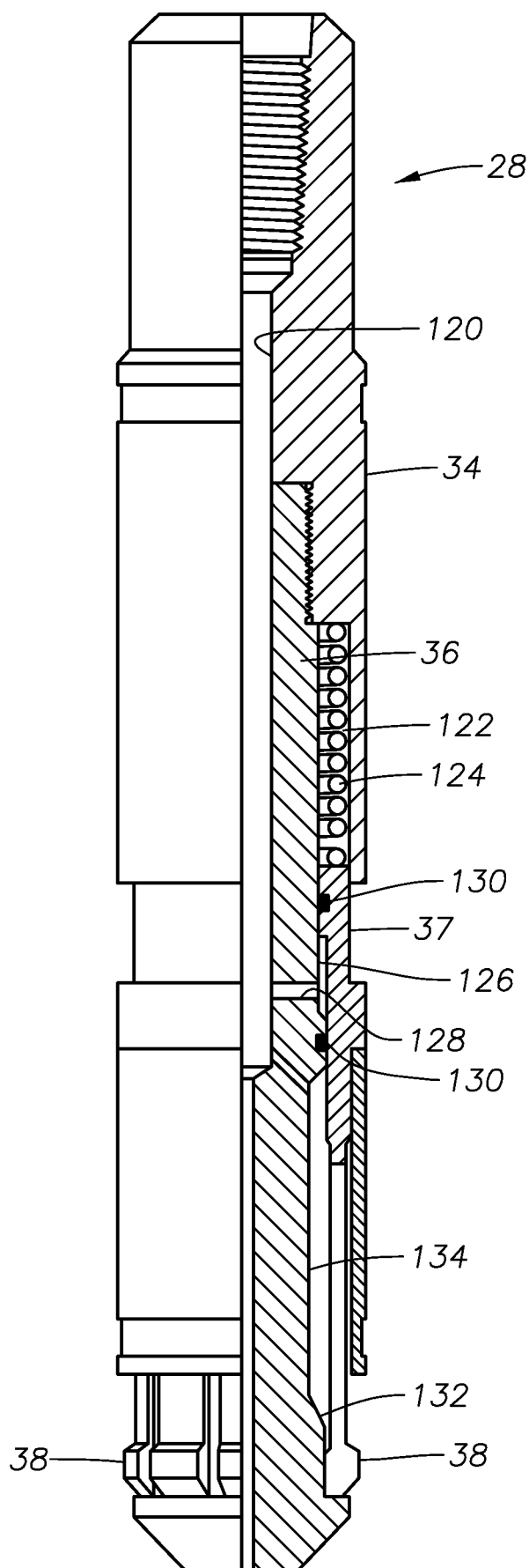


Fig. 6

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Fig. 7



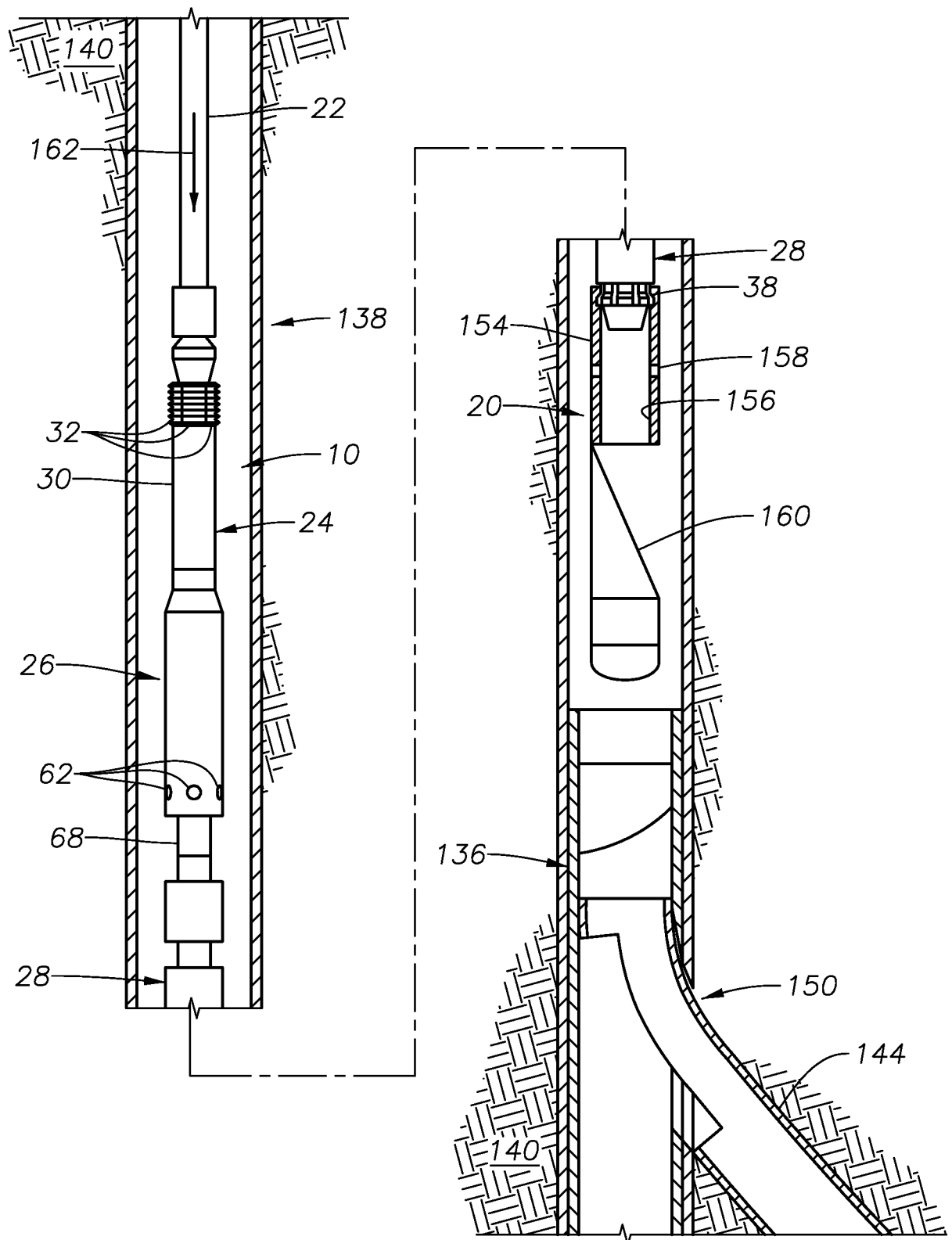


Fig. 8

