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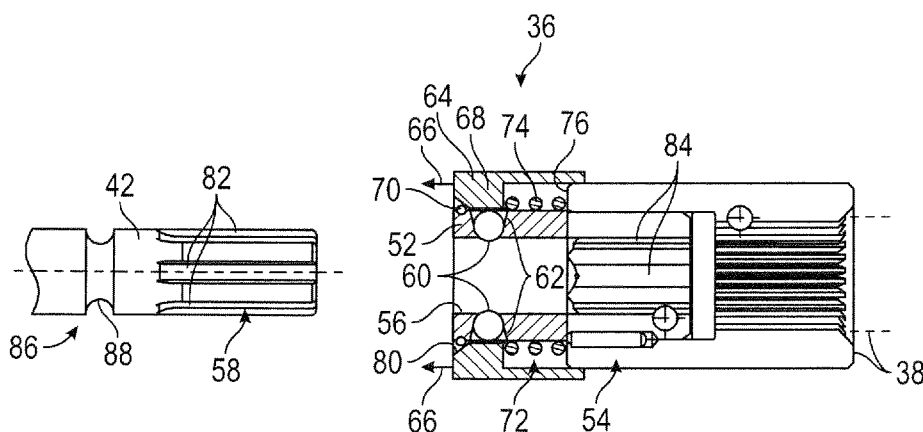


FIG.2

(57) Abstract: A technique enables quick release coupling of pumping sections used to construct a pumping system, e.g. an electric submersible progressive cavity pumping system. The electric submersible progressive cavity pumping system may comprise a first pump section with a first internal shaft and a second pump section with a second internal shaft. A quick release coupling is used to releasably coupled ends of the first internal shaft and the second internal shaft. As a result, the electric submersible progressive cavity pumping system may be handled and shipped in separate sections and then assembled at the wellsite or other end-use location.



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SYSTEM AND METHOD FOR QUICK RELEASE COUPLING OF PUMPING SYSTEM COMPONENTS

BACKGROUND

[0001] Submersible pumping systems are used in a variety of downhole pumping
5 operations, including hydrocarbon production operations. One type of submersible
pumping system is an electric submersible progressive cavity pumping system. This type
of pumping system may be powered with a submersible motor located downhole rather
than using, for example, a surface drive coupled with a downhole progressive cavity
pump via a sucker rod. Other than the submersible motor, the components of a
10 conventional electric submersible progressive cavity pumping system generally are
assembled as a single unit before insulation. As a result, the preassembled pumping
system components provide a relatively long pumping system, e.g. 10-15 m or more,
which presents difficulties with respect to storage, handling, and installation into a well.
The system length also can present problems with respect to transportation and often is
15 transported as oversized cargo.

SUMMARY

[0002] In general, a system and methodology are provided for enabling quick
release coupling of pumping sections used to construct a pumping system, e.g. an
electric submersible progressive cavity pumping system. According to an embodiment,
20 the electric submersible progressive cavity pumping system has a first pump section
with a first internal shaft and a second pump section with a second internal shaft. A
quick release coupling is used to releasably coupled ends of the first internal shaft and
the second internal shaft. As a result, the electric submersible progressive cavity
pumping system may be handled and shipped in separate sections and then assembled at
25 the wellsite or other end-use location.

[0003] However, many modifications are possible without materially departing
from the teachings of this disclosure. Accordingly, such modifications are intended to be
included within the scope of this disclosure as defined in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

30 [0004] Certain embodiments of the disclosure will hereafter be described with
reference to the accompanying drawings, wherein like reference numerals denote like
elements. It should be understood, however, that the accompanying figures illustrate the

various implementations described herein and are not meant to limit the scope of various technologies described herein, and:

[0005] Figure 1 is a schematic illustration of a portion of an electric submersible progressive cavity pumping system having sections which may be releasably joined via a quick release coupling, according to an embodiment of the disclosure;

[0006] Figure 2 is a cross-sectional illustration of an embodiment of a quick release coupling, according to an embodiment of the disclosure;

[0007] Figure 3 is an illustration similar to that of Figure 2 but showing the quick release coupling in a different operational position, according to an embodiment of the disclosure; and

[0008] Figure 4 is a cross-sectional illustration of another embodiment of a quick release coupling, according to an embodiment of the disclosure.

DETAILED DESCRIPTION

[0009] In the following description, numerous details are set forth to provide an understanding of some embodiments of the present disclosure. However, it will be understood by those of ordinary skill in the art that the system and/or methodology may be practiced without these details and that numerous variations or modifications from the described embodiments may be possible.

[0010] The disclosure herein generally involves a system and methodology for enabling releasable coupling of pumping sections via a quick release coupling. The quick release coupling may be employed in a variety of electric submersible pumping systems which are used downhole in the production of oil or used in other applications. According to an embodiment, an electric submersible progressive cavity pumping system may be constructed in at least two sections which are releasably joined by at least one quick release coupling. The electric submersible progressive cavity pumping system may comprise various components, such as a progressive cavity pump, flex shaft unit, support unit, submersible motor, and/or other components suitable for a given pumping operation.

[0011] The progressive cavity pump section may be in the form of a screw pump which utilizes eccentricity of the rotor and stator axes to pump fluid. In this type of pump, relatively high rotating friction torque exists between the rotor and the stator such that the rotor creates axial force up or down when rotated in a desired direction of

rotation within the stator. The system and methodology described herein provide a special coupling having a quick release function which enables splitting of the electric submersible progressive cavity pumping system into two or more pieces. The pieces can then be connected at the well during installation (or at other suitable end-use locations).

5 [0012] According to an example, the electric submersible progressive cavity pumping system may comprise a first pump section with a first internal shaft and a second pump section with a second internal shaft. The quick release coupling is used to releasably coupled ends of the first internal shaft and the second internal shaft. As a result, the electric submersible progressive cavity pumping system may be handled and
10 shipped in separate sections and then assembled at the wellsite or other end-use location.

 [0013] Referring generally to Figure 1, a pumping system 30 is illustrated as constructed in separate pumping system sections 32, 34 which may be releasably joined via a quick release coupling 36. In the specific embodiment illustrated, the pumping system 30 is in the form of an electric submersible progressive cavity pumping system
15 having first pump section 32 with a first internal shaft 38 rotatably positioned within a first outer housing 40. According to this embodiment, the electric submersible progressive cavity pumping system 30 also comprises second pump section 34 with a second internal shaft 42 rotatably positioned within a second outer housing 44.

 [0014] During preparation and installation of the electric submersible progressive
20 cavity pumping system 30, the quick release coupling 36 may be used to quickly and easily form a releasable coupling between the first internal shaft 38 and the second internal shaft 42. Coupling the shafts 38, 42 forms an overall pumping system shaft for driving the corresponding pump, e.g. the progressive cavity pump. In the illustrated example, the first outer housing 40 and the second outer housing 44 also may be joined
25 after coupling shafts 38, 42 via a suitable coupling 46. Coupling 46 may be in the form of a threaded coupling, flange type coupling, or other suitable coupling. In some applications, at least one of the outer housing 40, 44 is axially adjustable, e.g. slidable, to facilitate enclosure of the quick release coupling 36 and engagement of the housing coupling 46.

30 [0015] In Figure 1, the pumping system sections 32, 34 are illustrated as being assembled at a wellsite 48 in general proximity with a wellbore 50 into which the electric submersible progressive cavity pumping system 30 is to be deployed. However,

the pumping system sections 32, 34 as well as other sections of pumping system 30 may be coupled together for installation at other suitable locations after initial handling and shipping of the separate pumping system sections.

[0016] Referring generally to Figure 2, an embodiment of quick release coupling 36 is illustrated. In this example, the quick release coupling 36 comprises a coupling body 52 connected to an end 54 of the first internal shaft 38. By way of example, the coupling body 52 may be welded to end 54, integrally formed with end 54, or secured to end 54 by a suitable connector or other connection technique. The coupling body 52 comprises an internal passage 56 sized to receive an end 58 of the second internal shaft 42.

[0017] Additionally, the quick release coupling 36 may comprise a radially movable element 60, e.g. a plurality of radially movable elements 60, which are positioned in corresponding passages(s) 62 disposed in the coupling body 52. By way of example, the corresponding passages 62 may be radially oriented passages 62 extending generally radially through the coupling body 52. In the illustrated embodiment, the radially inward ends of the passages 62 are constructed to prevent the movable elements 60 from falling into internal passage 56. The radially movable elements 60 may be in the form of balls or other suitable elements captured in the corresponding passages 62.

[0018] In the embodiment illustrated, the quick release coupling 36 also comprises a bushing retainer 64 slidably positioned over the coupling body 52, e.g. along an exterior surface of the coupling body 52. According to an example, the bushing retainer 64 is spring biased in the direction of arrows 66 and to a position forcing the plurality of radially movable elements 60 to a radially inward position, as illustrated in Figure 2. In this radially inward position, the movable elements 60, e.g. balls, extend into internal passage 56. By way of example, the bushing retainer 64 may have a thicker diameter section 68 which slides along the exterior surface of coupling body 52 to a position effectively blocking or preventing the radially movable elements 60 from moving outwardly along passages 62.

[0019] In some embodiments, the bushing retainer 64 may be retained on coupling body 52 by a suitable retention member 70 which may be connected with the coupling body 52 to limit free axial movement of the bushing retainer 64. By way of example, the retention member 70 may be in the form of the illustrated snap ring. The

snap ring may be positioned about an end of the coupling body 52 to block unwanted removal of the bushing retainer 64 from the coupling body 52.

[0020] The spring biasing of the bushing retainer 64 in the direction of arrows 66 may be accomplished by a spring member 72. In some embodiments, the spring member
5 72 may be in the form of a coil spring 74 positioned about coupling body 52 between the thicker diameter section 68 of bushing retainer 64 and an end surface 76 of first internal shaft 38.

[0021] To assemble the first pump section 32 with the second pump section 34, the shaft ends 54, 58 are moved into proximity with each other. The bushing retainer 64
10 is then shifted axially along coupling body 52 in the direction of arrows 78 as illustrated in Figure 3. This axial shifting of bushing retainer 64 moves the thicker diameter section 68 to a position at least substantially clearing passages 62 which allows the radially movable elements 60 to move radially outward. It should be noted the bushing retainer 64 may comprise a sloped surface 80 or other suitable retention feature positioned to
15 allow the radially outward movement of movable elements 60 while still preventing the movable elements 60 from falling out of the corresponding passages 62.

[0022] Once the radially movable elements 60 are allowed to move in a radially outward direction, the second internal shaft end 58 may be inserted through internal passage 56 and into the first internal shaft end 54. In the illustrated embodiment, the
20 second internal shaft end 58 comprises splines 82 which are slidably received in corresponding spline features 84 to form a splined connection. The spline features 84 may be formed internally within first internal shaft end 54. The splined connection rotationally secures or locks the second internal shaft 42 to the first internal shaft 38 to ensure the overall shaft 38, 42 rotates as a unit when operating the electric submersible
25 progressive cavity pumping system 30 or other type of pumping system.

[0023] After the shaft end 58 is fully inserted into shaft end 54, the bushing retainer 64 may be released so the spring member 72 can force bushing retainer 64 in the axial direction of arrows 66. The axial movement of bushing retainer 64 forces the radially movable elements 60 to their radially inward position (see Figure 2). The
30 radially movable elements 60 are forced into a corresponding recess 86 formed in or proximate the end 58 of second internal shaft 42. In the illustrated example, recess 86 is in the form of a circumferential groove 88 formed around shaft 42 on an inward side of

splines 82. The thicker diameter section 68 of bushing retainer 64 holds the movable elements 60 in the groove 88.

[0024] When the radially movable elements 60, e.g. balls, are moved into and held within recess 86, the shaft ends 54, 58 become axially locked together. In other words, the second internal shaft 42 is not able to axially separate from the first internal shaft 38.

[0025] At this stage, the outer housings 40, 44 may be joined via coupling 46. In some embodiments, at least one of the outer housings is axially movable or comprises an axially movable portion which may be slid into engagement with the corresponding outer housing to facilitate joining via coupling 46. Depending on the construction of outer housings 40, 44 and the accessibility of quick release coupling 36, the shifting of bushing retainer 64 may be done by hand or by suitable hand tooling or automated tooling.

[0026] To disassemble the first and second pump sections 32, 34, the procedure may be reversed. The outer housings 40, 44 may be decoupled to enable shifting of retainer bushing 64 in the direction of arrows 78. Once the thicker diameter section 68 is sufficiently clear of passages 62, the movable elements 60 are able to shift radially outward a sufficient distance to clear recess 86 as the shaft ends 54, 58 are pulled apart.

[0027] Referring generally to Figure 4, another embodiment of quick release coupling 36 is illustrated. In this example, the quick release coupling 36 again comprises coupling body 52. However, this embodiment of coupling body 52 includes an extended portion 90 having an internal passage 92, e.g. a splined passage, for receiving first internal shaft 38. In some embodiments, the splined passage 92 may work in cooperation with a retention member 94 to rotationally and axially secure first internal shaft 38. The coupling body 52 also comprises internal passage 56 sized to receive end 58 of the second internal shaft 42.

[0028] The quick release coupling 36 may again comprise radially movable element 60, e.g. a plurality of radially movable elements 60 which are positioned in corresponding passages 62 disposed in the coupling body 52. By way of example, the corresponding passages 62 may be radially oriented passages 62 extending generally radially through the coupling body 52. In the illustrated embodiment, the radially inward ends of the passages 62 are constructed to prevent the movable elements 60 from falling

into internal passage 56. The radially movable elements 60 may be in the form of balls or other suitable elements captured in the corresponding passages 62.

[0029] Referring again to Figure 4, the illustrated embodiment of quick release coupling 36 also comprises bushing retainer 64 slidably positioned over the coupling
5 body 52, e.g. along an exterior surface of the coupling body 52. The bushing retainer 64 may be spring biased in a direction toward an abutment 96. By way of example, the abutment 96 may be in the form of an abutment ring held in place by a retention ring 98. The abutment 96 and the retention ring 98 may both be mounted along an exterior surface of coupling body 52. The abutment 96 serves as another type of retention
10 member 70.

[0030] When the bushing retainer 64 is biased against abutment 96, the plurality of radially movable elements 60 are forced to a radially inward position, as illustrated. In this radially inward position, the movable elements 60, e.g. balls, extend into internal passage 56. By way of example, the bushing retainer 64 may include the thicker
15 diameter section 68 which is located to effectively block the radially movable elements 60 from moving outwardly along passages 62 while the bushing retainer 64 is biased against abutment 96.

[0031] The bushing retainer 64 may be biased toward abutment 96 by spring member 72. In some embodiments, the spring member 72 may be in the form of coil
20 spring 74 positioned about coupling body 52 between the thicker diameter section 68 of bushing retainer 64 and a shoulder 100 of coupling body 52.

[0032] To assemble the first pump section 32 with the second pump section 34, the shaft 38 is inserted and retained within internal passage 92. Additionally, the shaft end 58 of shaft 42 is moved into internal passage 56 while the bushing retainer 64 is
25 shifted axially along coupling body 52 in a direction to the right in Figure 4. This axial shifting of bushing retainer 64 moves the thicker diameter section 68 to a position at least substantially clearing passages 62 which allows the radially movable elements 60 to move radially outward. It should be noted the bushing retainer 64 may comprise sloped surface 80 or other suitable feature positioned to allow the radially outward
30 movement of movable elements 60 while still preventing the movable elements 60 from falling out of the corresponding passages 62.

[0033] Once the radially movable elements 60 are allowed to move in a radially outward direction, the second internal shaft end 58 may be inserted through internal passage 56. In some embodiments, the second internal shaft end 58 may comprise splines which are slidably received in splined internal passage 92 to form a splined connection. A splined connection rotationally secures or locks the second internal shaft 42 with respect to the first internal shaft 38 to ensure the overall shaft 38, 42 rotates as a unit when operating the electric submersible progressive cavity pumping system 30 or other type of pumping system.

[0034] It should be noted the bushing retainer 64 may comprise a groove 102 or a plurality of grooves 102 which are slidably engaged with corresponding pins 104. The corresponding pins 104 may be secured to coupling body 52, as illustrated. When the bushing retainer 64 is shifted against spring member 72 to release movable elements 60, the pins 104 slide along grooves 102. The grooves 102 also may comprise retention features 106 which enable twisting of the bushing retainer 64 until the pins 104 are positioned in retention features 106. When the pins 104 are captured in retention features 106, the bushing retainer 64 is held in this fully retracted position to facilitate insertion and connection of shaft 42.

[0035] After the shaft end 58 is fully inserted into shaft end 54, the bushing retainer 64 may be released by rotating the bushing retainer 64 until pins 104 are released from retention features 106. The spring member 72 is then able to force bushing retainer 64 in an axial direction toward abutment 96. This axial movement of bushing retainer 64 forces the radially movable elements 60 to their radially inward position. The radially movable elements 60 are forced into the corresponding recess 86 formed in or proximate the end 58 of second internal shaft 42 (see embodiment illustrated in Figures 2 and 3). As with the previously described embodiment, recess 86 may be in the form of circumferential groove 88 formed around shaft 42. The thicker diameter section 68 of bushing retainer 64 holds the movable elements 60 in the recess 86.

[0036] When the radially movable elements 60, e.g. balls, are moved into and held within recess 86, the shaft ends 54, 58 become axially locked together. In other words, the second internal shaft 42 is not able to axially separate with respect to the first internal shaft 38.

[0037] Depending on the parameters of a given application, the pumping system 30 may have many types of components arranged in various configurations. For example, the pumping system 30 may comprise various types and sizes of progressive cavity pumps, flex shaft units, support units, motors, and/or other pumping system components constructed in various arrangements. The pumping system 30 also may utilize pumping structures other than progressive cavity style pumps.

[0038] Similarly, the quick release coupling 36 may comprise various types of components and features constructed in suitable sizes and materials. For example, the coupling body 52 and the bushing retainer 64 may have different sizes and configurations. Similarly, a single radially movable element 60 or a plurality of radially movable elements 60 may be constructed as balls, cylinders, elongated elements with hemispherical ends, or other suitable elements able to shift inwardly and outwardly to selectively lock and unlock the interconnected shaft ends 54, 58. Additionally, various mechanisms may be used to rotationally lock the shaft ends 54, 58, including splines 82, 84, key and keyway configurations, and/or other suitable locking features.

[0039] Although a few embodiments of the disclosure have been described in detail above, those of ordinary skill in the art will readily appreciate that many modifications are possible without materially departing from the teachings of this disclosure. Accordingly, such modifications are intended to be included within the scope of this disclosure as defined in the claims.

CLAIMS

What is claimed is:

1. A system for enabling quick release of sections of a pumping assembly, comprising:

5 an electric submersible progressive cavity pumping system having a first pump section with a first internal shaft and a second pump section with a second internal shaft, the second internal shaft being coupled with the first internal shaft via a quick release coupling having:

10 a coupling body connected to an end of the first internal shaft, the coupling body comprising an internal passage sized to receive an end of the second internal shaft;

 a plurality of radially movable elements captured in corresponding passages oriented through the coupling body; and

15 a bushing retainer slidably positioned over the coupling body, the bushing retainer being spring biased to a position forcing the plurality of radially movable elements to a radially inward position for engagement with a groove oriented in a circumferential direction about the end of the second internal shaft.

2. The system as recited in claim 1, wherein the quick release coupling comprises a snap ring positioned about the coupling body to block removal of the bushing retainer from the coupling body.

20 3. The system as recited in claim 1, wherein the plurality of radially movable elements comprises a plurality of radially movable balls.

4. The system as recited in claim 1, wherein the end of the first internal shaft and the end of the second internal shaft are engaged via splines and releasably held in splined engagement via the quick release coupling.

25 5. The system as recited in claim 4, wherein the bushing retainer is spring biased via a coil spring disposed about the coupling body.

30 6. The system as recited in claim 5, wherein sufficient linear movement of the bushing retainer against the coil spring allows the plurality of radially movable elements to shift radially outward until the end of the second internal shaft can be released from the end of the first internal shaft.

7. A method of releasably coupling, comprising

constructing an electric submersible progressive cavity pumping system with a first pump section having a first internal shaft located in a first outer housing and a second pump section having a second internal shaft located in a second outer housing;

5 using a quick release coupling to releasably engage an end of the first internal shaft with a corresponding end of the second internal shaft; and
coupling the first outer housing with the second outer housing.

8. The method as recited in claim 7, further comprising forming the quick release coupling with a coupling body connected to the end of the first internal shaft and providing the coupling body with an internal passage sized to receive the end of the
10 second internal shaft.

9. The method as recited in claim 8, further comprising forming the quick release coupling with a plurality of radially movable elements captured in corresponding passages oriented through the coupling body.

10. The method as recited in claim 9, further comprising forming the quick
15 release coupling with a bushing retainer slidably positioned over the coupling body; and spring biasing the bushing retainer to a position forcing the plurality of radially movable elements to a radial inward position for engagement with a recess formed in the corresponding end of the second internal shaft when the corresponding end of the second internal shaft is joined with the end of the first internal shaft.

20 11. The method as recited in claim 10, further comprising holding the bushing retainer in slidable engagement with the coupling body via a snap ring.

12. The method as recited in claim 11, further comprising forming the plurality of radially movable elements as balls.

25 13. The method as recited in claim 12, further comprising rotationally affixing the corresponding end of the second internal shaft with the end of the first internal shaft via splines.

14. The method as recited in claim 13, further comprising providing the spring bias with a coil spring placed over the coupling body.

15. A system, comprising:
30 a first pump section with a first internal shaft and a second pump section with a second internal shaft, the second internal shaft being rotationally secured to the first

internal shaft via splines and being coupled with the first internal shaft via a quick release coupling, the quick release coupling having:

a coupling body connected to an end of the first internal shaft, the coupling body comprising an internal passage sized to receive an end of the second internal shaft;

5 a plurality of radially movable ball elements captured in the coupling body; and

a bushing retainer slidably positioned over the coupling body, the bushing retainer being biased to a position forcing the plurality of radially movable ball elements to a radially inward position for engagement with a corresponding feature in the second internal shaft to axially secure the second internal shaft to the first internal shaft.

10 16. The system as recited in claim 15, wherein the quick release coupling comprises a snap ring positioned about the coupling body to block removal of the bushing retainer from the coupling body.

17. The system as recited in claim 15, wherein the plurality of radially movable ball elements is captured in radially oriented passages through the coupling body.

15 18. The system as recited in claim 15, wherein the first and second internal shafts are disposed in first and second outer pump system housings respectively.

19. The system as recited in claim 15, wherein the bushing retainer is spring biased via a coil spring disposed about the coupling body.

20 20. The system as recited in claim 19, wherein sufficient linear movement of the bushing retainer against the coil spring allows the plurality of radially movable ball elements to move radially outward until the end of the second internal shaft can be released from the end of the first internal shaft.

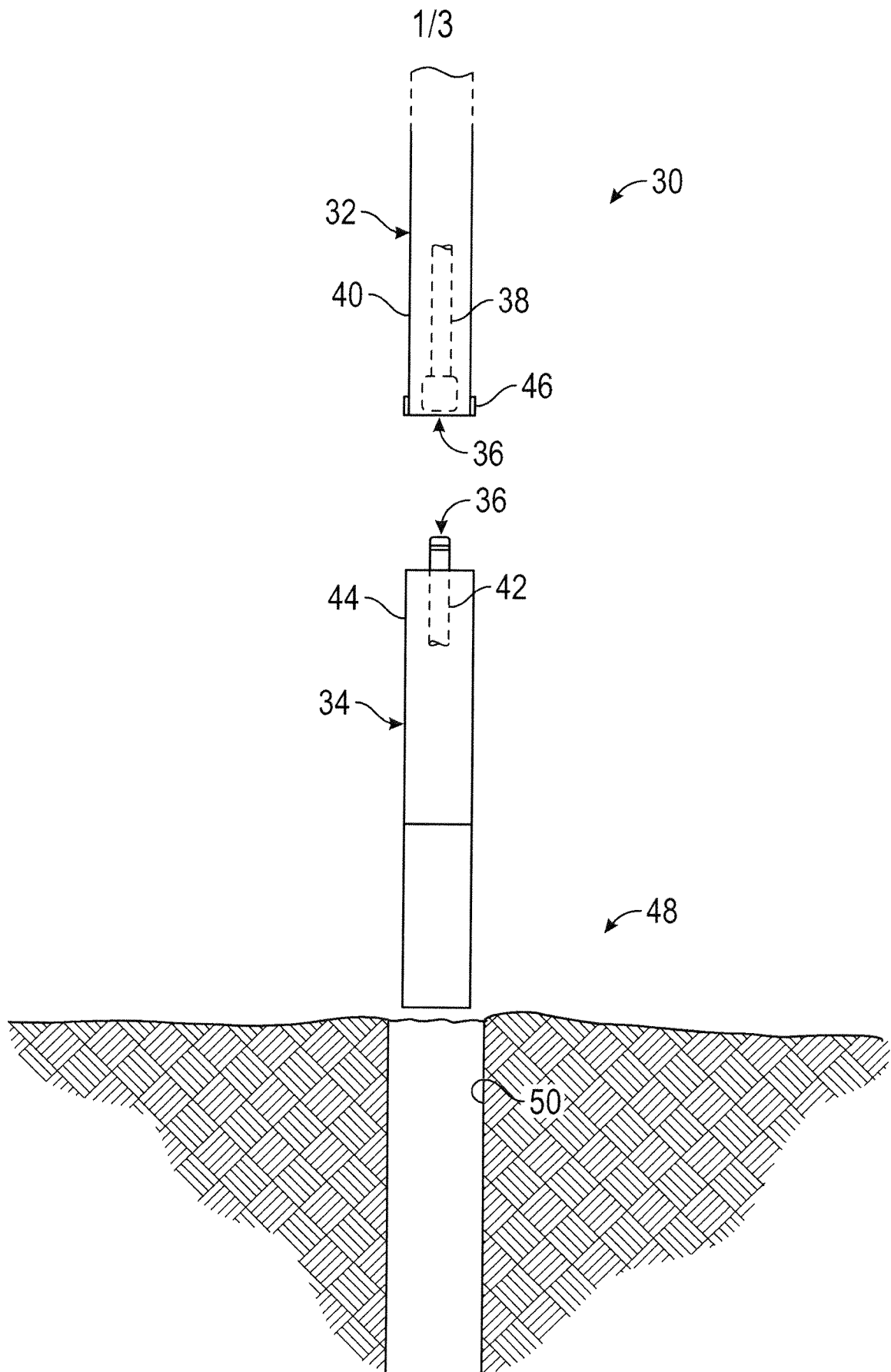


FIG.1

2/3

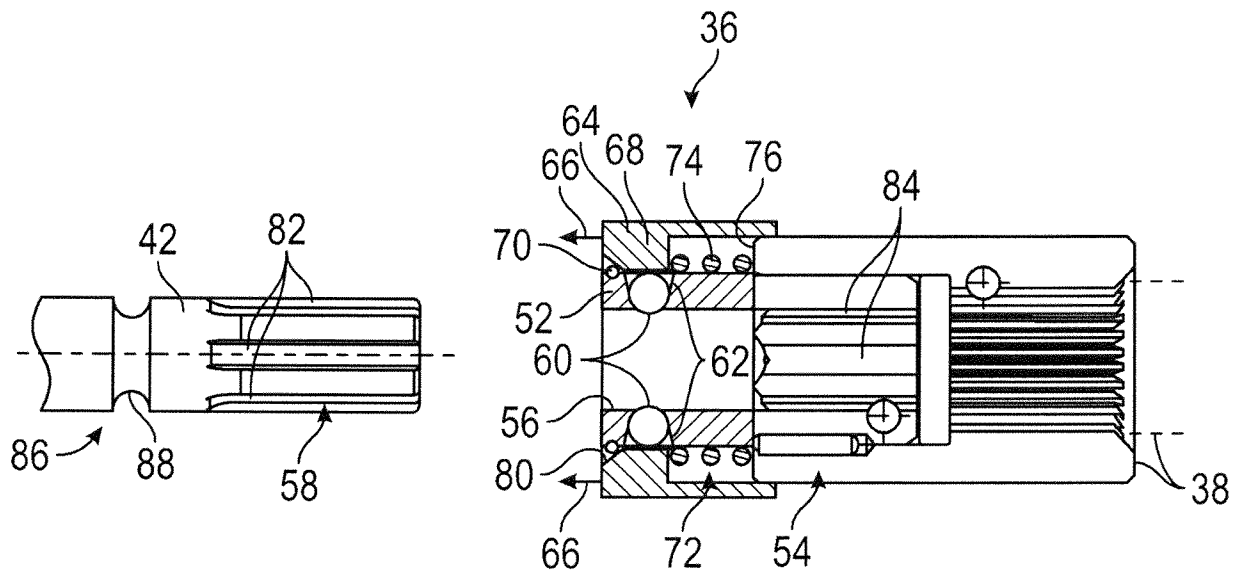


FIG. 2

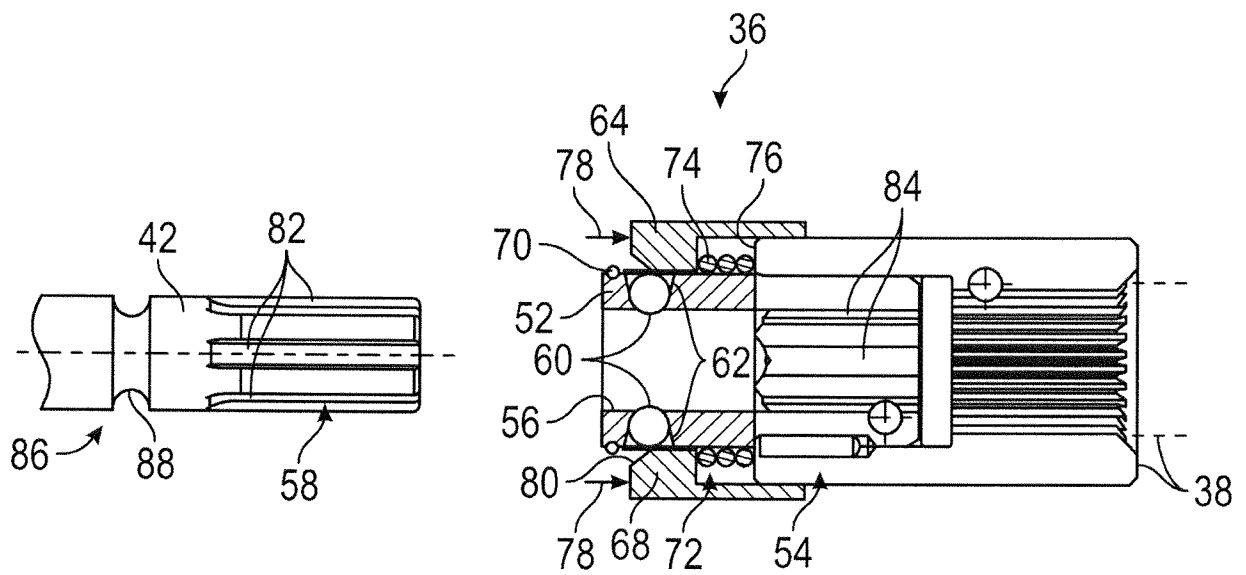


FIG. 3

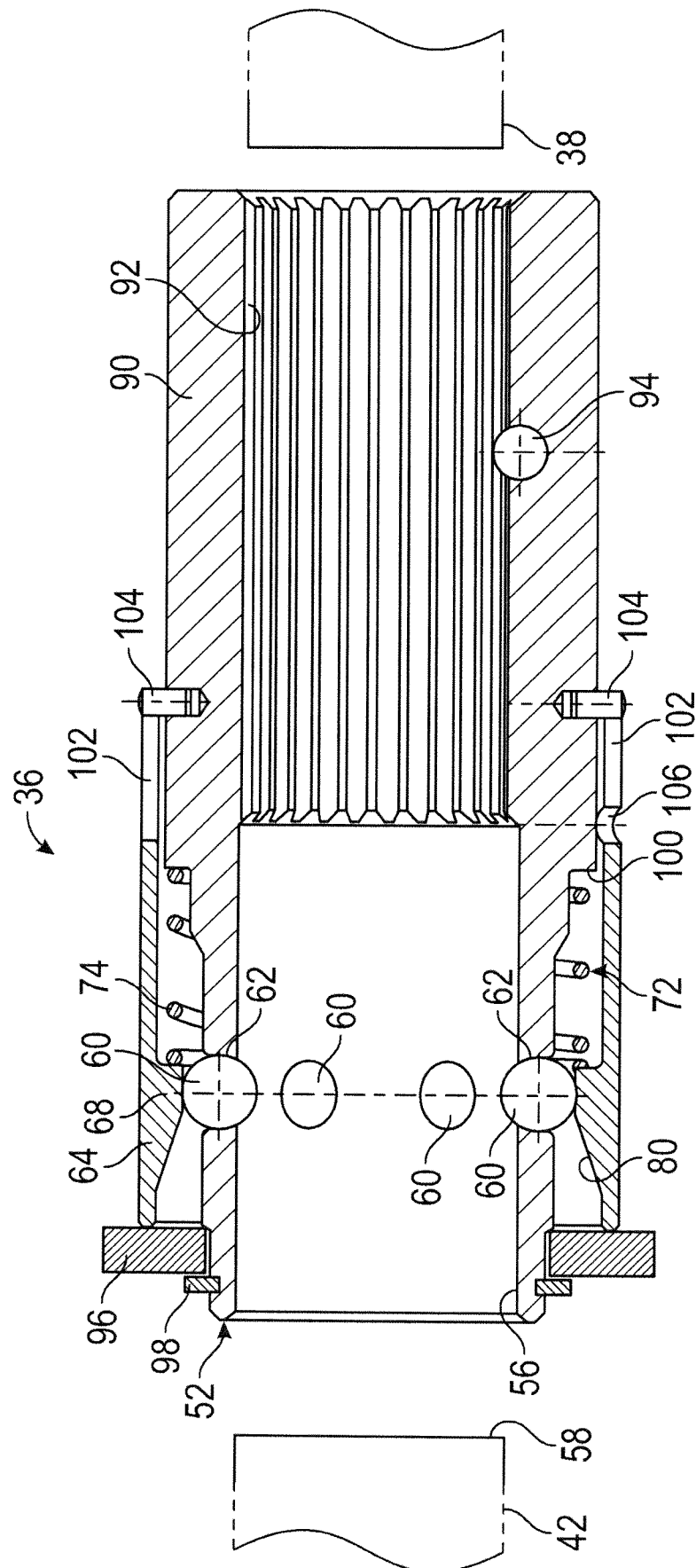


FIG.4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/RU 2018/000827

A. CLASSIFICATION OF SUBJECT MATTER		
F16B 21/06 (2006.01) F16B 21/18 (2006.01) F16L 37/23 (2006.01)		
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)		
F16B 21/00-21/20, F16L 37/00-37/26		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
PatSearch (RUPTO internal), USPTO, PAJ, Esp@cenet, DWPI, EAPATIS, PATENTSCOPE		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	RU 2617386 C1 (AKTSIONERNOE OBTSESCTVO «NOVOMET-PERM») 24.04.2017 abstract; p. 6, line 33 –p. 7, line 1	1-20
Y	RU 168807 U1 (MOKHOV MIKHAIL ALBERTOVICH. et al.) 21.02.2017, abstract	1-20
Y	RU 2118734 C1 (OTKRITOE AKTCIONERNOE OBTSESTVO FINANSOVO-PROMISHLENNAJ KOMPANIJ «KEDR-M») 10.09.1998, p. 3, lines 38-47; fig. 1,2	1-20
Y	SU 1645732 A1 (KOMPANISTOV S. N.) 30.04.1991, col. 2, lines 8-4	1-20
A	RU 2656509 C1 (LOGINOVA OLGA IOSIFOVNA) 05.06.2018	1-20
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
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Date of the actual completion of the international search		Date of mailing of the international search report
21 August 2019 (21.08.2019)		05 September 2019 (05.09.2019)
Name and mailing address of the ISA/RU: Federal Institute of Industrial Property, Berezhkovskaya nab., 30-1, Moscow, G-59, GSP-3, Russia, 125993 Facsimile No: (8-495) 531-63-18, (8-499) 243-33-37		Authorized officer V. Grishanov Telephone No. 8 499 240 25 91