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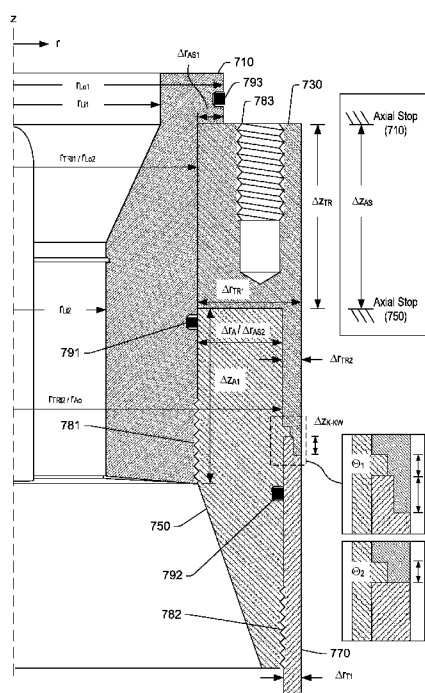


Fig. 9

(57) Abstract: An assembly can include a cylindrical torque-resisting component that includes a flange portion, a first face, a through bore, and a counter-bore that defines a second face; a cylindrical adapter component that includes external threads, a through bore with internal threads, and an axial stop; a cylindrical locking component that includes external threads that engage the internal threads of the cylindrical adapter component, and an axial stop where the axial stops delimit the first and second faces of the cylindrical torque-resisting component; and a tube that includes internal threads that engage the external threads of the cylindrical adapter component where an end of the cylindrical torque-resisting component and an end of the tube include key and keyway features that orient the cylindrical torque-resisting component with respect to the tube.

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SUBMERSIBLE TORQUE-RESISTING COUPLING

BACKGROUND

[0001] Submersible equipment can include various components that are coupled, for example, at joints. Fluid leakage at one or more of the joints can damage such equipment.

SUMMARY

[0002] An assembly can include a cylindrical torque-resisting component that includes a flange portion, a first face, a through bore, and a counter-bore that defines a second face; a cylindrical adapter component that includes external threads, a through bore with internal threads, and an axial stop; a cylindrical locking component that includes external threads that engage the internal threads of the cylindrical adapter component, and an axial stop where the axial stops delimit the first and second faces of the cylindrical torque-resisting component; and a tube that includes internal threads that engage the external threads of the cylindrical adapter component where an end of the cylindrical torque-resisting component and an end of the tube include key and keyway features that orient the cylindrical torque-resisting component with respect to the tube. A method can include providing an assembly that includes a cylindrical torque-resisting component that includes a flange portion, a first face, a through bore, and a counter-bore that defines a second face; a cylindrical adapter component that includes external threads, a through bore with internal threads, and an axial stop; a cylindrical locking component that includes external threads that engage the internal threads of the cylindrical adapter component, and an axial stop where the axial stops axially locate the first and second faces of the cylindrical torque-resisting component; and a tube that includes internal threads that engage the external threads of the cylindrical adapter component where an end of the cylindrical torque-resisting component and an end of the tube include key and keyway features that orient the cylindrical torque-resisting component with respect to the tube; applying torque to the assembly; and via the key and keyway features, limiting rotation of the cylindrical torque-resisting component with respect to the tube. An electric submersible pump can include a shaft; a pump operatively coupled to the shaft; an electric motor operatively coupled to the shaft; and a housing where the housing includes an assembly that includes a cylindrical

torque-resisting component, a cylindrical adapter component, and a cylindrical locking component where an end of the cylindrical torque-resisting component and an end of the housing include key and keyway features that orient the cylindrical torque-resisting component with respect to the tube. Various other apparatuses, systems, methods, etc., are also disclosed.

[0003] This summary is provided to introduce a selection of concepts that are further described below in the detailed description. This summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in limiting the scope of the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Features and advantages of the described implementations can be more readily understood by reference to the following description taken in conjunction with the accompanying drawings.

[0005] Fig. 1 illustrates examples of equipment in geologic environments;

[0006] Fig. 2 illustrates an example of an electric submersible pump system;

[0007] Fig. 3 illustrates examples of equipment;

[0008] Fig. 4 illustrates an example of a system that includes a motor;

[0009] Fig. 5 illustrates examples of equipment;

[0010] Fig. 6 illustrates examples of equipment;

[0011] Fig. 7 illustrates an example of an assembly;

[0012] Fig. 8 illustrates the assembly of Fig. 7;

[0013] Fig. 9 illustrates an example of a portion of an assembly;

[0014] Fig. 10 illustrates an example of a method;

[0015] Fig. 11 illustrates an example of a locking component;

[0016] Fig. 12 illustrates an example of a torque-resisting component;

[0017] Fig. 13 illustrates an example of an adapter component;

[0018] Fig. 14 illustrates an example of a tube;

[0019] Fig. 15 illustrates an example of a portion of an assembly and examples of components; and

[0020] Fig. 16 illustrates example components of a system and a networked system.

DETAILED DESCRIPTION

[0021] The following description includes the best mode presently contemplated for practicing the described implementations. This description is not to be taken in a limiting sense, but rather is made merely for the purpose of describing the general principles of the implementations. The scope of the described implementations should be ascertained with reference to the issued claims.

[0022] Fig. 1 shows examples of geologic environments 120 and 140. In Fig. 1, the geologic environment 120 may be a sedimentary basin that includes layers (e.g., stratification) that include a reservoir 121 and that may be, for example, intersected by a fault 123 (e.g., or faults). As an example, the geologic environment 120 may be outfitted with any of a variety of sensors, detectors, actuators, etc. For example, equipment 122 may include communication circuitry to receive and to transmit information with respect to one or more networks 125. Such information may include information associated with downhole equipment 124, which may be equipment to acquire information, to assist with resource recovery, etc. Other equipment 126 may be located remote from a well site and include sensing, detecting, emitting or other circuitry. Such equipment may include storage and communication circuitry to store and to communicate data, instructions, etc. As an example, one or more satellites may be provided for purposes of communications, data acquisition, etc. For example, Fig. 1 shows a satellite in communication with the network 125 that may be configured for communications, noting that the satellite may additionally or alternatively include circuitry for imagery (e.g., spatial, spectral, temporal, radiometric, etc.).

[0023] Fig. 1 also shows the geologic environment 120 as optionally including equipment 127 and 128 associated with a well that includes a substantially horizontal portion that may intersect with one or more fractures 129. For example, consider a well in a shale formation that may include natural fractures, artificial fractures (e.g., hydraulic fractures) or a combination of natural and artificial fractures. As an example, a well may be drilled for a reservoir that is laterally extensive. In such an example, lateral variations in properties, stresses, etc. may exist where an assessment of such variations may assist with planning, operations, etc. to develop the reservoir (e.g., via fracturing, injecting, extracting, etc.). As an example, the equipment 127 and/or 128 may include components, a system, systems, etc. for

fracturing, seismic sensing, analysis of seismic data, assessment of one or more fractures, etc.

[0024] As to the geologic environment 140, as shown in Fig. 1, it includes a well 141 (e.g., a bore) and equipment 147 for artificial lift, which may be an electric submersible pump (e.g., an ESP). In such an example, a cable or cables may extend from surface equipment to the equipment 147, for example, to provide power, to carry information, to sense information, etc.

[0025] Conditions in a geologic environment may be transient and/or persistent. Where equipment is placed within a geologic environment, longevity of the equipment can depend on characteristics of the environment and, for example, duration of use of the equipment as well as function of the equipment. Where equipment is to endure in an environment over an extended period of time, uncertainty may arise in one or more factors that could impact integrity or expected lifetime of the equipment. As an example, where a period of time may be of the order of decades, equipment that is intended to last for such a period of time may be constructed to endure conditions imposed thereon, whether imposed by an environment or environments and/or one or more functions of the equipment itself.

[0026] As an example, an environment may be a harsh environment, for example, an environment that may be classified as being a high-pressure and high-temperature environment (HPHT). A so-called HPHT environment may include pressures up to about 138 MPa (e.g., about 20,000 psi) and temperatures up to about 205 degrees C (e.g., about 400 degrees F and about 480 K), a so-called ultra-HPHT environment may include pressures up to about 241 MPa (e.g., about 35,000 psi) and temperatures up to about 260 degrees C (e.g., about 500 degrees F and about 530 K) and a so-called HPHT-hc environment may include pressures greater than about 241 MPa (e.g., about 35,000 psi) and temperatures greater than about 260 degrees C (e.g., about 500 degrees F and about 530 K). As an example, an environment may be classified based in one of the aforementioned classes based on pressure or temperature alone. As an example, an environment may have its pressure and/or temperature elevated, for example, through use of equipment, techniques, etc. For example, a SAGD operation may elevate temperature of an environment (e.g., by 100 degrees C or more; about 370 K or more).

[0027] Fig. 2 shows an example of an ESP system 200 that includes an ESP 210 as an example of equipment that may be placed in a geologic environment. As

an example, an ESP may be expected to function in an environment over an extended period of time (e.g., optionally of the order of years).

[0028] In the example of Fig. 2, the ESP system 200 includes a network 201, a well 203 disposed in a geologic environment (e.g., with surface equipment, etc.), a power supply 205, the ESP 210, a controller 230, a motor controller 250 and a VSD unit 270. The power supply 205 may receive power from a power grid, an onsite generator (e.g., natural gas driven turbine), or other source. The power supply 205 may supply a voltage, for example, of about 4.16 kV.

[0029] As shown, the well 203 includes a wellhead that can include a choke (e.g., a choke valve). For example, the well 203 can include a choke valve to control various operations such as to reduce pressure of a fluid from high pressure in a closed wellbore to atmospheric pressure. A wellhead may include one or more sensors such as a temperature sensor, a pressure sensor, a solids sensor, etc.

[0030] As to the ESP 210, it is shown as including cables 211 (e.g., or a cable), a pump 212, gas handling features 213, a pump intake 214, a motor 215, one or more sensors 216 (e.g., temperature, pressure, strain, current leakage, vibration, etc.) and a protector 217.

[0031] As an example, an ESP may include a REDA™ HOTLINE™ high-temperature ESP motor. Such a motor may be suitable for implementation in a thermal recovery heavy oil production system, such as, for example, SAGD system or other steam-flooding system.

[0032] As an example, an ESP motor can include a three-phase squirrel cage with two-pole induction. As an example, an ESP motor may include steel stator laminations that can help focus magnetic forces on rotors, for example, to help reduce energy loss. As an example, stator windings can include copper and insulation.

[0033] As an example, the one or more sensors 216 of the ESP 210 may be part of a digital downhole monitoring system. For example, consider the commercially available PHOENIX™ MULTISENSOR XT150 system marketed by Schlumberger Limited (Houston, Texas). A monitoring system may include a base unit that operatively couples to an ESP motor (see, e.g., the motor 215), for example, directly, via a motor-base crossover, etc. As an example, such a base unit (e.g., base gauge) may measure intake pressure, intake temperature, motor oil temperature, motor winding temperature, vibration, current leakage, etc. As

explained with respect to Fig. 4, a base unit may transmit information via a power cable that provides power to an ESP motor and may receive power via such a cable as well.

[0034] As an example, a remote unit may be provided that may be located at a pump discharge (e.g., located at an end opposite the pump intake 214). As an example, a base unit and a remote unit may, in combination, measure intake and discharge pressures across a pump (see, e.g., the pump 212), for example, for analysis of a pump curve. As an example, alarms may be set for one or more parameters (e.g., measurements, parameters based on measurements, etc.).

[0035] Where a system includes a base unit and a remote unit, such as those of the PHOENIX™ MULTISENSOR XT150 system, the units may be linked via wires. Such an arrangement provide power from the base unit to the remote unit and allows for communication between the base unit and the remote unit (e.g., at least transmission of information from the remote unit to the base unit). As an example, a remote unit is powered via a wired interface to a base unit such that one or more sensors of the remote unit can sense physical phenomena. In such an example, the remote unit can then transmit sensed information to the base unit, which, in turn, may transmit such information to a surface unit via a power cable configured to provide power to an ESP motor.

[0036] In the example of Fig. 2, the well 203 may include one or more well sensors 220, for example, such as the commercially available OPTICLINE™ sensors or WELLWATCHER BRITEBLUE™ sensors marketed by Schlumberger Limited (Houston, Texas). Such sensors are fiber-optic based and can provide for real time sensing of temperature, for example, in SAGD or other operations. As shown in the example of Fig. 1, a well can include a relatively horizontal portion. Such a portion may collect heated heavy oil responsive to steam injection. Measurements of temperature along the length of the well can provide for feedback, for example, to understand conditions downhole of an ESP. Well sensors may extend a considerable distance into a well and possibly beyond a position of an ESP.

[0037] In the example of Fig. 2, the controller 230 can include one or more interfaces, for example, for receipt, transmission or receipt and transmission of information with the motor controller 250, a VSD unit 270, the power supply 205 (e.g., a gas fueled turbine generator, a power company, etc.), the network 201, equipment in the well 203, equipment in another well, etc.

[0038] As shown in Fig. 2, the controller 230 may include or provide access to one or more modules or frameworks. Further, the controller 230 may include features of an ESP motor controller and optionally supplant the ESP motor controller 250. For example, the controller 230 may include the UNICONN™ motor controller 282 marketed by Schlumberger Limited (Houston, Texas). In the example of Fig. 2, the controller 230 may access one or more of the PIPESIM™ framework 284, the ECLIPSE™ framework 286 marketed by Schlumberger Limited (Houston, Texas) and the PETREL™ framework 288 marketed by Schlumberger Limited (Houston, Texas) (e.g., and optionally the OCEAN™ framework marketed by Schlumberger Limited (Houston, Texas)).

[0039] In the example of Fig. 2, the motor controller 250 may be a commercially available motor controller such as the UNICONN™ motor controller. The UNICONN™ motor controller can connect to a SCADA system, the ESPWATCHER™ surveillance system, etc. The UNICONN™ motor controller can perform some control and data acquisition tasks for ESPs, surface pumps or other monitored wells. As an example, the UNICONN™ motor controller can interface with the aforementioned PHOENIX™ monitoring system, for example, to access pressure, temperature and vibration data and various protection parameters as well as to provide direct current power to downhole sensors. The UNICONN™ motor controller can interface with fixed speed drive (FSD) controllers or a VSD unit, for example, such as the VSD unit 270.

[0040] For FSD controllers, the UNICONN™ motor controller can monitor ESP system three-phase currents, three-phase surface voltage, supply voltage and frequency, ESP spinning frequency and leg ground, power factor and motor load.

[0041] For VSD units, the UNICONN™ motor controller can monitor VSD output current, ESP running current, VSD output voltage, supply voltage, VSD input and VSD output power, VSD output frequency, drive loading, motor load, three-phase ESP running current, three-phase VSD input or output voltage, ESP spinning frequency, and leg-ground.

[0042] In the example of Fig. 2, the ESP motor controller 250 includes various modules to handle, for example, backspin of an ESP, sanding of an ESP, flux of an ESP and gas lock of an ESP. The motor controller 250 may include any of a variety of features, additionally, alternatively, etc.

[0043] In the example of Fig. 2, the VSD unit 270 may be a low voltage drive (LVD) unit, a medium voltage drive (MVD) unit or other type of unit (e.g., a high voltage drive, which may provide a voltage in excess of about 4.16 kV). As an example, the VSD unit 270 may receive power with a voltage of about 4.16 kV and control a motor as a load with a voltage from about 0 V to about 4.16 kV. The VSD unit 270 may include commercially available control circuitry such as the SPEEDSTAR™ MVD control circuitry marketed by Schlumberger Limited (Houston, Texas).

[0044] Fig. 3 shows cut-away views of examples of equipment such as, for example, a portion of a pump 320, a protector 370, a motor 350 of an ESP and a sensor unit 360. The pump 320, the protector 370, the motor 350 and the sensor unit 360 are shown with respect to cylindrical coordinate systems (e.g., r , z , Θ). Various features of equipment may be described, defined, etc. with respect to a cylindrical coordinate system. As an example, a lower end of the pump 320 may be coupled to an upper end of the protector 370, a lower end of the protector 370 may be coupled to an upper end of the motor 350 and a lower end of the motor 350 may be coupled to an upper end of the sensor unit 360 (e.g., via a bridge or other suitable coupling).

[0045] As shown in Fig. 3, a shaft segment of the pump 320 may be coupled via a connector to a shaft segment of the protector 370 and the shaft segment of the protector 370 may be coupled via a connector to a shaft segment of the motor 350. As an example, an ESP may be oriented in a desired direction, which may be vertical, horizontal or other angle. As shown in Fig. 3, the motor 350 is an electric motor that includes a connector 352, for example, to operatively couple the electric motor to a multiphase power cable, for example, optionally via one or more motor lead extensions (see, e.g., Fig. 4). Power supplied to the motor 350 via the connector 352 may be further supplied to the sensor unit 360, for example, via a wye point of the motor 350 (e.g., a wye point of a multiphase motor).

[0046] As an example, a connector may include features to connect one or more transmission lines dedicated to a monitoring system. For example, the connector 352 may include a socket, a pin, etc., that can couple to a transmission line dedicated to the sensor unit 360. As an example, the sensor unit 360 can

include a connector that can connect the sensor unit 360 to a dedicated transmission line or lines, for example, directly and/or indirectly.

[0047] As an example, the motor 350 may include a transmission line jumper that extends from the connector 352 to a connector that can couple to the sensor unit 360. Such a transmission line jumper may be, for example, one or more conductors, twisted conductors, an optical fiber, optical fibers, a waveguide, waveguides, etc. As an example, the motor 350 may include a high-temperature optical material that can transmit information. In such an example, the optical material may couple to one or more optical transmission lines and/or to one or more electrical-to-optical and/or optical-to-electrical signal converters.

[0048] Fig. 4 shows a block diagram of an example of a system 400 that includes a power source 401 as well as data 402 (e.g., information). The power source 401 provides power to a VSD block 470 while the data 402 may be provided to a communication block 430. The data 402 may include instructions, for example, to instruct circuitry of the circuitry block 450, one or more sensors of the sensor block 460, etc. The data 402 may be or include data communicated, for example, from the circuitry block 450, the sensor block 460, etc. In the example of Fig. 4, a choke block 440 can provide for transmission of data signals via a power cable 411 (e.g., including motor lead extensions “MLEs”). A power cable may be provided in a format such as a round format or a flat format with multiple conductors. MLEs may be spliced onto a power cable to allow each of the conductors to physically connect to an appropriate corresponding connector of an electric motor (see, e.g., the connector 352 of Fig. 3). As an example, MLEs may be bundled within an outer casing (e.g., a layer of armor, etc.).

[0049] As shown, the power cable 411 connects to a motor block 415, which may be a motor (or motors) of an ESP and be controllable via the VSD block 470. In the example of Fig. 4, the conductors of the power cable 411 electrically connect at a wye point 425. The circuitry block 450 may derive power via the wye point 425 and may optionally transmit, receive or transmit and receive data via the wye point 425. As shown, the circuitry block 450 may be grounded.

[0050] As an example, a cable may carry current to power a multiphase electric motor or other piece of equipment (e.g., downhole equipment powerable by a cable).

[0051] Fig. 5 shows an example of a pump system 500 and various examples of motor equipment. For example, the pump system 500 includes a pothead unit 501 includes opposing ends 502 and 504 and a through bore, for example, defined by a bore wall 505. As shown, the ends 502 and 504 may include flanges configured for connection to other units (e.g., a protector unit at the end 502 and a motor unit at the end 504). In the example of Fig. 5, the pothead unit 501 includes cable passages 507-1, 507-2 and 507-3 (e.g., cable connector sockets) configured for receipt of cable connectors 516-1, 516-2 and 516-3 of respective cables 514-1, 514-2 and 514-3.

[0052] Fig. 6 shows a perspective cut-away view of an example of a motor assembly 600 that includes a power cable 644 (e.g., MLEs, etc.) to supply energy, a shaft 650, a housing 660 that may be made of multiple components (e.g., multiple units joined to form the housing 660), stacked laminations 680, stator windings 670 of wire (e.g., magnet wire) and rotor laminations 690 and rotor windings 695 coupled to the shaft 650 (e.g., rotatably driven by energizing the stator windings 670).

[0053] As shown in Fig. 6, the housing 660 includes an inner surface 661 and an outer surface 665. As an example, the housing 660 can define one or more cavities via its inner surface 661 where one or more of the cavities may be hermetically sealed. As an example, such a cavity may be filled at least partially with dielectric oil. As an example, dielectric oil may be formulated to have a desired viscosity and/or viscoelastic properties, etc.

[0054] As shown, the shaft 650 may be fitted with a coupling 652 to couple the shaft to another shaft. A coupling may include, for example, splines that engage splines of one or more shafts. The shaft 650 may be supported by bearings 654-1, 654-2, 654-3, etc. disposed in the housing 660.

[0055] As shown, the housing 660 includes opposing axial ends 662 and 664 with the substantially cylindrical outer surface 665 extending therebetween. The outer surface 665 can include one or more sealable openings for passage of oil (e.g., dielectric oil), for example, to lubricate the bearings and to protect various components of the motor assembly 600. As an example, the motor assembly 600 may include one or more sealable cavities. For example, a passage 666 allows for passage of one or more conductors of the cable 644 (e.g., or cables) to a motor cavity 667 of the motor assembly 600 where the motor cavity 667 may be a sealable cavity. As shown, the motor cavity 867 houses the stator windings 670 and the

stator laminations 680. As an example, an individual winding may include a plurality of conductors (e.g., magnet wires). For example, a cross-section 672 of an individual winding may reveal a plurality of conductors that are disposed in a matrix (e.g., of material or materials) or otherwise bound together (e.g., by a material or materials). In the example of Fig. 6, the motor housing 660 includes an oil reservoir 668, for example, that may include one or more passages (e.g., a sealable external passage and a passage to the motor cavity 667) for passage of oil.

[0056] As an example, a shaft may be reciprocating, for example, where a shaft includes one or more magnets (e.g., permanent magnets) that respond to current that passes through stator windings.

[0057] Fig. 7 shows an example of an assembly 700 that includes a locking component 710, a torque-resisting component 730, an adapter component 750 and a tube 770 (e.g., a housing, etc.). In the example of Fig. 7, the locking component 710 can be operatively coupled to the adapter component 750 to clamp the torque-resisting component 730 at least in part axially therebetween. The torque-resisting component 730 and the tube 770 can include key and keyway features such that the torque-resisting component 730 is limited in its rotation about a longitudinal axis. For example, the assembly 700 may be described at least in part with respect to a cylindrical coordinate system (r , z and Θ) where a z -axis is a longitudinal axis and where the torque-resisting component 730 is limited in its rotation in the azimuthal direction Θ (e.g., clockwise and counter-clockwise) via the key and keyway features of the torque-resisting component 730 and the tube 770. In such an example, the locking component 710 can axially draw the key and keyway features into a meshed arrangement such that they act to limit rotation of the torque-resisting component 730 with respect to the tube 770 (e.g., the key/keyway features may be considered to be anti-rotation features, etc.).

[0058] As an example, the adapter component 750 can include threads or other coupling features (e.g., bayonet, etc.) to operatively couple the adapter component 750 to the tube 770 and, for example, the locking component 710 can include threads or other coupling features (e.g., bayonet, etc.) to operatively couple the locking component 710 to the adapter component 750. In such an example, the tube 770 and/or the locking component 710 can include corresponding coupling features (e.g., threads, bayonet, etc.). As an example, the tube 770 can include

internal features and external features. For example, consider internal threads and external keyways (e.g., arcuate slots, etc.).

[0059] In the assembly 700 of Fig. 7, various components can be rotatable and various components can be non-rotatable with respect to components of the assembly 700. For example, the orientation of the torque-resisting component 730 and the tube 770 can be fixed via key and keyway features while the locking component 710 and the adapter component 750 may be rotatable, for example, to axially position the components 710 and 750 in the assembly 700. As mentioned, axial positioning of the component 710 and 750 can be implemented to axially locate the torque-resisting component 730.

[0060] As an example, the assembly 700 of Fig. 7 may form a weld-free cylindrical tubing connection. In such an example, the connection may resist a thread-loosening torque load and, for example, accommodate sealing and axial loading of the connection.

[0061] As an example, the assembly 700 of Fig. 7 may be a portion of a downhole tool such as, for example, a portion of an electric submersible pump (ESP). As an example, the assembly 700 of Fig. 7 may form a seal that acts to seal a space within the tube 770 from an external environment. For example, consider a space filled with a dielectric oil being sealed from well fluid in an external environment. In such an example, the seal may include one or more seal elements such as, for example, O-ring elements. As an example, a seal or seals may be weldless seals. As an example, a seal or seals may be substantially lead-free seals (e.g., Pb free where Pb solder or soldering material is not utilized). Such an approach may avoid environmental concerns associated with lead (Pb).

[0062] The assembly 700 of Fig. 7 may be utilized as an alternative to welding threaded connections for the purpose of resisting torque. As an example, the approach utilized in the assembly 700 of Fig. 7 may allow for protecting one or more components in contact or near a connection from unwanted heat generated from welding activity. As an example, the approach utilized in the assembly 700 of Fig. 7 may be suitable for housing materials (e.g., tube materials, etc.) that are not suitable for welding or that may demand complex and time-consuming post-weld heat treatment. As an example, the approach utilized in the assembly 700 of Fig. 7 may reduce processing time (e.g., at assembly and/or at disassembly) when compared to welded approaches, for example, via reducing time associated with breaking or

machining off one or more weld (e.g., and/or excessive bead material, etc.). For example, where disassembly is desired, a weldless connection of components 710, 730 and 750 to the tube 770 can occur via rotating the locking component 710 with respect to the adapter component 750 and via rotating the adapter component 750 with respect to the tube 770.

[0063] As an example, the assembly 700 of Fig. 7 can be an arrangement of components and associated features that achieve a desired housing connection with desired torque resistance in a weld-free connection where axial load can be suitably born (e.g., axial compression and/or tension) where desired sealing is achieved for the connection.

[0064] Fig. 7 also shows to azimuthal angles Θ_1 and Θ_2 as measured about the z-axis. The angles Θ_1 and Θ_2 are demarcated by dotted lines where the angle Θ_1 corresponds to a key portion of the torque-resisting component 730 be capable of being received by a keyway of the tube 770 and where the angle Θ_2 corresponds to a key of the tube 770 being received by a keyway of the torque-resisting component 730. In such an example, various dimensions vary to define key and keyway features for different azimuthal angle spans of the torque-resisting component 730 and the tube 770. Such key and keyway features can mate such that torque can be transmitted between the torque-resisting component 730 and the tube 770. In such an example, certain components may be considered to be rotatable components that include threads while the torque-resisting component can be threadless as to its mating with the locking component 710, the adapter component 750 and the tube 770. The torque-resisting component 730 can include a flange portion with bolt holes, which may be threadless (e.g., for use of a nut), threaded through bores, threaded partial bores, etc., such that another component can be attached to the torque-resisting component 730. In the example of Fig. 7, the length of the tube 770 may be longer or shorter than shown and, for example, one or both ends of the tube 770 may include key and/or keyway features.

[0065] Fig. 8 shows two cross-sectional views and two side views of the assembly 700 of Fig. 7. As an example, the tube 770 may include key and/or keyway features at a single end or at both ends. As shown in Fig. 8, torque applied to the tube 770 may transmit torque to the torque-resisting component 730 via the key and keyway features. In such an example, torque may be transmitted to a

bolted connection with another component (e.g., as bolted to the torque-resisting component 730).

[0066] As an example, a submersible coupling may be subjected to torsional load. In such an example, mating key and keyway features can transmit the torque load to a bolted connection between a torque-resisting component and a mating part (e.g., a component bolted to the torque-resisting component). In such an example, the bolted connection can transmit the torque, for example, to another connection, etc.

[0067] In the example of Fig. 8, various load arrows are illustrated as to approximate loading directions for the torque-resisting component 730 and the tube 770. As to the load on the torque-resisting component 730, such load may be transferrable via a coupling mechanism such as, for example, bolts, etc. For example, in the example of Fig. 8, the torque-resisting component 730 can include threaded bolt bores that can receive respective bolts where the bolts can couple another component to the torque-resisting component 730. Such an other component may be, for example, another tube or another torque-resisting component (e.g., of another assembly, etc.). Thus, in the example of Fig. 8, the load indicated by the arrows pointing to the left can be transferred to the torque-resisting component 730 via threads of the torque-resisting component 730. As to the load indicated by the arrow pointing to the right, this load can be borne by coupling features such as, for example, internal threads of the tube 770, which may be mated with external threads of the adapter component 750.

[0068] As an example, torque loading of one or more component can vary based on one or more of a variety of factors, which can depend on the application. For example, as to an ESP, considering powering an ESP motor and associated conditions such as, for example, startup conditions. As an example, a startup may include a gradual ramping up via a VSD to an operating frequency or, for example, a more abrupt startup via use of a direct switchboard. As an example, for an ESP, torque may be of the order of one thousand foot-pound force or more (e.g., of the order of about 1300 Newton meter or more).

[0069] As an example, one or more materials, one or more dimensions, and/or types of manufacture processes may be selected, adjusted, etc. to form one or more components. For example, such selections, adjustments, etc. may be made with respect to torsional strength in view of an intended application. Material of

construction and/or dimensions (e.g., thinning or thickening walls of key-keyway features, etc.) may be tailored to an application.

[0070] As to loading, if axial load on a submersible coupling (e.g., a submersible connection or connector assembly) exceeds an expected load capacity, a stronger material may be considered, lengthening of the thread connections and/or deepening of threads may be considered, deepening of bolt threads, addition of bolt holes, etc. may be considered, etc. Upon such considerations, one or more of materials, dimensions, methods of manufacture, etc. may be selected and utilized to make one or more components.

[0071] As an example, where a possible mechanical weakness exists at a shoulder of the locking component 710, an axial dimension and/or a radial dimension of a portion or portions of the locking component 710 may be increased (see, e.g., the axial stop features described with respect to the example of Fig. 9). Such an approach may aim to increase length of an axial portion that forms at least part of a shoulder (e.g., an axial stop shoulder, etc.), for example, to increase axial load capacity (e.g., shear strength) of the shoulder.

[0072] As an example, where a possible mechanical weakness exists at an inner corner of the torque-resistant component 730, the corner may be contoured or otherwise shaped to reduce concentration of stress when compared to an approximately 90 degree corner. As an example, a chamfer or chamfers may be formed to reduce stress concentrations, for example, as one or more internal surface chamfers and/or as one or more external surface chamfers (see, e.g., a chamfer 733 of the torque-resisting component 730 and a chamfer 759 of the adapter component 750 of Fig. 15). As an example, mating chamfers may be provided where the chamfers may or may not directly contact, yet allow for reduction of stress concentration. As an example, one or more features may be tailored to achieve a desired amount of mechanical integrity and ability to handle loads and, for example, to reduce concentration of stresses.

[0073] In the example of Fig. 8, the torque-resisting component 730 may not include internal threads nor external threads that engage threads of one or more of the components 710, 750 and 770. In such an example, the torque-resisting component 730 can be "locked" in an assembly via the locking component 710 where, for example, internal threads of the adapter component 750 mate with external threads of the locking component 710. In such an example, the torque-

resisting component 730 may be considered to be “clamped” between the adapter component 750 and the locking component 710. For example, the adapter component 750 and the locking component can axially delimit the torque-resisting component 730. For example, an axial boundary may be formed by a portion of the locking component 710 and an axial boundary may be formed by a portion of the adapter component 750 where these axial boundaries define a maximum axial distance in which a portion of the torque-resisting component exists. As an example, a sub-assembly may be formed by the components 710, 730 and 750 where the sub-assembly is then operatively coupled to the tube 770, for example, via external threads of the adapter component 750 mating with internal threads of the tube 770; noting that, for example, one or more other approaches to assembly may be performed.

[0074] Fig. 9 shows an enlarged cross-sectional view of a portion of the assembly 700 of Fig. 7. In the example of Fig. 9, threaded regions 781, 782 and 783 are shown where the threaded region 781 includes external threads of the locking component 710 and internal threads of the adapter component 750, where the threaded region 782 includes external threads of the adapter component 750 and internal threads of the tube 770, and where the threads 783 are associated with a partial bore of the torque-resisting component 730 (e.g., for coupling another component to the assembly 700).

[0075] In the example of Fig. 9, seals 791, 792 and 793 are shown where the seal 791 is seated in an annular groove of the locking component 710 (e.g., to form a seal with the adapter component 750), where the seal 792 is seated in an annular groove of the adapter component 750 (e.g., to form a seal with the tube 770) and where the seal 793 is seated in an annular groove of the locking component 710. As an example, the seal 793 may provide for sealing a joint (e.g., an interface between at least two surfaces) where the joint is defined at least in part by the locking component 710 and at least in part by one or more other components, which may be, for example, bolted to the torque-resisting component 730.

[0076] Fig. 9 also shows various dimensions via arrows, including radial dimensions (r) and axial dimensions (z). Such dimensions may be utilized to describe, at least in part, one or more components, features, etc.

[0077] Fig. 9 shows an axial dimension Δz_{TR} associated with a portion of the torque-resisting component 730 and an axial dimension Δz_{AS} associated with an axial stop of the locking component 710 and an axial stop of the adapter component 750. In such an example, the axial dimension Δz_{TR} associated with the portion of the torque-resisting component 730 is less than or equal to the axial dimension Δz_{AS} associated with the axial stops. In such an example, the axial stops axially delimit the torque-resisting component 730. As an example, such axial stops may axially delimit the torque-resisting component 730 where one or more elements may exist within the axial dimension Δz_{AS} associated with an axial stop of the locking component 710 and an axial stop of the adapter component 750. In such an example, an element may be a seal element, a material compatibility element, a friction reduction element, etc. As an example, an element may be an annular element of dimensions approximately the same as one of the seals 791, 792 and 793.

[0078] In the example of Fig. 9, an axial dimension Δz_{K-KW} is shown as being associated with key and keyway features. As an example, such key and keyway features may provide for transfer of torque from the tube 770 to the torque-resisting component 730 and/or vice versa. As an example, axial positioning of the key and keyway features may be determined at least in part by a portion of the adapter component 750. For example, a portion of the adapter component 750 (e.g., an external ridge, etc.) may be dimensioned to allow for engagement and contact between surfaces of the key and keyway features when the tube 770 rotates and/or when the torque-resisting component 730 rotates. In such an example, the portion of the adapter component 750 may be dimensioned to provide for a small axial clearance between a key and/or keyway axial end of the torque-resisting component 730 and a key and/or keyway axial end of the tube 770. In such a manner, rotation may cause contact on surfaces other than axial end surfaces of key and keyway features (e.g., consider key and keyway feature side surface contact). In such an example, axial ends of the torque-resisting component 730 and the tube 770 may contact the portion of the adapter component 750 such that the adapter component 750 bears axial load, which may include, as an example, some amount of friction (e.g., depending on one or more factors, conditions, etc.).

[0079] As an example, the adapter component 750 may be brought into contact with the tube 770 via the external threads of the adapter component 750 and the internal threads of the tube 770. In such an example, an external ridge of the adapter component 750 may axially delimit the adapter component 750 with respect to the tube 770. For example, such an external ridge may prevent further tightening in a manner that would translate the adapter component 750 deeper into the tube 770. In such an example, the tube 770 can include a shoulder that can come into contact with the external ridge where the shoulder may be positioned to avoid interference with key and/or keyway features of the tube 770 and key and/or keyway features of the torque-resisting component 730.

[0080] Fig. 9 also shows various dimensions such as r_{Lo1} , a first outer radius of the locking component 710; r_{Li1} , a first inner radius of the locking component 710; r_{Lo2} , a second, smaller outer radius of the locking component 710 that can correspond approximately to r_{Tri1} , a first inner radius of the torque-resisting component 730; r_{Li2} , a second, smaller inner radius of the locking component 710; Δr_{AS1} , a first axial stop surface annular dimension that can correspond to an axial face dimension of the locking component 710; Δr_{AS2} , a second axial stop surface annular dimension that can correspond to a surface dimension Δr_A of the adapter component 750 (e.g., an axial stop surface); Δr_{TR1} , a first annular dimension of a wall portion of the torque-resisting component 730; Δr_{TR2} , a second annular dimension of a wall portion of the torque-resisting component 730 where a difference between the first and second annular dimensions can correspond to the second surface dimension Δr_A of the adapter component 750; r_{Tri2} , a second, larger inner radius of the torque-resisting component 730 that can correspond approximately to an outer radius r_{Ao} of the adapter component 750; and Δr_{T1} , a first annular dimension of a wall portion of the tube 770.

[0081] Fig. 9 also shows enlarged views of a key and keyway portion for two different cross-sections, corresponding to two different azimuthal angles Θ_1 and Θ_2 , for example, as illustrated in Fig. 7. As shown, the angle Θ_1 corresponds to a key feature of the torque-resisting component 730 being received by a keyway feature of the tube 770; whereas, the angle Θ_2 corresponds to a what may be considered a key feature of the tube 770 (e.g., a full wall portion) being received by a keyway feature of the torque-resisting component 730. In these examples, the adapter component

750 includes an annular ridge that can be utilized to axially locate the torque-resisting component 730 with respect to the tube 770. Such an annular ridge may be brought into contact with the tube 770, for example, via threads 782. For example, the adapter component 750 can be rotated with respect to the tube 770 to translate the adapter component 750 at least in part axially into a bore of the tube 770 until an axial face of the annular ridge contacts an end (e.g., axial face) of the tube 770. In such an example, the annular ridge may define a clearance for one or more key and keyway features that act with respect to torque.

[0082] Fig. 10 shows an example of a method 1000 that includes a provision block 1010 for providing the torque-resisting component 730 and a sub-assembly that includes the adapter component 750 operatively coupled to the tube 770 (e.g., via threads, etc.); a placement block 1020 for placing the torque-resisting component 730 with respect to the sub-assembly; a provision block 1030 for providing the locking component 710; and a locking block 1040 for locking the torque-resisting component 730 at least in part axially between a portion of the locking component 710 and a portion of the adapter 750, which includes locking the torque-resisting component 730 with respect to the tube 770.

[0083] The method 1000 may lock the torque-resisting component 730 both axially and azimuthally where axial locking is achieved via, for example, threaded engagement of the locking component 710 and the adapter component 750 and where azimuthal locking is achieved via, for example, key and keyway features of the torque-resisting component 730 and the tube 770. As an example, the method 1000 can include clamping the torque-resisting component 730 at one axial face via the locking component 710 and at an opposing axial face via the adapter component 750. In such an example, the axial faces may include common radii, for example, a first annular surface and a second annular surface where the first and second annular surfaces include a common radial span (e.g., along an axial line offset from the longitudinal z-axis).

[0084] Fig. 11 shows various views of an example of the locking component 710. As shown in Fig. 11, the locking component 710 can include opposing ends 712 and 714, a shoulder that defines in part an axial stop 713 (e.g., an axial face, etc.), an outer surface 715, an internal through bore 716, an annular groove 717 disposed in the outer surface 715 and an annular groove 718, for example, between the axial face 712 and the axial stop 713, which may receive one or more seal

elements. As an example, the axial stop 713 can be a locating face that may contact a component such as, for example, the torque-resisting component 730. As an example, the axial stop 713 can at least in part delimit the torque-resisting component 730 (see, e.g., the axial face 731). As an example, in delimiting the torque-resisting component 730, an element (e.g., a seal element, a spacer element, etc.) may be disposed at least in part between the axial stop 713 of the locking component and the axial face 731 of the torque-resisting component 730.

[0085] The locking component 710 of Fig. 11 can include coupling features such as, for example, external threads, an external bayonet, etc. For example, such coupling features may couple to corresponding coupling features of the adapter component 750 (e.g., internal threads, etc.).

[0086] In the example of Fig. 11, arrows are shown to illustrate examples of loads. For example, a load may be placed on the axial stop 713 (e.g., via the torque-resisting component 730) and a load may be carried by external threads (e.g., via the adapter component 750). In the example of Fig. 11, an axial dimension Δz_{LC} is shown, which may be selected to provide sufficient integrity to the locking component 710 to carry load at the axial stop 713 (e.g., a shoulder or axial face).

[0087] Fig. 12 shows various views of an example of the torque-resisting component 730. As shown in Fig. 12, the torque-resisting component 730 can include opposing ends 732 and 734, threaded partial bores, axial faces 731 and 738, an outer surface 735, an internal through bore 736, one or more keys 737 and one or more keyways 739. As an example, the axial face 731 can be a locating face that may contact a component such as, for example, the locking component 710 (see, e.g., the axial stop 713). As an example, the axial face 738 can be a locating face that may contact a component such as, for example, the adapter component 750. As shown in the example of Fig. 12, the axial face 738 can be part of a counter-bore formed within the through bore 736.

[0088] As an example, the one or more keys 737 and the one or more keyways 739 can be formed into the end 734 of the torque-resisting component 730 and can mate with corresponding features of an end of the tube 770. Such mating can allow for limiting rotation of the torque-resisting component 730 about a longitudinal axis (e.g., z-axis). As mentioned, the torque-resisting component 730

may be clamped and held in place via other components such as, for example, the locking component 710 being coupled to the adapter component 750.

[0089] As an example, the axial faces 731 and 738 may include common radii, for example, a first annular surface and a second annular surface where the first and second annular surfaces include a common radial span (e.g., along an axial line offset from the longitudinal z-axis).

[0090] In the example of Fig. 12, arrows illustrate load that may be applied to the torque-resisting component 730, for example, by a component that is operatively coupled to the torque-resisting component 730 via bolts. As mentioned, threads in bolt bores may carry load applied via threads of bolts received in such bolt bores. As an example, a torque-resisting component may include bores where threads are provided via nuts. For example, consider nuts that may be positioned at ends of bores where a bolt may pass through a bore and engage a nut (e.g., via threads). As an example, a flange portion of a torque-resisting component may be formed in a suitable manner with respect to one or more types of coupling mechanisms (e.g., bolts and threaded bores, bolts and nuts, etc.).

[0091] Fig. 13 shows various views of an example of the adapter component 750. As shown in Fig. 13, the adapter component 750 can include an axial stop 751 (e.g., an axial face), opposing ends 752 and 754, an outer surface 755, an internal through bore 756, an annular extension 753 (e.g., an annular lip, etc.) that extends radially outwardly from the outer surface 755 and an annular groove 757 that extends radially inwardly from the outer surface 755. As an example, the axial stop 751 can be a locating face that may contact a component such as, for example, the torque-resisting component 730 (see, e.g., the axial face 738). As an example, the axial stop 751 can at least in part delimit the torque-resisting component 730 (see, e.g., the axial face 738). As an example, in delimiting the torque-resisting component 730, an element (e.g., a seal element, a spacer element, etc.) may be disposed at least in part between the axial stop 751 of the adapter component and the axial face 738 of the torque-resisting component 730.

[0092] Fig. 14 shows various views of an example of the tube 770. As shown in Fig. 14, the tube 770 can include opposing ends 772 and 774, an outer surface 775, an internal through bore 776 defined by a wall 778, one or more keys 771 and one or more keyways 777, which may be, for example, bordered by a wall 779, which can be a portion of the wall 778. As an example, the end 772 can include an

annular surface 775 of the wall 778 of the tube 770 where the wall 778 is cutaway at one or more regions to form the one or more keyways 777, optionally where the wall 779 is of a thinner radial dimension than the wall 778. As an example, the one or more keyways 777 may be formed as recesses in the wall 778 where such recesses are open at the end 772 of the tube 770.

[0093] In the example of Fig. 14, the tube 770 is shown along with radii that indicate radial dimensions of features at or proximate to the end 772, which may exist at the end 774. Fig. 14 also shows an angular span Θ that may define, at least in part, an orientation, an arrangement, a dimension, etc. of one or more of the one or more keys 771 and/or one or more of the one or more keyways 777 of the tube 770. As an example, formation of a keyway may inherently form a key.

[0094] Fig. 15 shows an example of a portion of an assembly 1500 that includes the locking component 710, the torque-resisting component 730, the adapter component 750, the tube 770 and another component 790 that is bolted via bolts 795 to the torque-resisting component 730. As shown, the bolt 795 passes through a bore of a flange portion of the component 790 such that a threaded portion of the bolt 795 is received by threads of a threaded bore of a flange portion of the torque-resisting component 730. In such an example, a washer or other type of element may be utilized in addition to the bolt 795. As an example, bolts may be tightened according to a specification.

[0095] As an example, the component 790 can include an inner surface that may be sealed via a seal element disposed at least in part in one or more annular grooves. For example, the locking component 710 and/or the component 790 can include one or more annular grooves. In such an example, one or more seal elements may provide for sealing an interior space from an exterior space, which may be, for example, a well fluid space, etc. In the example of Fig. 15, the component 790 is not coupled to the torque-resisting component 730 in a manner that involves rotation of the component 790 with respect to the torque-resisting component 730. For example, these two components are not threaded together via rotation. Rather, in the example of Fig. 15, the component 790 is bolted to the torque-resisting component 730 such that axial force is applied by a plurality of individual bolts. Such an approach allows for transmission of torque without substantial risk of interference with the bolt-based coupling mechanism.

[0096] In the example of Fig. 15, the torque-resisting component 730 includes an internal chamfer 733 and the adapter component 750 includes an external chamfer 759. As mentioned, such shaped surfaces may act to reduce the concentration of stress, which may enhance integrity of a component when loaded (e.g., subjected to stress, strain, etc.). In the example of Fig. 15, the chamfer 733 includes dimensions that correspond approximately to those of the chamfer 759. In such an example, the chamfers may contact or a small clearance may exist.

[0097] As an example, a coupling assembly that includes a torque-resisting component may be utilized to operatively couple one or more types of components, which may form, for example, a submersible system. For example, such an assembly may be applied to one or more types of joints that can benefit from a torque-resistant tubing connection. As an example, in an ESP system, such an assembly may be applied to an electric motor, a protector, an intake, a pump, a gauge, and/or one or more other types of downhole equipment.

[0098] As an example, an assembly can include a threaded adapter component, a torque-resisting component, a load transfer locking component and a slotted housing. As an example, such an assembly can include threads for coupling the locking component and the adapter component and for coupling the adapter component and the tube. As an example, an assembly can include one or more seal elements, which may be, for example, elastomeric seal elements. As an example, a seal element may be an O-ring. As an example, a seal element may be a metallic component and/or include a metallic component or components (e.g., optionally including an elastomeric coating, etc.).

[0099] As an example, an assembly can include key and keyway features that serve as a torque transfer mechanism, for example, to transfer torque from a housing (e.g., a tube) to a bolted part that bolts to a torque-resisting component (see, e.g., the torque-resisting component 730).

[00100] As an example, an assembly can include an arrangement of components where, for example, external threads of a locking component can connect to internal threads of an adapter component and where, for example, a key-and-slot connection mechanism (e.g., key-and-keyway) can be provided between a tube and a torque-resisting component to act as an anti-rotation feature. As an example, a torque-resisting component can include one or more anti-rotation features and, for example, one or more coupling features such as threaded bolt

bores for receiving bolts that can bolt a component to the torque-resisting component. As an example, a locking component can provide a function for, at least in part, locking a torque-resisting component in place in an assembly as well as, for example, providing threads for threaded coupling of the locking component to an adapter component.

[00101] As an example, a method can include machining key and/or keyway features into an end of a tube. As an example, a method can include machining key and/or keyway features into an end of a torque-resisting component.

[00102] As an example, a method can include install an appropriate seal to an adapter component (e.g., in an annular groove in an outer surface) and connecting the adapter to a tube (e.g., a housing), for example, via threading external threads of the adapter component into internal threads of the tube, for example, until the tube shoulders up against the adapter component. For example, an extension that extends radially outwardly from an outer surface of the adapter component may act as a shoulder to which the tube may shoulder-up against such that an axial arrangement of the tube with respect to the adapter component is achieved (e.g., the adapter component is received in a bore of the tube to an axial depth).

[00103] As an example, the foregoing method can include sliding a torque-resisting component over a portion of the adapter component until the torque-resisting component shoulders up against the adapter component. As an example, the torque-resisting component can include an internal recess that accommodates the extension of the adapter component. For example, the extension of the adapter component can include opposing axial faces where one face abuts the torque-resisting component and where the other face abuts the tube. In such an example, the axial dimension (e.g., axial height) of the extension may allow for proper engagement of key and keyway features of the torque-resisting component and the tube.

[00104] As an example, in the foregoing method, one or more seal elements may be installed as appropriate, for example, to form a seal between an outer surface of the locking component and an inner surface of the adapter component. As an example, the locking component can include an annular groove that can receive, at least in part, a seal element or seal elements, for example, to seal a component that may be attached to the torque-resisting component (e.g., consider a component that is bolted to the torque-resisting component).

[00105] As an example, the foregoing method can include connecting the locking component to the adapter component via threads such that internal threads of the adapter component mate with external threads of the locking component. In such an example, the torque-resisting component may be suitably oriented (e.g., rotated, etc.) such that key and keyway features mate between the torque-resisting component and the tube (e.g., a protruding key of the torque-resisting component is received in a corresponding slot of the tube).

[00106] As mentioned, a torque-resisting component can include a flange portion with features such as threaded openings that can receive threaded bolts, for example, to bolt a component onto an assembly.

[00107] As an example, a method can include disconnecting one or more components of an assembly. For example, consider a method that includes unscrewing a locking component from an adapter component, optionally removing one or more seals from one or more annular grooves, etc. of the locking component; optionally sliding a torque-resisting component axially outwardly from the locking component; and unscrewing the adapter component from a tube (e.g., a housing).

[00108] As an example, an assembly can include a cylindrical torque-resisting component that includes a flange portion, a first face, a through bore, and a counter-bore that defines a second face; a cylindrical adapter component that includes external threads, a through bore with internal threads, and an axial stop; a cylindrical locking component that includes external threads that engage the internal threads of the cylindrical adapter component, and an axial stop where the axial stops delimit the first and second faces of the cylindrical torque-resisting component; and a tube that includes internal threads that engage the external threads of the cylindrical adapter component where an end of the cylindrical torque-resisting component and an end of the tube include key and keyway features that orient the cylindrical torque-resisting component with respect to the tube. In such an example, the flange portion can include bolt holes (e.g., for passage of bolt shafts and/or for threaded engagement of threaded bolts).

[00109] As an example, a cylindrical adapter component can include an annular extension that defines a shoulder that includes a face that abuts an end of the tube. For example, an annular extension can be an annular ridge that extends radially outwardly to a radius that is greater than one or more other radii of the cylindrical adapter component. Such a ridge may define an upper axial face and a

lower axial face where components can be located via contact with one or more of such axial faces. As an example, such a ridge may be proximate to key and keyway features and may define a clearance or clearances with respect to key and keyway features of other components (e.g., a torque-resisting component and a tube).

[00110] As an example, a cylindrical locking component and a cylindrical adapter component can be included in an assembly to clamp a torque-resisting component.

[00111] As an example, key and keyway features of a torque-resisting component and, for example, a tube, can limit rotation of the torque-resisting component with respect to the tube about a longitudinal axis of the assembly.

[00112] As an example, an assembly may be a substantially lead (Pb) free assembly. For example, an assembly may form a joint or joints where lead (Pb) solder or lead (Pb) based solder is not present to seal the joint or joints with respect to fluid. As an example, one or more components of an assembly can include annular grooves that can receive one or more seal elements. In such an example, a seal element may be metal, alloy, elastomer, etc. As an example, a seal element may be a metallic and polymeric seal element (e.g., including metal and/or alloy and an elastomer).

[00113] As an example, an assembly may be a weld-free assembly. For example, various joints may be formed and sealed without welding such that the assembly is weld-free.

[00114] As an example, an assembly can include at least one seal element. As an example, a cylindrical adapter component can include an annular groove that receives a seal element that forms a seal between an outer surface of a cylindrical adapter component and an inner surface of a tube. As an example, a cylindrical locking component can include an annular groove that receives a seal element that forms a seal between an outer surface of the cylindrical locking component and an inner surface of the cylindrical adapter component.

[00115] As an example, an assembly can include a tube that can be a tube of an electric submersible pump (ESP) system. For example, consider an electric motor housing tube, a protector tube, a gauge tube, an inlet portion tube, a pot head tube, etc.

[00116] As an example, a component can be coupled to a flange portion of a cylindrical torque-resisting component. For example, consider a bolted coupling

where bolts apply force in an axial direction to couple the components. As an example, an assembly can include a pot head of an electric submersible motor.

[00117] As an example, a method can include providing an assembly that includes a cylindrical torque-resisting component that includes a flange portion, a first face, a through bore, and a counter-bore that defines a second face; a cylindrical adapter component that includes external threads, a through bore with internal threads, and an axial stop; a cylindrical locking component that includes external threads that engage the internal threads of the cylindrical adapter component, and an axial stop where the axial stops axially locate the first and second faces of the cylindrical torque-resisting component; and a tube that includes internal threads that engage the external threads of the cylindrical adapter component where an end of the cylindrical torque-resisting component and an end of the tube include key and keyway features that orient the cylindrical torque-resisting component with respect to the tube; applying torque to the assembly; and via the key and keyway features, limiting rotation of the cylindrical torque-resisting component with respect to the tube. In such an example, the method can include applying torque to the cylindrical torque-resisting component and/or applying torque includes applying torque to the tube. For example, consider a method that includes applying torque generated at least in part by an electric submersible motor.

[00118] As an example, an electric submersible pump can include a shaft; a pump operatively coupled to the shaft; an electric motor operatively coupled to the shaft; and a housing where the housing includes an assembly that includes a cylindrical torque-resisting component, a cylindrical adapter component, and a cylindrical locking component where an end of the cylindrical torque-resisting component and an end of the housing include key and keyway features that orient the cylindrical torque-resisting component with respect to the tube. In such an example, the cylindrical torque-resisting component can include a flange portion, a first face, a through bore, and a counter-bore that defines a second face; where the cylindrical adapter component includes external threads, a through bore with internal threads, and an axial stop; and where the cylindrical locking component includes external threads that engage the internal threads of the cylindrical adapter component, and an axial stop where the axial stops delimit the first and second faces of the cylindrical torque-resisting component. As an example, a housing can be a housing of an electric motor of an electric submersible pump.

[00119] As an example, one or more methods described herein may include associated computer-readable storage media (CRM) blocks. Such blocks can include instructions suitable for execution by one or more processors (or cores) to instruct a computing device or system to perform one or more actions.

[00120] According to an embodiment, one or more computer-readable media may include computer-executable instructions to instruct a computing system to output information for controlling a process. For example, such instructions may provide for output to sensing process, an injection process, drilling process, an extraction process, an extrusion process, a pumping process, a heating process, etc.

[00121] Fig. 16 shows components of a computing system 1600 and a networked system 1610. The system 1600 includes one or more processors 1602, memory and/or storage components 1604, one or more input and/or output devices 1606 and a bus 1608. According to an embodiment, instructions may be stored in one or more computer-readable media (e.g., memory/storage components 1604). Such instructions may be read by one or more processors (e.g., the processor(s) 1602) via a communication bus (e.g., the bus 1608), which may be wired or wireless. The one or more processors may execute such instructions to implement (wholly or in part) one or more attributes (e.g., as part of a method). A user may view output from and interact with a process via an I/O device (e.g., the device 1606). According to an embodiment, a computer-readable medium may be a storage component such as a physical memory storage device, for example, a chip, a chip on a package, a memory card, etc.

[00122] According to an embodiment, components may be distributed, such as in the network system 1610. The network system 1610 includes components 1622-1, 1622-2, 1622-3, . . . , 1622-N. For example, the components 1622-1 may include the processor(s) 1602 while the component(s) 1622-3 may include memory accessible by the processor(s) 1602. Further, the component(s) 1622-2 may include an I/O device for display and optionally interaction with a method. The network may be or include the Internet, an intranet, a cellular network, a satellite network, etc.

Conclusion

[00123] Although only a few examples have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the examples. Accordingly, all such modifications are intended to be included within

the scope of this disclosure as defined in the following claims. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents, but also equivalent structures. Thus, although a nail and a screw may not be structural equivalents in that a nail employs a cylindrical surface to secure wooden parts together, whereas a screw employs a helical surface, in the environment of fastening wooden parts, a nail and a screw may be equivalent structures. It is the express intention of the applicant not to invoke 35 U.S.C. § 112, paragraph 6 for any limitations of any of the claims herein, except for those in which the claim expressly uses the words “means for” together with an associated function.

CLAIMS

What is claimed is:

1. An assembly comprising:
 - a cylindrical torque-resisting component that comprises a flange portion, a first face, a through bore, and a counter-bore that defines a second face;
 - a cylindrical adapter component that comprises external threads, a through bore with internal threads, and an axial stop;
 - a cylindrical locking component that comprises external threads that engage the internal threads of the cylindrical adapter component, and an axial stop wherein the axial stops delimit the first and second faces of the cylindrical torque-resisting component; and
 - a tube that comprises internal threads that engage the external threads of the cylindrical adapter component wherein an end of the cylindrical torque-resisting component and an end of the tube comprise key and keyway features that orient the cylindrical torque-resisting component with respect to the tube.
2. The assembly of claim 1 wherein the flange portion comprises bolt holes.
3. The assembly of claim 1 wherein the cylindrical adapter component comprises an annular extension that defines a shoulder that comprises a face that abuts an end of the tube.
4. The assembly of claim 1 wherein the cylindrical locking component and the cylindrical adapter component clamp the torque-resisting component.
5. The assembly of claim 1 wherein the key and keyway features limit rotation of the torque-resisting component with respect to the tube about a longitudinal axis of the assembly.
6. The assembly of claim 1 comprising a substantially lead (Pb) free assembly.
7. The assembly of claim 1 comprising a weld-free assembly.

8. The assembly of claim 1 comprising at least one seal element.
9. The assembly of claim 1 wherein the cylindrical adapter component comprises an annular groove that receives a seal element that forms a seal between an outer surface of the cylindrical adapter component and an inner surface of the tube.
10. The assembly of claim 1 wherein the cylindrical locking component comprises an annular groove that receives a seal element that forms a seal between an outer surface of the cylindrical locking component and an inner surface of the cylindrical adapter component.
11. The assembly of claim 1 wherein the tube comprises a tube of an electric submersible pump system.
12. The assembly of claim 1 comprising a component coupled to the flange portion of the cylindrical torque-resisting component.
13. The assembly of claim 1 comprising a pot head of an electric submersible motor.
14. A method comprising:
 - providing an assembly that comprises
 - a cylindrical torque-resisting component that comprises a flange portion, a first face, a through bore, and a counter-bore that defines a second face;
 - a cylindrical adapter component that comprises external threads, a through bore with internal threads, and an axial stop;
 - a cylindrical locking component that comprises external threads that engage the internal threads of the cylindrical adapter component, and an axial stop wherein the axial stops axially locate the first and second faces of the cylindrical torque-resisting component; and
 - a tube that comprises internal threads that engage the external threads of the cylindrical adapter component wherein an end of the cylindrical torque-

resisting component and an end of the tube comprise key and keyway features that orient the cylindrical torque-resisting component with respect to the tube;

applying torque to the assembly; and

via the key and keyway features, limiting rotation of the cylindrical torque-resisting component with respect to the tube.

15. The method of claim 14 wherein applying torque comprises applying torque to the cylindrical torque-resisting component.

16. The method of claim 14 wherein applying torque comprises applying torque to the tube.

17. The method of claim 14 wherein applying torque comprises applying torque generated at least in part by an electric submersible motor.

18. An electric submersible pump comprising:

a shaft;

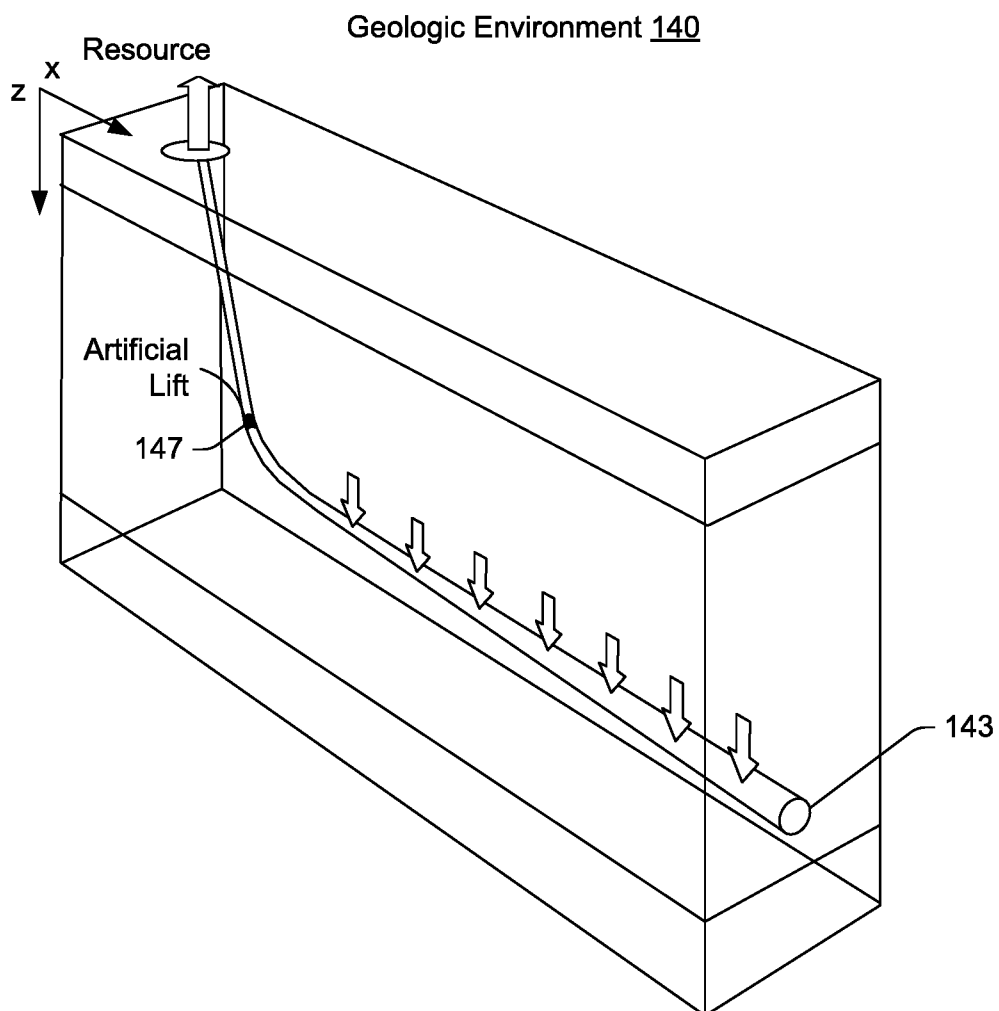
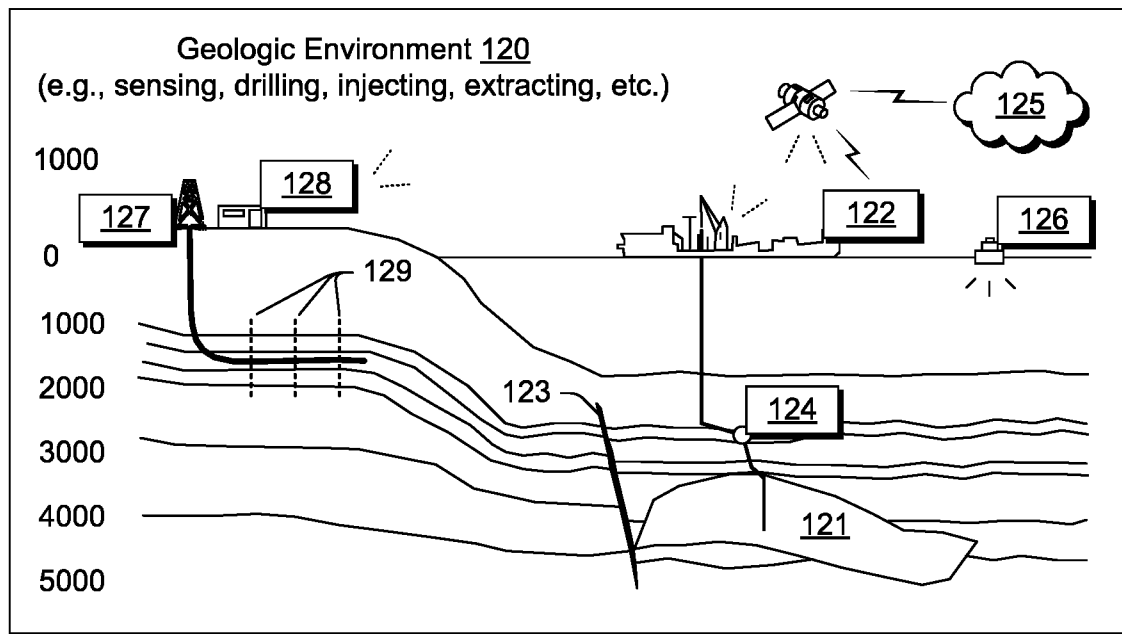
a pump operatively coupled to the shaft;

an electric motor operatively coupled to the shaft; and

a housing wherein the housing comprises an assembly that comprises a cylindrical torque-resisting component, a cylindrical adapter component, and a cylindrical locking component wherein an end of the cylindrical torque-resisting component and an end of the housing comprise key and keyway features that orient the cylindrical torque-resisting component with respect to the tube.

19. The electric submersible pump of claim 18 wherein the cylindrical torque-resisting component comprises a flange portion, a first face, a through bore, and a counter-bore that defines a second face; wherein the cylindrical adapter component comprises external threads, a through bore with internal threads, and an axial stop; and wherein the cylindrical locking component comprises external threads that engage the internal threads of the cylindrical adapter component, and an axial stop wherein the axial stops delimit the first and second faces of the cylindrical torque-resisting component.

20. The electric submersible pump of claim 18 wherein the housing comprises a housing of the electric motor.

**Fig. 1**

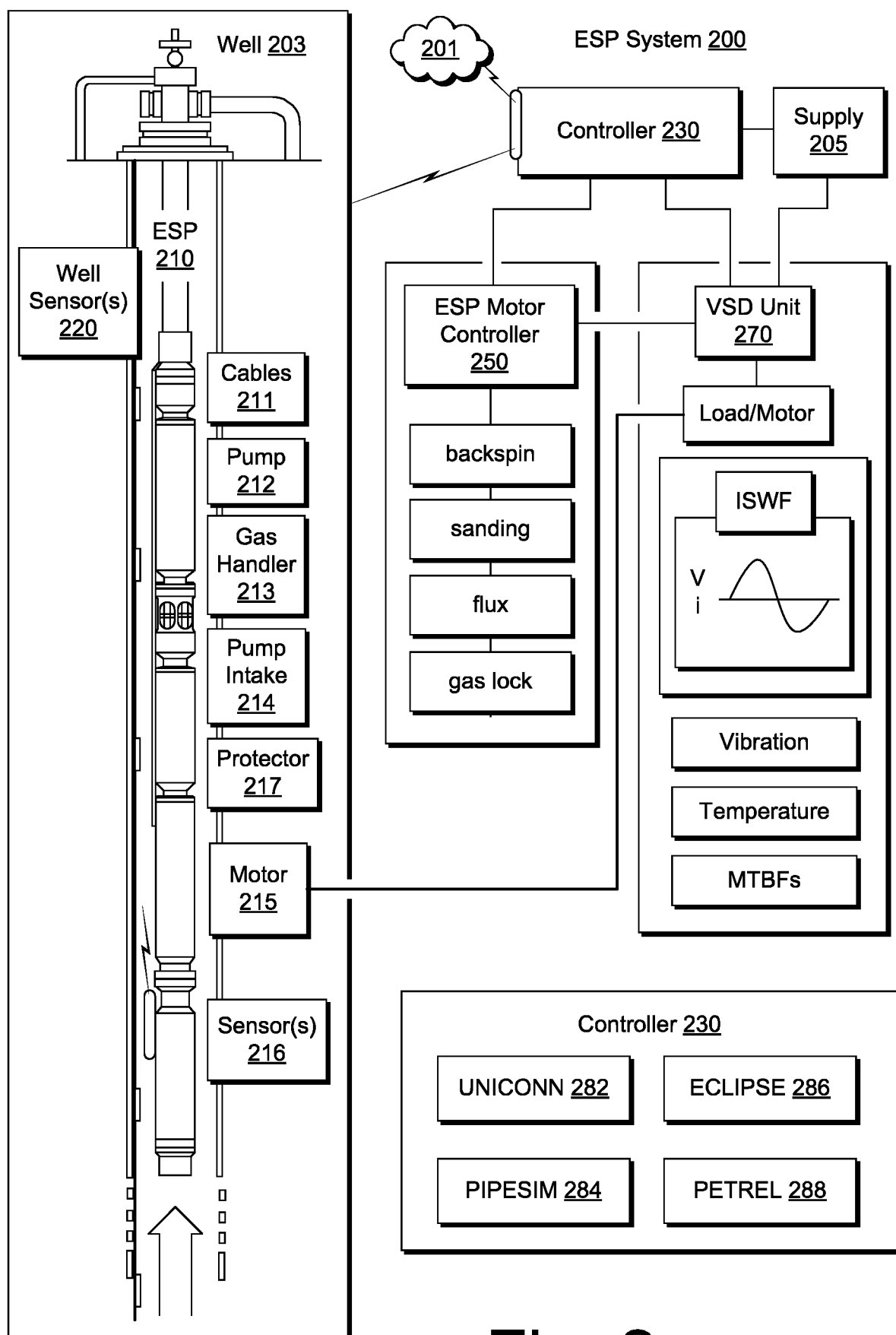


Fig. 2

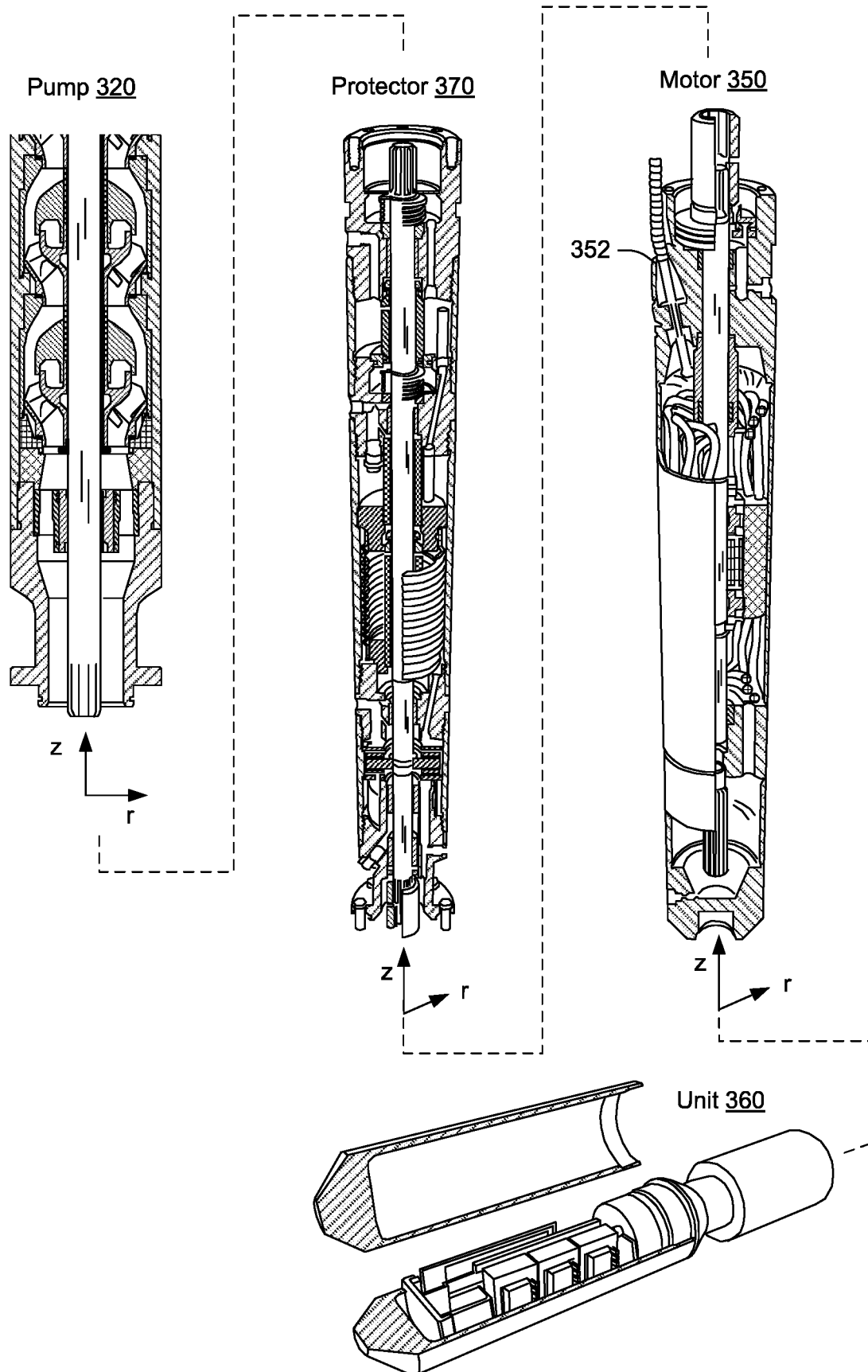


Fig. 3

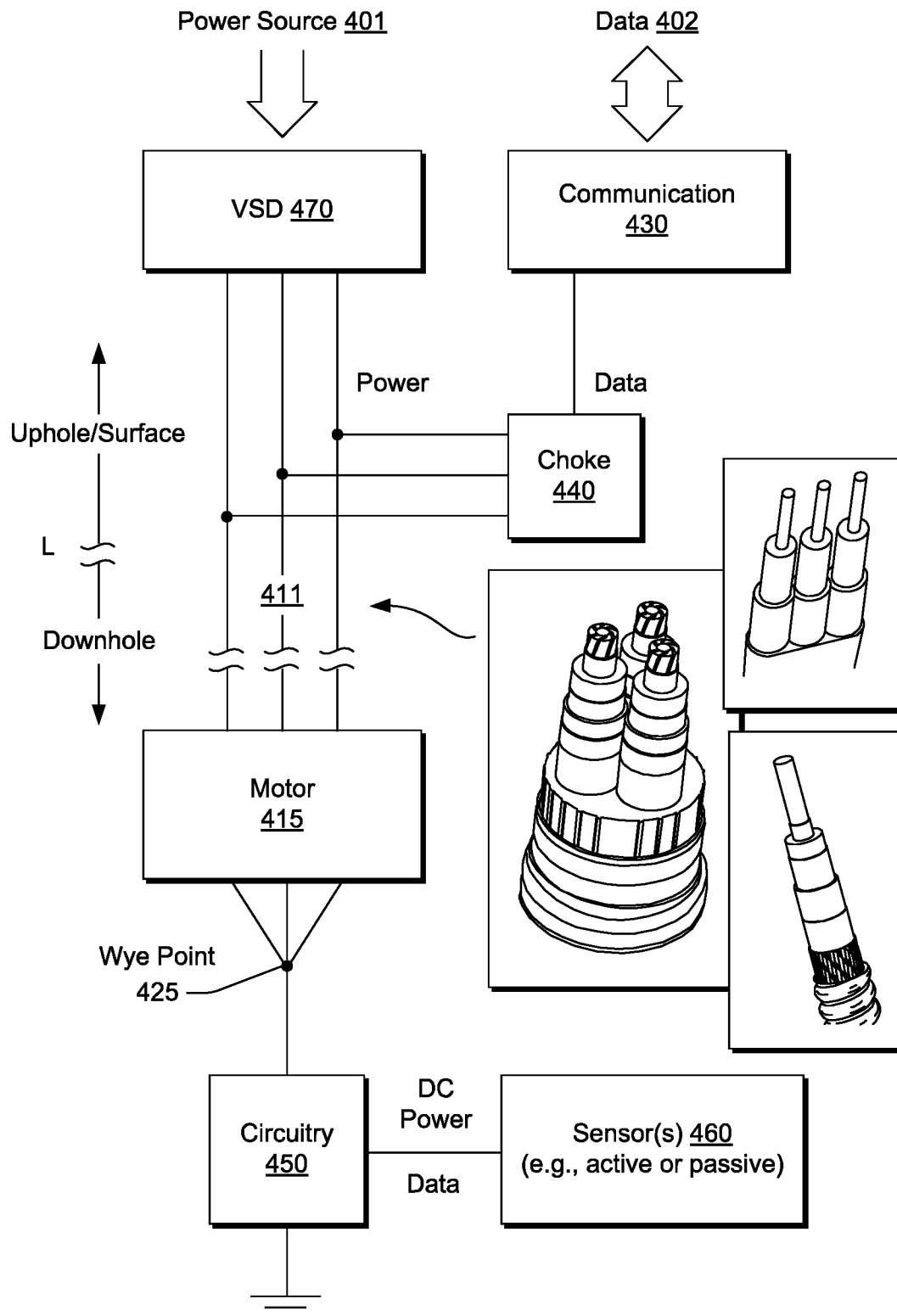


Fig. 4

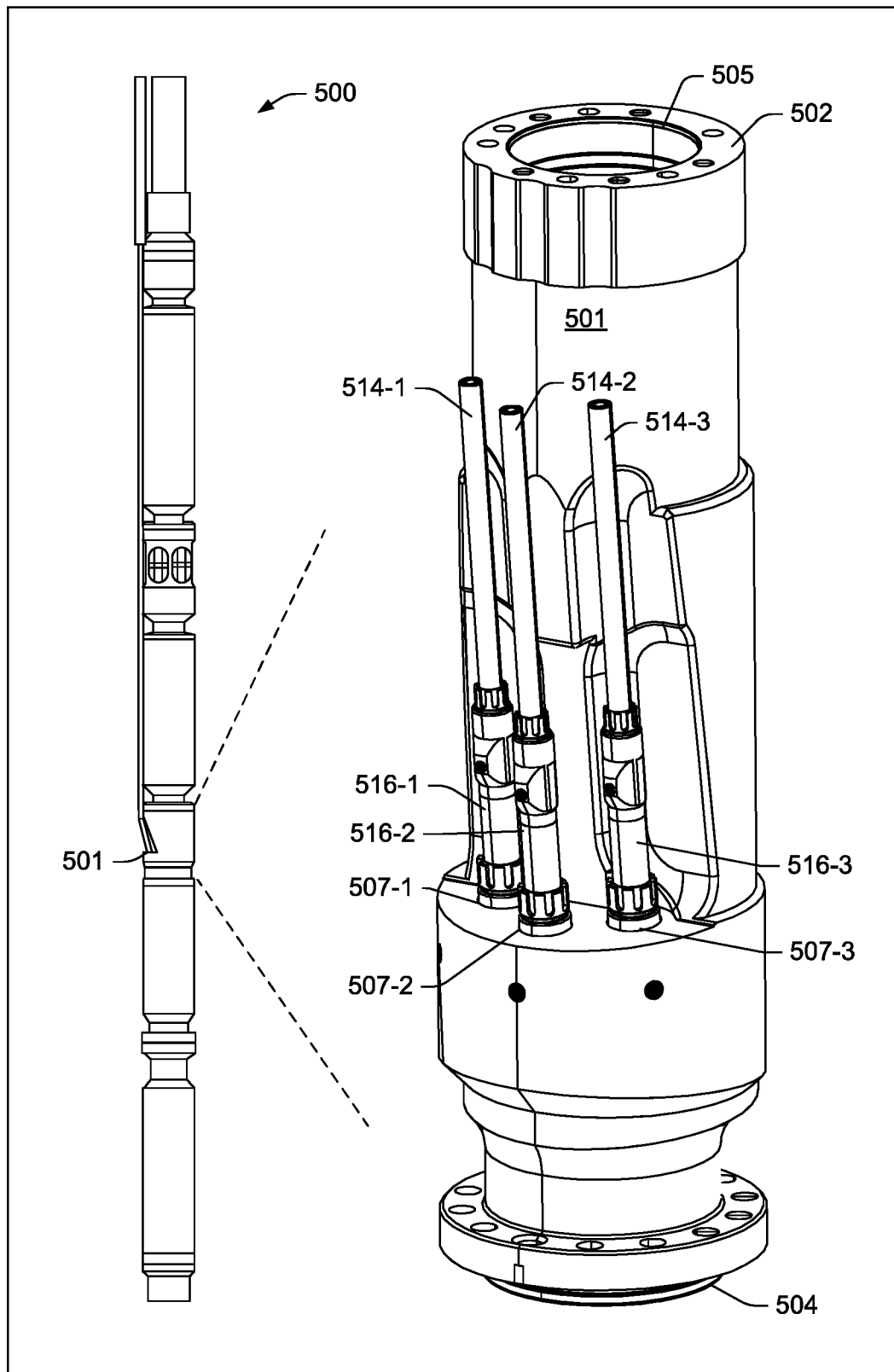


Fig. 5

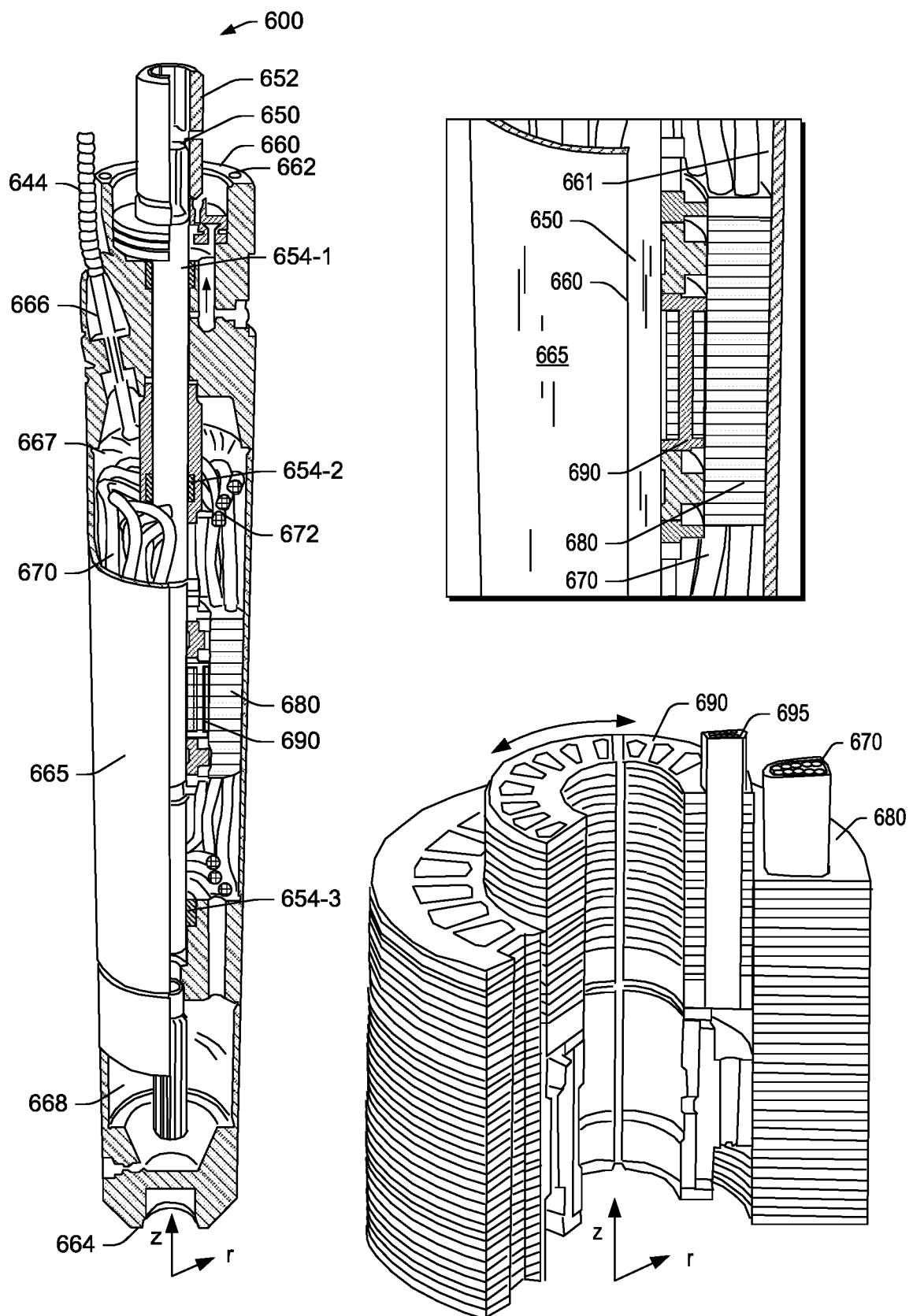
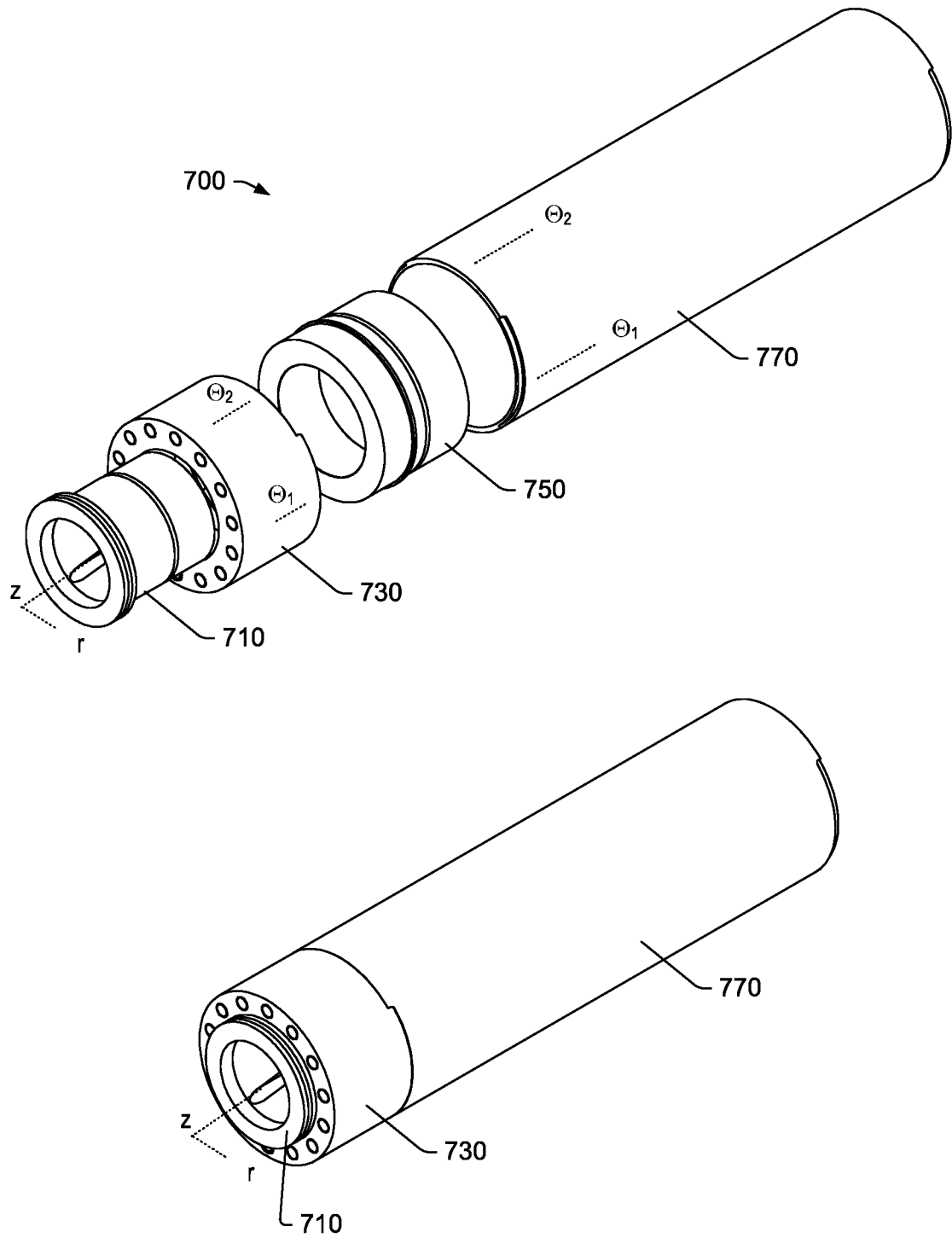


Fig. 6

**Fig. 7**

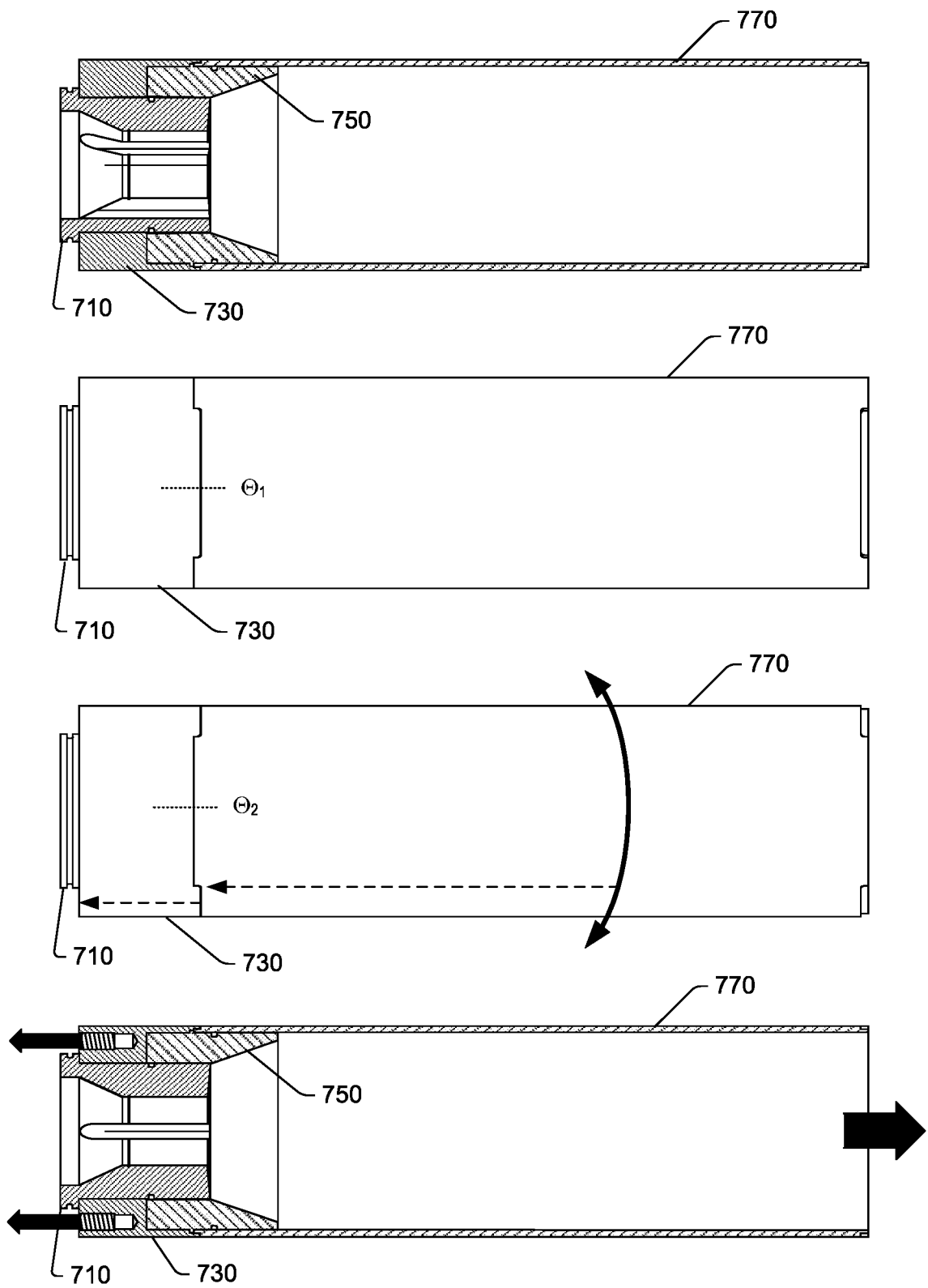


Fig. 8

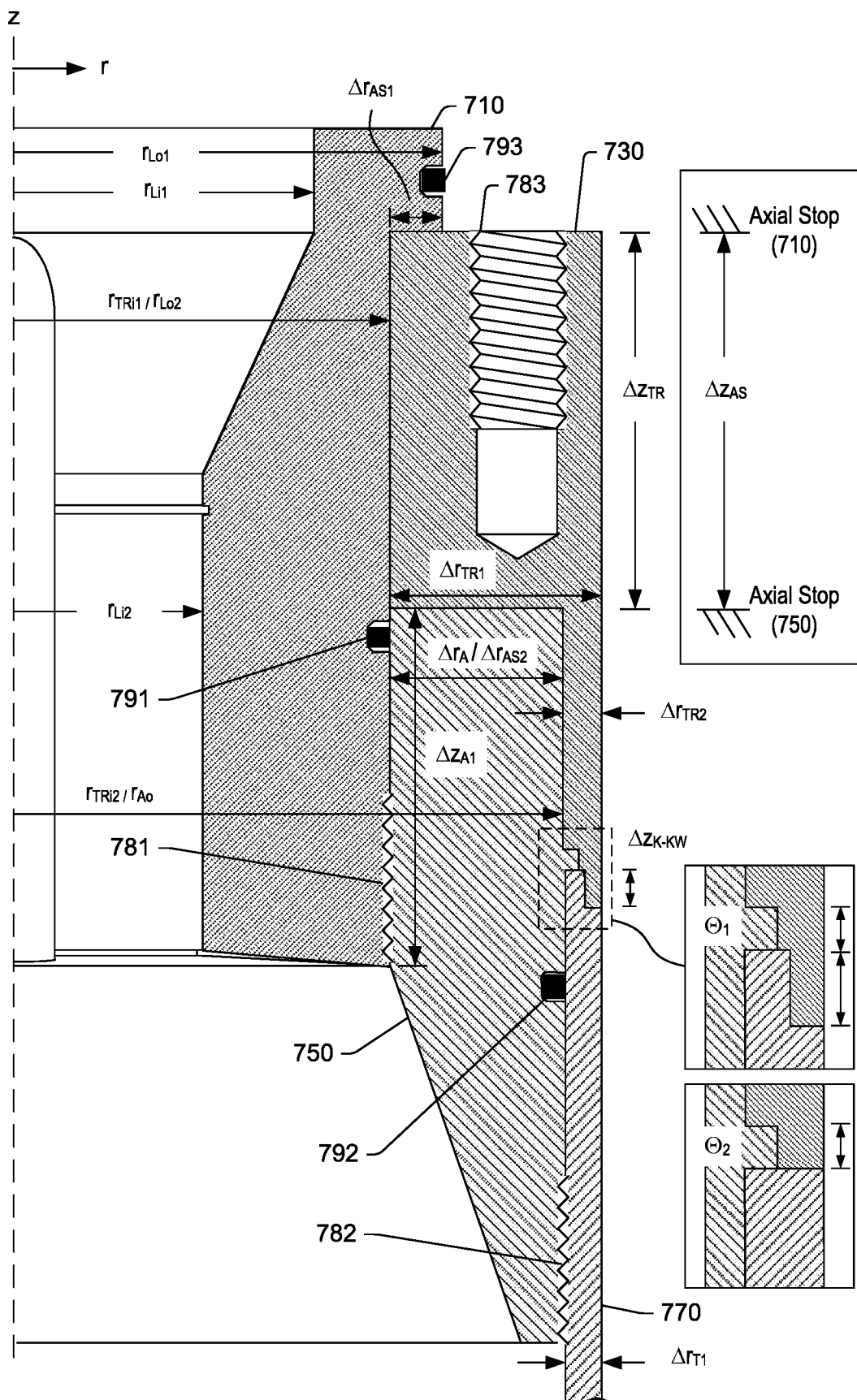


Fig. 9

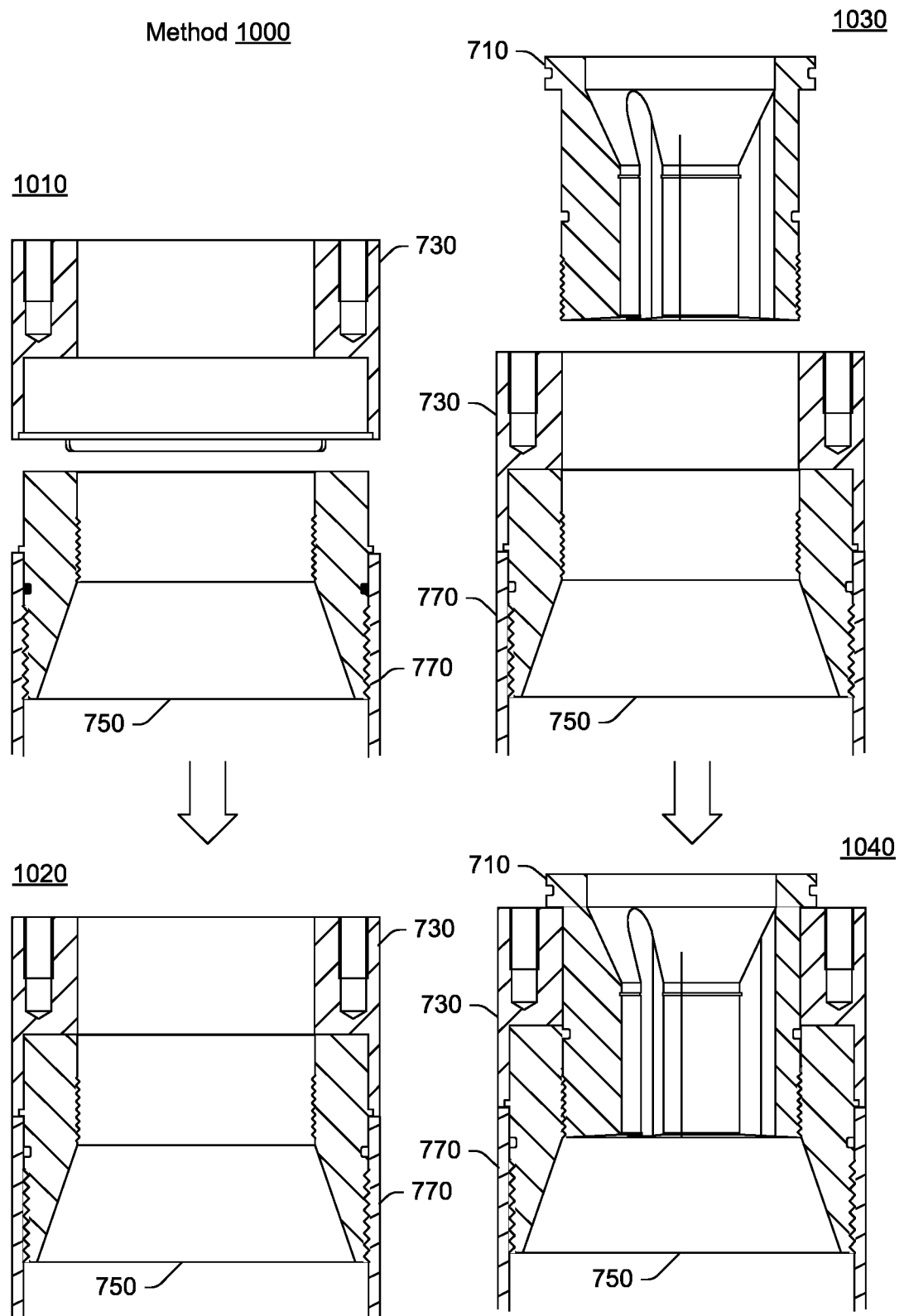


Fig. 10

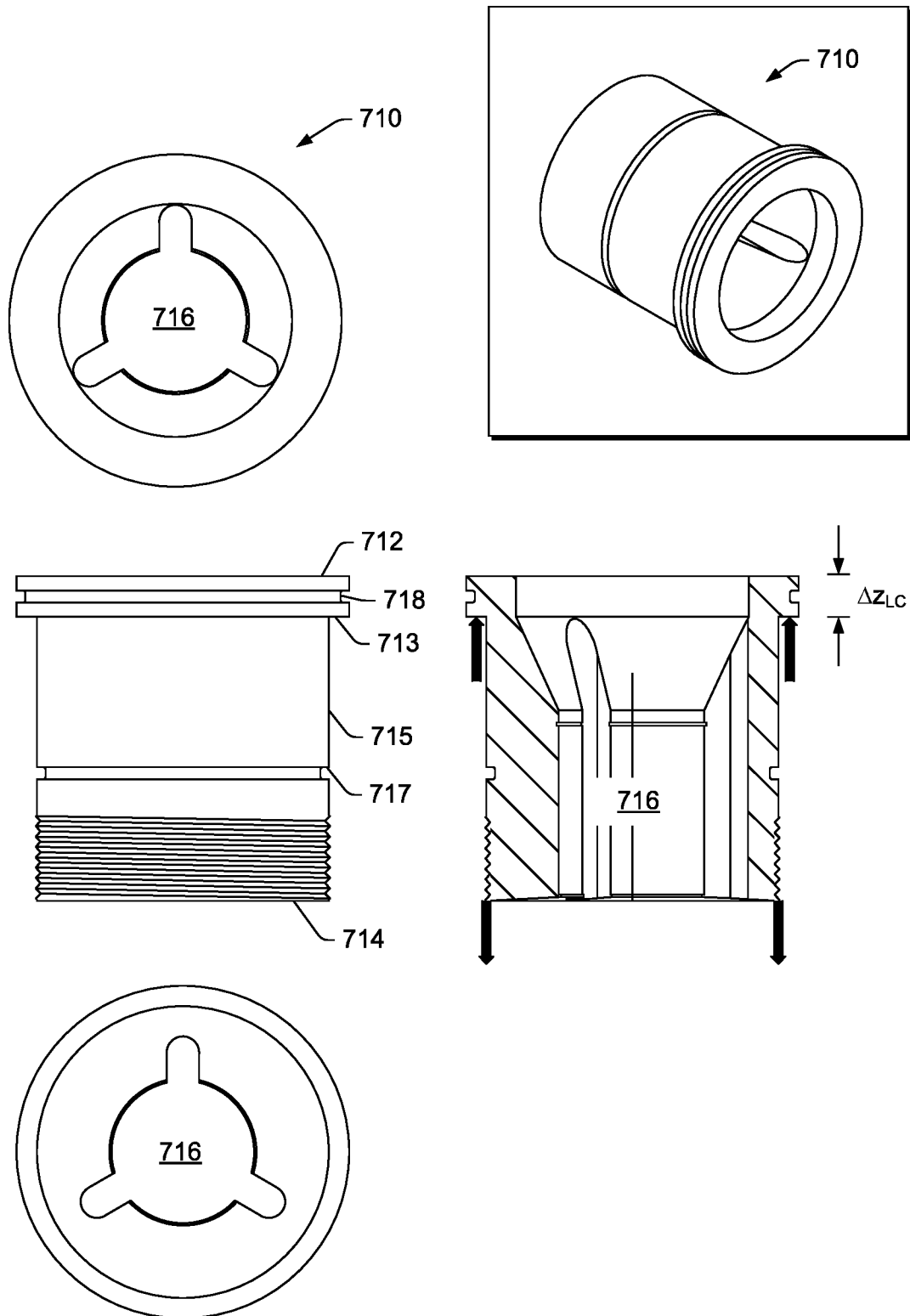


Fig. 11

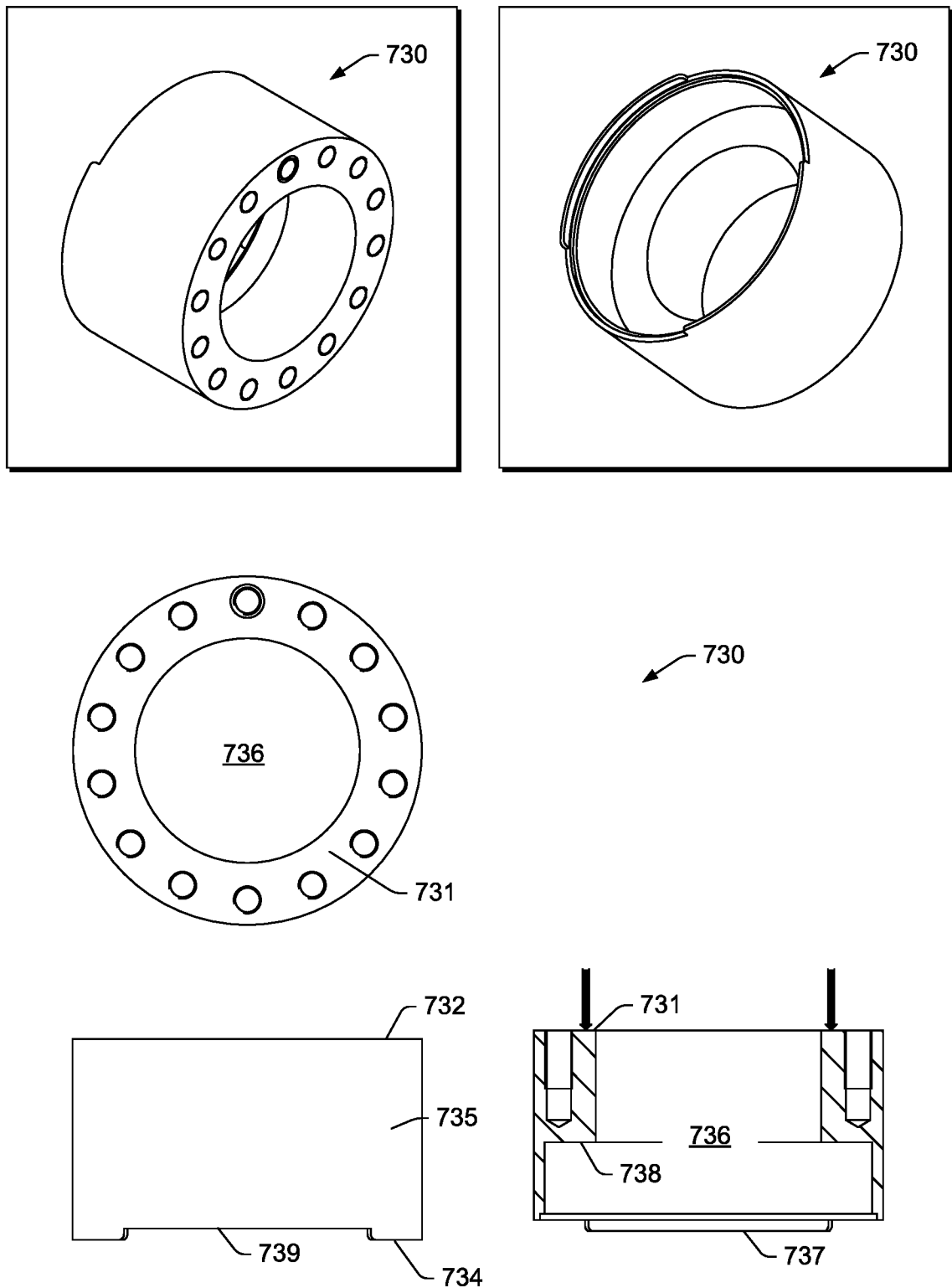


Fig. 12

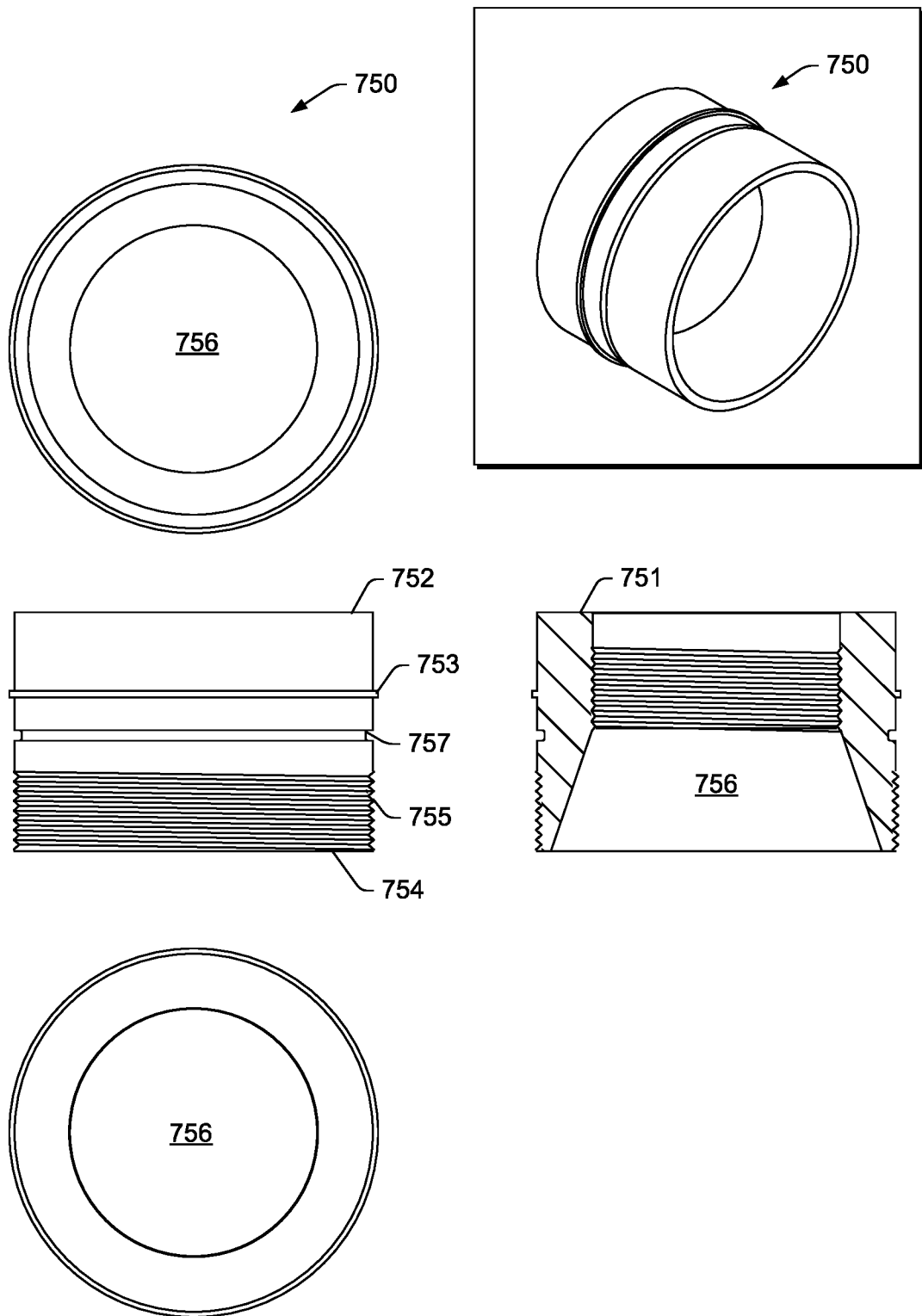


Fig. 13

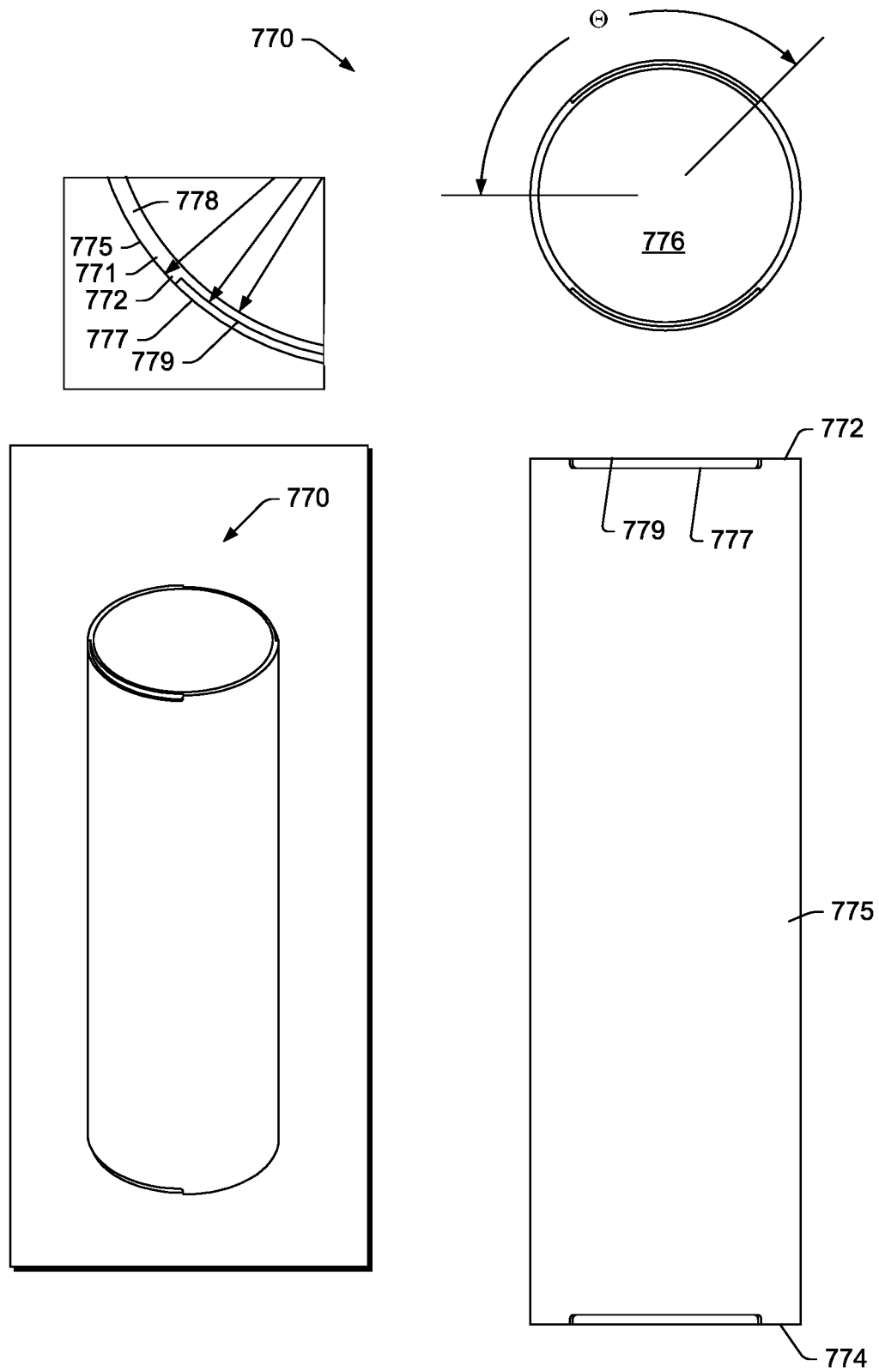


Fig. 14

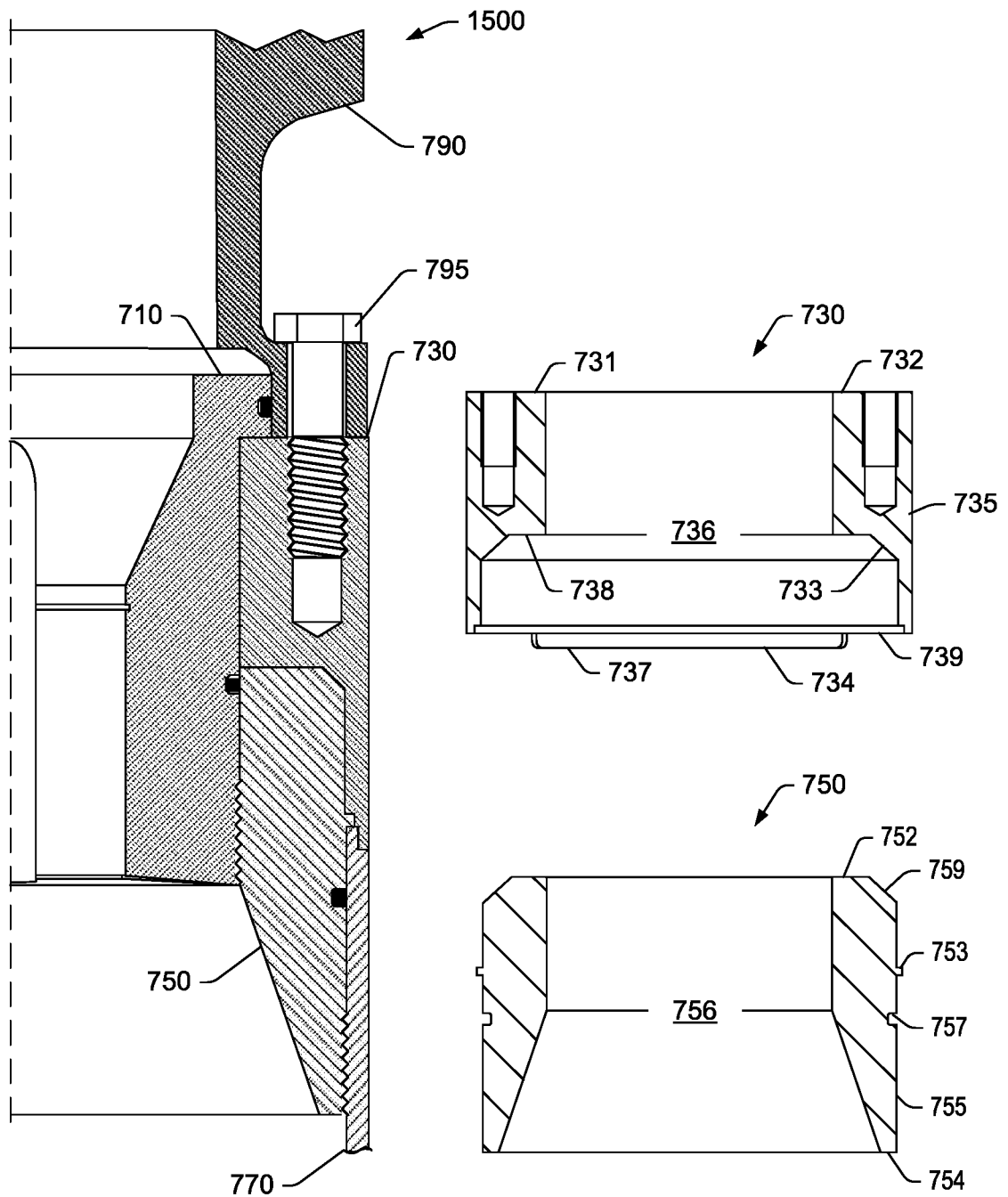


Fig. 15

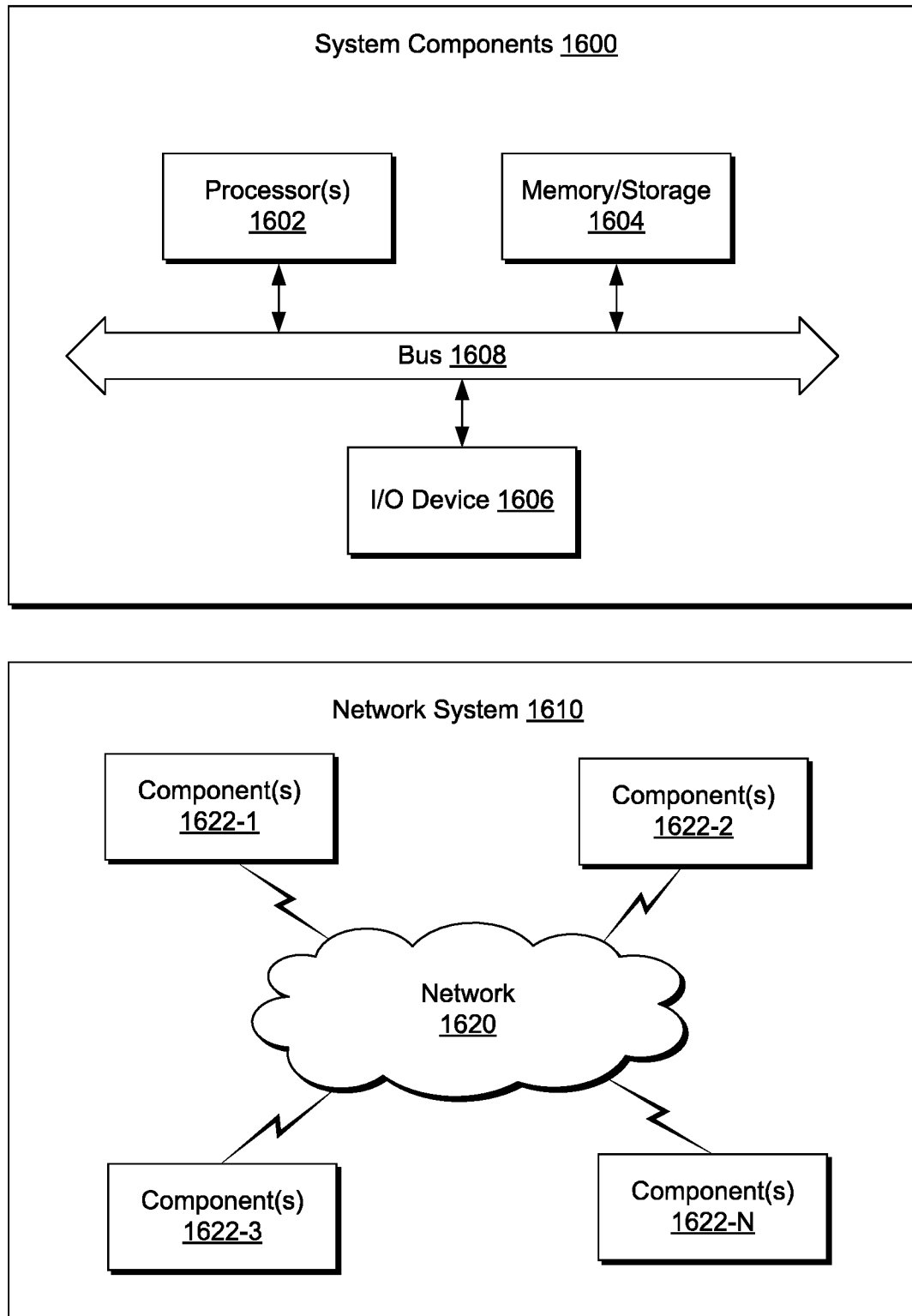


Fig. 16

A. CLASSIFICATION OF SUBJECT MATTER**E21B 17/02(2006.01)i, F04D 13/08(2006.01)i, F04D 13/10(2006.01)i, E21B 4/02(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 17/02; H02K 15/00; F04D 13/08; F04B 35/04; F04D 13/06; E21B 19/16; F04D 29/00; F04D 29/04; F04D 13/10; E21B 4/02

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: electric, submersible, pump, motor, coupling, joint, lock, adapter, torque, cylindrical, clamp

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2010-0150751 A1 (MERRILL et al.) 17 June 2010 See paragraphs [0007]-[0009], [0018]-[0026]; and figures 1-4.	1-20
Y	US 2016-0032928 A1 (BAKER HUGHES INCORPORATED) 04 February 2016 See paragraph [0030]; and figures 2, 4-5.	1-20
A	US 2005-0022999 A1 (HUGHES, WILLIAM JAMES) 03 February 2005 See paragraphs [0064]-[0070]; and figures 9-12, 12A.	1-20
A	WO 2014-120781 A1 (SCHLUMBERGER TECHNOLOGY CORPORATION) 07 August 2014 See paragraphs [0028]-[0030]; and figures 1-2.	1-20
A	US 2013-0340245 A1 (SCHLUMBERGER TECHNOLOGY CORPORATION) 26 December 2013 See paragraphs [0025], [0040]-[0042]; and figures 1, 8-9.	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

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"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

03 March 2017 (03.03.2017)

Date of mailing of the international search report

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Name and mailing address of the ISA/KR

International Application Division

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2016/035147

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010-0150751 A1	17/06/2010	CA 2746095 A1 CA 2746095 C GB 2477694 A GB 2477694 B RU 2011127912 A RU 2519132 C2 SG 172065 A1 US 8419390 B2 WO 2010-068833 A2 WO 2010-068833 A3	17/06/2010 02/06/2015 10/08/2011 12/12/2012 20/01/2013 10/06/2014 28/07/2011 16/04/2013 17/06/2010 14/10/2010
US 2016-0032928 A1	04/02/2016	WO 2016-018656 A1	04/02/2016
US 2005-0022999 A1	03/02/2005	US 2005-0023831 A1 US 7226090 B2 US 7390032 B2	03/02/2005 05/06/2007 24/06/2008
WO 2014-120781 A1	07/08/2014	US 2014-0209323 A1 US 9394750 B2	31/07/2014 19/07/2016
US 2013-0340245 A1	26/12/2013	NO 20130844 A	23/12/2013