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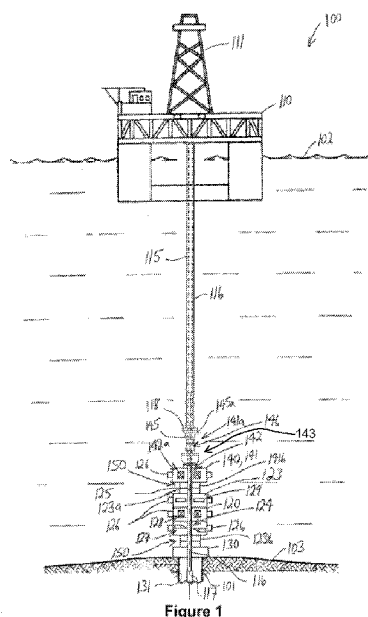
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(54) Title: SUBSEA CONNECTOR WITH A SPLIT CLAMP LATCH ASSEMBLY



(57) Abstract: Methods and devices for forming a subsea connection over an existing subsea connection are described herein. In one embodiment, a subsea connector for forming a sealed connection to a subsea connection comprises a connector body including a sealing portion. The connector body comprises a throughbore running therethrough. The subsea connector also comprises a latch clamp assembly coupled to the sealing portion. The latch clamp assembly comprises at least a first clamp portion and a second clamp portion movable to couple to an existing subsea connection. The connector body and latch clamp assembly together form a sealed connection to the existing subsea connection.

Subsea Connector with a Split Clamp Latch Assembly

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims benefit of U.S. provisional patent application Serial No. 61/499,040 filed June 20, 2011, and entitled "Subsea Connector with a Split Clamp Latch Assembly," which is hereby incorporated herein by reference in its entirety for all purposes.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable

BACKGROUND

Field of the Invention

[0003] This invention relates generally to systems and methods of subsea operations in the exploration and production of hydrocarbons. More specifically, the invention relates to a method of forming a subsea connection over an existing subsea connection.

Background of the Invention

[0004] In offshore drilling operations, a blowout preventer (BOP) is installed on a wellhead at the sea floor and a lower marine riser package (LMRP) mounted to the BOP. In addition, a drilling riser extends from a flex joint at the upper end of LMRP to a drilling vessel or rig at the sea surface. A drill string is then suspended from the rig through the drilling riser, LMRP, and the BOP into the well bore. A choke line and a kill line are also suspended from the rig and coupled to the BOP, usually as part of the drilling riser assembly.

[0005] During drilling operations, drilling fluid, or mud, is delivered through the drill string, and returned up an annulus between the drill string and casing that lines the well bore. In the event of a rapid influx of formation fluid into the annulus, commonly known as a "kick," the BOP and/or LMRP may actuate to seal the annulus and control the well. In particular, BOPs and LMRPs comprise closure members capable of sealing and closing the well in order to prevent the release of high-pressure gas or liquids from the well. Thus, the BOP and LMRP are used as safety devices that close, isolate, and seal the wellbore. Heavier drilling mud may be delivered through the drill string, forcing fluid from the annulus through the choke line or kill line to protect the well equipment disposed above the BOP and LMRP from the high pressures

associated with the formation fluid. Assuming the structural integrity of the well has not been compromised, drilling operations may resume. However, if drilling operations cannot be resumed, cement or heavier drilling mud is delivered into the well bore to kill the well.

[0006] In the event that the BOP and LMRP fail to actuate or insufficiently actuate in response to a surge of formation fluid pressure in the annulus, a blowout may occur. The blowout may damage subsea well equipment and hardware such as the BOP, LMRP, or drilling riser. This can be problematic if it results in the discharge of hydrocarbons into the surrounding sea water. In addition, it may be challenging to rectify as the damage may be far below the sea surface. In particular, damage to subsea well equipment may result in damage to subsea connections such as a subsea flange connection. A new connection may be needed in order to couple a subsea device such as a capping device to the damaged subsea connection. In cases where the subsea connection uses a flange connection, circumstances may not allow for the separation of the existing connection. Consequently, there is a need for methods and apparatuses for forming a subsea connection over an existing subsea connection.

BRIEF SUMMARY

[0007] These and other needs in the art are addressed in one embodiment by a subsea connector for forming a sealed connection to an existing subsea connection which comprises a connector body including a sealing portion. The connector body comprises a throughbore running therethrough. The subsea connector also comprises a latch clamp assembly coupled to the sealing portion. The latch clamp assembly comprises at least a first clamp portion and a second clamp portion movable to couple to an existing subsea connection. The connector body and latch clamp assembly together form a sealed connection to the existing subsea connection.

[0008] In another embodiment, a method of forming a subsea connection comprises positioning a subsea connector adjacent an existing subsea connection. The subsea connector comprises an connector body comprising a sealing portion. The connector body comprises a throughbore running therethrough. The subsea connector also comprises a latch clamp assembly coupled to the sealing portion. The latch clamp assembly comprises at least a first clamp portion and a second clamp portion movable to couple to an existing subsea connection. The connector body and latch clamp assembly together capable of forming a sealed connection to the existing subsea connection. The method also comprises guiding the subsea connector into engagement with the existing subsea connection. Additionally, the method comprises actuating the subsea connector so as to form a sealed connection with the existing subsea connection.

[0009] In another embodiment, a method of forming a subsea connection comprises positioning a subsea connector adjacent an existing subsea connection. The subsea connector comprises a connector body comprising a sealing portion. The connector body comprises a throughbore running therethrough and a subsea connection coupled to the connector body. The subsea connector also comprises a latch clamp assembly coupled to the sealing portion. The latch clamp assembly comprises at least a first clamp portion and a second clamp portion movable to couple to an existing subsea connection. The connector body and latch clamp assembly together form a sealed connection to the existing subsea connection. The method further comprises moving the subsea connector laterally over subsea wellbore. In addition, the method comprises lowering the subsea connector into engagement with the existing subsea connection. The method also comprises actuating the subsea connector so as to form a sealed connection with the existing subsea connection and coupling a capping device on to the subsea connector to cap the subsea well.

[0010] The foregoing has outlined rather broadly the features and technical advantages of the invention in order that the detailed description of the invention that follows may be better understood. Additional features and advantages of the invention will be described hereinafter that form the subject of the claims of the invention. It should be appreciated by those skilled in the art that the conception and the specific embodiments disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] For a detailed description of the preferred embodiments of the invention, reference will now be made to the accompanying drawings in which:

[0012] Figure 1 is a schematic view of an embodiment of an offshore drilling system;

[0013] Figure 2 is an enlarged view of the riser flex joint of the lower marine riser package of Figure 1;

[0014] Figure 3 is a schematic view of the offshore drilling system of Figure 1 with the riser portion severed from the riser flex joint;

[0015] Figure 4A is a side view of an embodiment a subsea connector installed on an existing subsea connection in open position. In this exemplary embodiment, the existing subsea connection is a flex joint flange connection;

[0016] Figure 4B is a cross-sectional side view of an embodiment a subsea connector. In this view, the subsea connector is show with the latch clamp assembly in closed mode or position;

[0017] Figure 4C illustrates perspective views of an embodiment of a subsea connector in the open and closed position;

[0018] Figure 4D illustrates cross-sectional perspective views of an embodiment of a subsea connector in the open and closed position

[0019] Figure 4E is a cross-sectional side view of an embodiment a subsea connector being installed on an existing subsea connection. In particular, the guidance profile 522c of the guide rail 522 is shown.

[0020] Figure 5A is a schematic view of an embodiment of a subsea connector being installed on to an existing subsea connection;

[0021] Figure 5B is a schematic view of an embodiment of a subsea connector being installed on to an existing subsea connection;

[0022] Figure 5C is a schematic view of an embodiment of a subsea connector being installed on to an existing subsea connection;

[0023] Figure 5D is a schematic view of an embodiment of a subsea connector being installed on to an existing subsea connection;

[0024] Figure 5E is a schematic view of an embodiment of a subsea connector being installed on to an existing subsea connection;

[0025] Figure 5F is a cross-sectional side view of an embodiment of a subsea connector installed on an existing subsea connection;

[0026] Figure 6 illustrates a schematic view of an embodiment of a subsea connector installed on an existing subsea connection. The subsea connector is shown coupled to a capping device;

NOTATION AND NOMENCLATURE

[0027] Certain terms are used throughout the following description and claims to refer to particular system components. This document does not intend to distinguish between components that differ in name but not function.

[0028] In the following discussion and in the claims, the terms “including” and “comprising” are used in an open-ended fashion, and thus should be interpreted to mean “including, but not limited to...”. Also, the term “couple” or “couples” is intended to mean either an indirect or direct connection. Thus, if a first device couples to a second device, that connection may be through a direct connection, or through an indirect connection via other devices and

connections. In addition, as used herein, the terms "axial" and "axially" generally mean along or parallel to a central axis (e.g., central axis of a body or a port), while the terms "radial" and "radially" generally mean perpendicular to the central axis. For instance, an axial distance refers to a distance measured along or parallel to the central axis, and a radial distance means a distance measured perpendicular to the central axis.

[0029] As used herein, the term "ROV" refers to remotely operate vehicle. Each ROV may include arms having a claw, a subsea camera for viewing the subsea operations (e.g., the relative positions of subsea tools or devices such as subsea connector 500), and an umbilical. Streaming video and/or images from cameras are communicated to the surface or other remote location via umbilical for viewing on a live or periodic basis. Arms and claws may be controlled via commands sent from the surface or other remote location to ROV through umbilical.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0030] Referring now to Figure 1, an embodiment of an offshore system 100 for drilling and/or producing a wellbore 101 is shown. In this embodiment, system 100 includes an offshore platform 110 at the sea surface 102, a subsea blowout preventer (BOP) 120 mounted to a wellhead 130 at the sea floor 103, and a lower marine riser package (LMRP) 140. Platform 110 is equipped with a derrick 111 that supports a hoist (not shown). A drilling riser 115 extends from platform 110 to LMRP 140. In general, riser 115 is a large-diameter pipe that connects LMRP 140 to the floating platform 110. During drilling operations, riser 115 takes mud returns to the platform 110. Casing 131 extends from wellhead 130 into subterranean wellbore 101.

[0031] Downhole operations are carried out by a tubular string 116 (e.g., drillstring, production tubing string, coiled tubing, etc.) that is supported by derrick 111 and extends from platform 110 through riser 115, LMRP 140, BOP 120, and into cased wellbore 101. A downhole tool 117 is connected to the lower end of tubular string 116. In general, downhole tool 117 may comprise any suitable downhole tool(s) for drilling, completing, evaluating and/or producing wellbore 101 including, without limitation, drill bits, packers, testing equipment, perforating guns, and the like. During downhole operations, string 116, and hence tool 117 coupled thereto, may move axially, radially, and/or rotationally relative to riser 115, LMRP 140, BOP 120, and casing 131.

[0032] BOP 120 and LMRP 140 are configured to controllably seal wellbore 101 and contain hydrocarbon fluids therein. Specifically, BOP 120 has a central or longitudinal axis 125 and

includes a body 123 with an upper end 123a releasably secured to LMRP 140, a lower end 123b releasably secured to wellhead 130, and a main bore 124 extending axially between upper and lower ends 123a, b. Main bore 124 is coaxially aligned with wellbore 101, thereby allowing fluid communication between wellbore 101 and main bore 124. In this embodiment, BOP 120 is releasably coupled to LMRP 140 and wellhead 130 with hydraulically actuated, mechanical wellhead-type connectors 150. In general, connectors 150 may comprise any suitable releasable wellhead-type mechanical connector such as the H-4® profile subsea connector available from VetcoGray Inc. of Houston, Texas or the DWHC profile subsea connector available from Cameron International Corporation of Houston, Texas. Typically, such wellhead-type mechanical connectors (e.g., connectors 150) comprise a male component or coupling, labeled with reference numeral 150a herein, that is inserted into and releasably engages a mating female component or coupling, labeled with reference numeral 150b herein. In addition, BOP 120 includes a plurality of axially stacked sets of opposed rams - opposed blind shear rams or blades 127 for severing tubular string 116 and sealing off wellbore 101 from riser 115, opposed blind rams 128 for sealing off wellbore 101 when no string (e.g., string 116) or tubular extends through main bore 124, and opposed pipe rams 129 for engaging string 116 and sealing the annulus around tubular string 116. Each set of rams 127, 128, 129 is equipped with sealing members that engage to prohibit flow through the annulus around string 116 and/or main bore 124 when rams 127, 128, 129 is closed.

[0033] Opposed rams 127, 128, 129 are disposed in cavities that intersect main bore 124 and support rams 127, 128, 129 as they move into and out of main bore 124. Each set of rams 127, 128, 129 is actuated and transitioned between an open position and a closed position. In the open positions, rams 127, 128, 129 are radially withdrawn from main bore 124 and do not interfere with tubular string 116 or other hardware that may extend through main bore 124. However, in the closed positions, rams 127, 128, 129 are radially advanced into main bore 124 to close off and seal main bore 124 (e.g., rams 127, 128) or the annulus around tubular string 116 (e.g., rams 129). Each set of rams 127, 128, 129 is actuated and transitioned between the open and closed positions by a pair of actuators 126. In particular, each actuator 126 hydraulically moves a piston within a cylinder to move a drive rod coupled to one ram 127, 128, 129.

[0034] Referring still to Figure 1, LMRP 140 has a body 141 with an upper end 141a connected to the lower end of riser 115, a lower end 141b releasably secured to upper end 123a with connector 150, and a throughbore 142 extending between upper and lower ends 141a, b. Throughbore 142 is coaxially aligned with main bore 124 of BOP 110, thereby

allowing fluid communication between throughbore 142 and main bore 124. LMRP 140 also includes an annular blowout preventer 142a comprising an annular elastomeric sealing element that is mechanically squeezed radially inward to seal on a tubular extending through bore 142 (e.g., string 116, casing, drillpipe, drill collar, etc.) or seal off bore 142. Thus, annular BOP 142a has the ability to seal on a variety of pipe sizes and seal off bore 142 when no tubular is extending therethrough.

[0035] Referring now to Figures 1 and 2, in this embodiment, upper end 141a of LMRP 140 comprises a riser flex joint 143 that allows riser 115 to deflect angularly relative to BOP 120 and LMRP 140 while hydrocarbon fluids flow from wellbore 101, BOP 120 and LMRP 140 into riser 115. In this embodiment, flex joint 143 includes a cylindrical base 144 rigidly secured to the remainder of LMRP 140 and a riser extension or adapter 145 extending upward from base 144. A fluid flow passage 146 extending through base 144 and adapter 145 defines the upper portion of throughbore 142. A flex element (not shown) disposed within base 144 extends between base 144 and riser adapter 145, and sealingly engages both base 144 and riser adapter 145. The flex element allows riser adapter 145 to pivot and angularly deflect relative to base 144, LMRP 140, and BOP 120. The upper end of adapter 145 distal base 144 comprises an annular flange 145a for coupling riser adapter 145 to a mating lower riser flange 118 at the lower end of riser 115 or to alternative devices. As best shown in Figure 2, upper flex joint flange 145a typically includes a plurality of circumferentially-spaced holes that receive bolts for securing upper flex joint flange 145a to a mating annular flange 118 at the lower end of riser 115. In addition, upper flex joint flange 145a includes a pair of circumferentially spaced guide holes, each guide hole having a diameter greater than the diameter of holes. In this embodiment, flex joint 143 also includes a mud boost line 149 having an inlet (not shown) in fluid communication with flow passages 142, 146, an outlet in flange 145a, and a valve 149c configured to control the flow of fluids through line 149. Although LMRP 140 has been shown and described as including a particular flex joint 143, in general, any suitable riser flex joint may be employed in LMRP 140.

[0036] During a "kick" or surge of formation fluid pressure in wellbore 101, one or more rams 127, 128, 129 of BOP 120 and/or LMRP 140 may be actuated to seal in wellbore 101. However, in some cases, rams 127, 128, 129 may not seal off wellbore 101, resulting in a blowout.

[0037] Referring to Figure 3, a substantial portion of riser 115 may be severed and removed after a blowout leaving a lower portion 115a remaining. Lower end portion 115a of riser 115 may have an uneven surface. In some instances, lower end portion 115a may have a tapered

side profile 115b. In addition, lower end portion 115a remains attached to lower riser flange 118. The combination of lower riser flange 118 and upper flex joint flange 145a may be referred to as the flex joint flange connection 147. As such, in order to cap the well, a connector can be installed which sealingly connects over lower end portion 115a, annular flange 118 of riser 115, and upper flex joint flange 145a, and additionally provides a generic connection or adapter for coupling a capping device such as a capping stack or a single valve manifold, as described in US Provisional Application Serial No. 61/475,032, filed April 13, 2011, incorporated herein by reference in its entirety for all purposes. Such a connector may preclude the removal of annular flange 118 and facilitate connection of a capping device or other subsea device.

[0038] Referring now to Figures 4A, an embodiment of a subsea connector 500 is shown. As mentioned above, embodiments of the subsea connector 500 sealingly “latch” or couple to a standard subsea connection, (*e.g.* a flange connection), and form a sealed connection with a capping device or other subsea device. It is emphasized that although embodiments of subsea connector 500 are described with respect to a subsea flex joint flange connection 147 as shown in the figures, subsea connector 500 may be used with any subsea connections known to those of skill in the art. In general, subsea connector 500 may include a connector body 501 with a subsea connection or coupling (*e.g.* flange) 503, and a latch clamp assembly 520 coupled to connector body 501. Preferably, connector body 501 has a cylindrical geometry. However, connector body 501 may be of any suitable geometry. Latch clamp assembly 520 is disposed circumferentially around sealing portion 501a of connector body 501. In an embodiment, subsea connection or coupling 503 may be a flange connection having a plurality of circumferentially spaced holes 503a, as shown in Figure 4B, for receiving bolts that secure a capping device or other member to subsea connector 500. In other embodiments, subsea connection or coupling 503 may be any subsea connection known to those of skill in the art such as without a limitation, a universal subsea hub connection.

[0039] Referring to Figure 4B, connector body 501 has a throughbore 504 through which fluids such as hydrocarbons may flow. Furthermore, lower portion of throughbore 504 located at the sealing portion 501a of connector body 501 has a sealing surface 505. Sealing surface 505 forms the sealed connection between subsea connector 500 and subsea coupling or connection 147. More particularly, sealing surface 505 contacts the outer surface of lower riser portion 115a and is configured to mate with outer surface of lower riser portion 115a. In some instances, lower riser portion 115a has a tapered or angled side profile. Accordingly, sealing surface 505 may have a corresponding angled or tapered inner surface 505a configured to mate

with lower riser portion 115a. In other embodiments, sealing surface 505 may be configured to mate or seal with a subsea connection without a protruding lower riser portion 115a. Alternatively, instead of a sealing surface 505, an interchangeable or removable sealing cartridge (not shown) may be used. In other words, depending on existing subsea connection, an appropriate sealing cartridge may be selected and coupled to sealing portion 501a. Thus, embodiments of subsea connector 500 may be adapted for use with any number of existing subsea connections.

[0040] Referring to Figures 4A and 4B, in an embodiment, latch clamp assembly 520 of subsea connector 500 includes a latch plate 521, a plurality of guide rails 522, a plurality of connecting rods 523, a first clamp portion 524a, a second clamp portion 524b, and a plurality of connecting members 525. In an embodiment, latch plate or frame 521 may serve as a stable platform or base through which to facilitate movement of clamp portions 524a, 524b. Latch plate 521 is coupled to seal portion 501a of connector body 501. Latch plate 521 may be coupled by any methods known to those of skill in the art. In an embodiment, latch plate 521 may be welded on to connector body 501. First and second clamp portion 524a, 524b, are movably coupled to latch plate 521 via the connecting members 525. Latch plate 521 has a plurality of slots or holes 521a through which a portion 525a of connecting members 525 may protrude. Holes 521a can be generally elongate to allow movement of connecting members 525. Furthermore, holes 521a can be arranged in a parallel fashion, as shown in Figure 4C, to only allow unidirectional movement (i.e lateral movement) of clamp portions 524a, 524b.

[0041] As will be described in more detail below, connecting members 525 can move or slide within holes 521a as clamp portions 524a, 524b are moved from an open position to a closed position. Connecting members 525 may be rotatably disposed in holes 527 of clamp portions 524a, 524b. In embodiments, connecting members 525 are threadingly engaged within holes 527 of clamp portions 524a, 524b. As such, when connecting members 525 are rotated, depending on which way connecting members 525 are rotated, clamp portions 524a, 524b are correspondingly moved in a longitudinal direction either up or down. As connecting members 525 are rotated, the threaded portions of connecting members 525 may engage with the corresponding threads within holes 527 and pulls clamp portions 524a, 524b against latch plate 521, thereby ensuring sealing surface 505 is securely seated on riser portion 115a to form a fluid tight seal. Top portions 525a protrude from holes 521a may have a shape suitable for engagement or coupling with an ROV tool. More specifically, top portions may have geometry similar to a nut fastener such as, without limitation, hexagonal, octagonal, rectangular, triangular, and the like. Any suitable geometry may be used.

[0042] Still referring to Figures 4A and 4B, clamp portions 524a, 524b are able to move longitudinally along axis, α , so as to secure sealing body 501 and clamp portions 524a, 524b against subsea coupling or connection 147. Furthermore, first and second clamp portion 524a, 524b are movably connected to each other by connecting rods 523. Clamp portions 524a, 524b can move laterally or radially toward and away from one another. In an embodiment, connecting rods 523 are threadingly connected to the clamp portions 524a, 524b. That is, each connecting rod 523 may be entirely threaded or partially threaded along its length. Accordingly, by rotating connecting rods 523, clamp portions 524a, 524b may be moved toward or away from one another. Connecting rods 523 may be manually rotated by an ROV or by an actuator (not shown) which is activated by an ROV.

[0043] In an embodiment, clamp portions 524a, 524b are configured to enclose and engage a subsea flange connection 147. More particularly, each clamp portion 524a, 524b may be in the shape of a semi-circle. However, clamp portions 524a, 524b may be of any suitable shape depending on the type of existing subsea connection 147. Clamp portions 524a, 524b may each have inner lips or rims 524c which disposed along the inner top edge 524d and inner bottom edge 524e of clamp portions 524a, 524b as shown clearly in Figure 4D. Inner rims 524c engage or contact subsea connection 147 and secure subsea connector 500 to subsea connection 147. Profile or cross-section of inner rims 524c may be of any suitable geometry in accordance with the type of subsea connection the subsea connector 500 is configured for. In embodiments, inner rims 524c may have a rectangular profile, a tapered profile, a rounded profile, etc. More particularly, inner rims 524c may be configured to engage or mate with an existing subsea connection as shown in Figures 4A-5D.

[0044] Latch clamp assembly 520 can also include a plurality of guide rails 522, which help with the deepwater installation of subsea connector 500 over the existing subsea connection 147. Although guide rails 522 are shown to be planar or rectangular in geometry, guide rails 522 may have any geometry suitable for guiding subsea connector 500 into engagement with an existing subsea connection 147. Guide rails 522 have an angled portion 522a and a straight portion 522b. In an embodiment, angled portion 522a of guide rails 522 are outwardly angled or angled away from central axis, α . Angled portion 522a may be disposed at any suitable angle. Furthermore, angled portion 522a may have a straight or curved inner edge 522d. Generally, guide rails 522 are coupled to clamp portions 524a, 524b and/or latch plate 521. In an embodiment, straight portion 522b of guide rails 522 may each have a guidance profile 522c or may be keyed as shown in Figure 4D. The guidance profile 522c of straight portion 522b

further provides guidance during subsea installation to assist with the positioning of sealing portion 501a over lower end portion 115a of the subsea connection 147.

[0045] Latch assembly 520 has an open position and a closed position as seen in Figures 4C-D. In the open position, clamp portions 524a, 524b are split or spaced apart a distance, d , so as to allow latch assembly 520 to be lowered on to an existing subsea connection 147. In the closed position, clamp portions 524a, 524b are in engagement or in contact with another so as to securely latch on to subsea connection 147. More particularly, in the closed position, inner rims 524c of clamp portions 524a, 524b are in contact or engage the outer surfaces of subsea connection 147.

[0046] In a further embodiment, an ROV interface panel (not shown) may be disposed on connector body 510. ROV interface panel may include any ROV interfaces known to those of skill in the art such as dials, handles, hot stabs, and the like. In certain embodiments, ROV interface panel may be used to control actuators or the like on subsea connector 500. However, ROV interface panel may be configured to control any part of subsea connector 500.

[0047] In operation, subsea connector 500 may be lowered adjacent to the plume through any methods known to those of skill in the art. For subsea deployment and installation of subsea connector 500, one or more ROVs 190 are preferably employed to aid in positioning subsea connector 500 and engaging connecting members 525 and connecting rods 523 to move clamp portions 524a, 524b into different positions.

[0048] Referring to Figure 5A, in this embodiment, subsea connector 500 is shown being controllably lowered subsea with a plurality of cables 180 secured to subsea connector 500 and extending to a surface vessel (not shown). Due to the weight of subsea connector 500, cables 180 are preferably relatively strong cables (e.g., steel cables) capable of withstanding the anticipated tensile loads. A winch or crane mounted to a surface vessel may be employed to support and lower subsea connector 500 on cables 180. Although cables 180 are employed to subsea connector 500 in this embodiment, in other embodiments, subsea connector 500 may be deployed subsea on a pipe or drill string. In an embodiment, as shown in Figure 5A, subsea connector 500 may be lowered adjacent or laterally offset to the flex joint flange connection 147 in order to avoid formation of hydrates. More particularly, using cables 180, subsea connector 500 is lowered subsea under its own weight from a location generally above and laterally offset from existing subsea connection 147. One or more ROVs 190 are used to assist in deploying and/or maneuvering subsea connector 500 around flex joint 143.

[0049] Referring now to Figures 5B-5C, once subsea connector 500 has been lowered adjacent to the flex joint 143, subsea connector 500 may be moved laterally so as to align latch

plate 521 and clamp portions 524a, 524b axially with existing subsea connection 147. Guide rails 522 may assist in the axial alignment of subsea connector 500 with existing subsea connection 147. While being deployed, clamp portions 524a, 524b are in an open position (i.e. spaced apart), allowing latch clamp assembly 520 to fit over the existing subsea connection 147. Subsea connector 500 is lowered until sealing surface 505 engages lower riser portion 115a and/or connector body 501 is seated on existing subsea connection 147 as shown in Figure 6C. Referring to Figures 5C-D, by way of ROV manipulation, ROVs may engage connecting rods 523 such that clamp portions 524a, 524b move toward or closer to one so that until clamp portions 524a, 524b engage subsea connection 147. Connecting rods 523 are rotated until clamp portions 524a, 524c are in the closed position as shown in Figure 5D. Connecting rods 523 may have ends which are configured to fit with existing ROV tools or a custom ROV tool. ROVs may then use these tools to rotate connecting rods 523. In embodiments with more than one connecting rod 523, connecting rods 523 may be rotated simultaneously or one after another.

[0050] Now referring to Figure 5E, each connecting member 525 may be secure or tightened via top portion 525a by an ROV tool 192 configured to engage with top portion 525a. ROVs may disengage from connecting rods 524 and then engage with connecting members 525. As described above, top portion 525a of each connecting member may have a specific geometry (e.g. hexagonal, rectangular, etc) to fit an ROV tool. ROV may engage this top portion 525a with a custom tool 192 or other standard tool so as to rotate connecting members 525. The connecting members 525 may be tightened simultaneously or one after another.

[0051] Figure 5F shows subsea connector 500 installed on existing subsea connection 147. The combination of the connecting members 525 and clamping portions 524a, 524b in the closed position securely couple subsea connector 500 to existing subsea connection 147, where sealing surface 505 forms a fluid tight seal with lower riser portion 115a. Once subsea connector 500 has been secured in place, subsea connection or coupling 503 (e.g., a flange) may now serve as a universal connector for a capping device (e.g. capping stacks, BOPs, valves, etc) or other suitable subsea device for capping the well. As shown in Figures 6, for illustrative purposes, subsea connector 500 is with a capping device 700. Much like the installation of subsea connector 500, a capping device 700 may be lowered by cables adjacent or laterally offset to flex joint 143. Once in position next to subsea connector 500, capping device 700 is lowered on to subsea connection 503 of subsea connector 500 and then coupled securely to subsea connection 503 to form a fluid tight connection. Capping device 700 may have one or more valves or chokes which may remain open during installation. These valves or

chokes may be gradually closed to ensure integrity of the well. Examples of capping devices are described in detail by US Provisional Application Serial No. 61/475,032, filed April 13, 2011, which is hereby incorporated herein by reference in its entirety for all purposes.

[0052] Although embodiments of subsea connector 500 have been discussed with respect to a flex joint flange connection 147 with flanges 118, 145a connected, it is envisioned that subsea connector 500 may be used in situations where lower riser flange 118 has been removed. In such an embodiment, sealing surface 505 may have a surface configured or adapted to mate on the surface of upper flex joint flange 145a as opposed to lower riser portion 115a. For example, instead of an angled or tapered profile, sealing surface 505 may have a, notched, stepped or completely flat profile.

[0053] Subsea connector 500 may also be used for other purposes besides the capping of a subsea blowout. In an exemplary embodiment, subsea connector 500 may be used to provide a subsea connection in cases where the upper and lower portions of a flange connection or other subsea connection are unable to be separated. The installation of subsea connector 500 would be similar as described above without the complications of having to deal with the discharge of hydrocarbons. Any subsea devices known to those of skill in the art could be connected to subsea connector 500 either via subsea connection 503 or welded to the subsea device. Examples of other subsea devices may include without limitation, flex joints, risers, lower marine riser packages, BOPs, valves, chokes, production trees, tubulars, subsea trees, combinations thereof, etc.

[0054] While the embodiments of the invention have been shown and described, modifications thereof can be made by one skilled in the art without departing from the spirit and teachings of the invention. The embodiments described and the examples provided herein are exemplary only, and are not intended to be limiting. Many variations and modifications of the invention disclosed herein are possible and are within the scope of the invention. Accordingly, the scope of protection is not limited by the description set out above, but is only limited by the claims which follow, that scope including all equivalents of the subject matter of the claims.

[0055] Any discussion of a reference is not an admission that it is prior art to the present invention, especially any reference that may have a publication date after the priority date of this application. The disclosures of all patents, patent applications, and publications cited herein are hereby incorporated herein by reference in their entirety, to the extent that they provide exemplary, procedural, or other details supplementary to those set forth herein.

CLAIMS

What is claimed is:

1. A subsea connector for forming a sealed connection to an existing subsea connection comprising:
 - a connector body comprising a sealing portion and a throughbore running therethrough; and
 - a latch clamp assembly coupled to the sealing portion, wherein the latch clamp assembly comprises at least a first clamp portion and a second clamp portion movable to couple to an existing subsea connection, and wherein the connector body and the latch clamp assembly together form a sealed connection to the existing subsea connection.
2. The subsea connector of claim 1 wherein the sealing portion comprises a sealing surface.
3. The subsea connector of claim 2 wherein the sealing surface has a beveled inner surface to mate with a tapered riser section.
4. The subsea connector of claim 1 wherein the latch clamp assembly further comprises a latch plate, the clamp portions being movably coupled to the latch plate, wherein the clamp portions are movable in at least two different directions, and wherein each clamp portion has one or more rims to engage the existing subsea connection.
5. The subsea connector of claim 1 wherein the clamp portions are movable in a radial direction and a longitudinal direction.
6. The subsea connector of claim 1 wherein each clamp portion is movably coupled to the latch plate by one or more connecting members.
7. The subsea connector of claim 6 wherein the clamp portions are threadingly connected to the one or more connecting members.
8. The subsea connector of claim 1 wherein the clamp portions are movably coupled to each other by one or more connecting rods.

9. The subsea connector of claim 8 wherein the clamp portions are movable from an open position to a closed position by the connecting rods, wherein in the closed position, the clamp portions engage and enclose the existing subsea connection.
10. The subsea connector of claim 9 wherein the clamp portions are spaced apart in the open position.
11. The subsea connector of claim 1, further comprising an ROV interface panel, the ROV interface panel comprising one or more ROV interfaces.
12. The subsea connector of claim 1, further comprising a subsea connection coupled to the connector body.
13. The subsea connector of claim 12 wherein the subsea connection coupled to the connector body is a flange connection.
14. The subsea connector of claim 1, further comprising a sealing cap coupled to the connector body.
15. The subsea connector of claim 1 wherein the existing subsea connection is a flange connection.
16. A method of forming a subsea connection comprising:
 - a) positioning a subsea connector adjacent an existing subsea connection, the subsea connector comprising:
 - a connector body comprising a sealing portion and a throughbore running therethrough; and
 - a latch clamp assembly coupled to the sealing portion, wherein the latch clamp assembly comprises at least a first clamp portion and a second clamp portion which are movable to couple to an existing subsea connection, and wherein the connector body and the latch clamp assembly together form a sealed connection to the existing subsea connection;
 - b) guiding the subsea connector into engagement with the existing subsea connection; and

- c) actuating the subsea connector so as to form a sealed connection with the existing subsea connection.

17. The method of claim 16 wherein (c) comprises actuating the clamp portions into a closed position so as to enclose the existing subsea connection within the clamp portions;

18. The method of claim 17 wherein actuating the subsea connector in (c) further comprises rotating one or more connecting rods coupled between the clamp portions to move the clamp portions into the closed position.

19. The method of claim 18 wherein actuating the subsea connector in (c) further comprises tightening one or more connecting members to secure the sealing portion of the connector body to the existing subsea connection.

20. The method of claim 16 wherein (a) through (c) utilizes one or more ROVs.

21. The method of claim 16 wherein the existing subsea connection is a subsea flange connection.

22. The method of claim 16, wherein the subsea connector further comprises a subsea connection coupled to the connector body.

23. The method of claim 22, further comprising coupling a subsea device to the subsea connector via the subsea connection after (c).

24. The method of claim 23, wherein the subsea device comprises a flex joint, a riser, a lower marine riser package, a BOP, a valve, a chokes, a subsea tree, or combinations thereof.

25. A method of capping a subsea well producing hydrocarbons into the surrounding sea comprising:

- a) positioning a subsea connector adjacent an existing subsea connection, the subsea connector comprising:

- a connector body comprising a sealing portion and a throughbore running therethrough, and a subsea connection coupled to the connector body; and

a latch clamp assembly coupled to the sealing portion, wherein the latch clamp assembly comprises at least a first clamp portion and a second clamp portion movable to couple to an existing subsea connection, and wherein the connector body and latch clamp assembly together form a sealed connection to the existing subsea connection;

- b) moving the subsea connector laterally over subsea wellbore;
- c) guiding the subsea connector into engagement with the existing subsea connection;
- d) actuating the subsea connector so as to form a sealed connection with the existing subsea connection; and
- e) coupling a capping device on to the subsea connector to cap the subsea well.

26. The method of claim 25 wherein the capping device is a BOP, a valve, or combinations thereof.

27. The method of claim 26, wherein (e) comprises coupling the capping device to the subsea connection of the subsea connector.

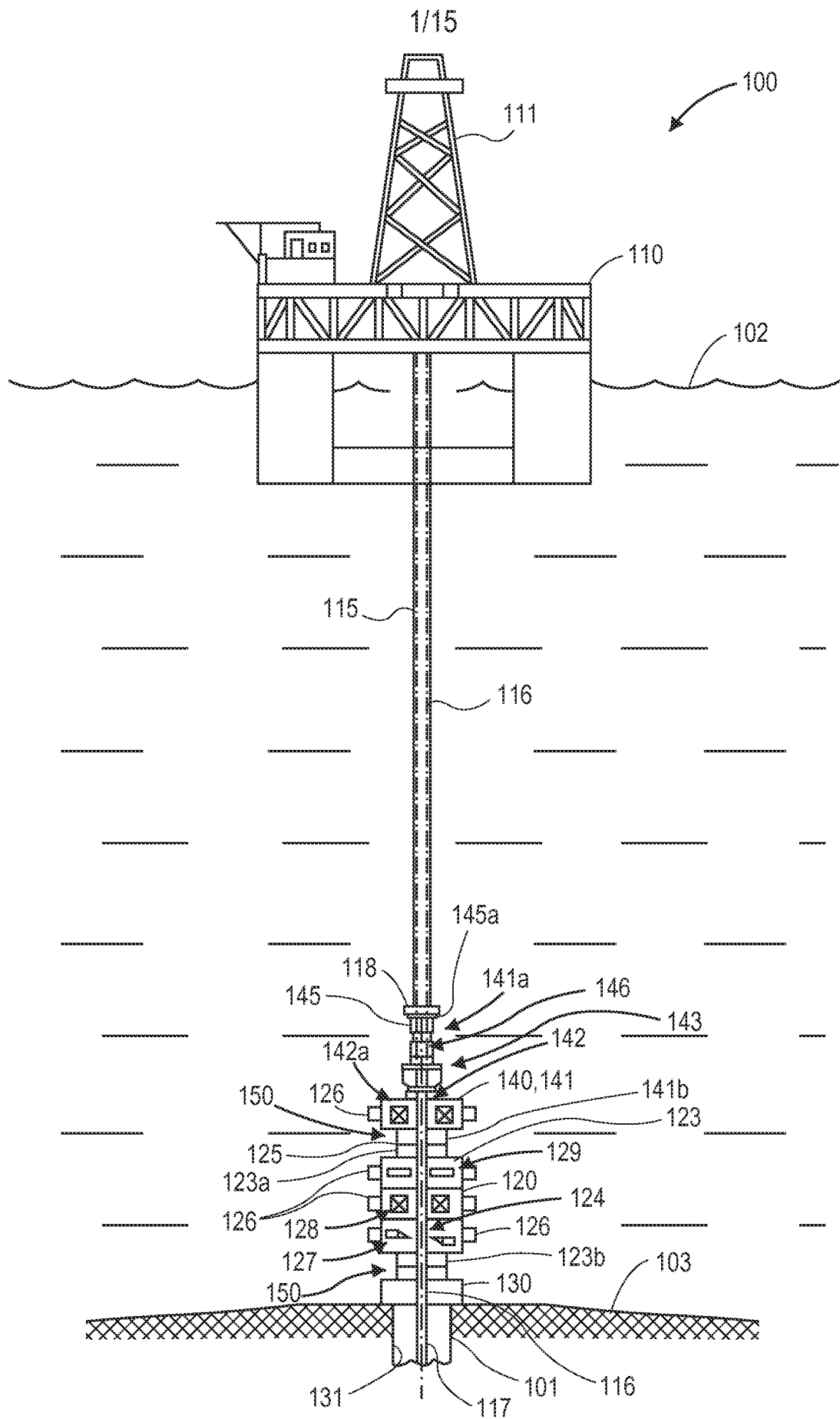


FIG. 1

SUBSTITUTE SHEET (RULE 26)

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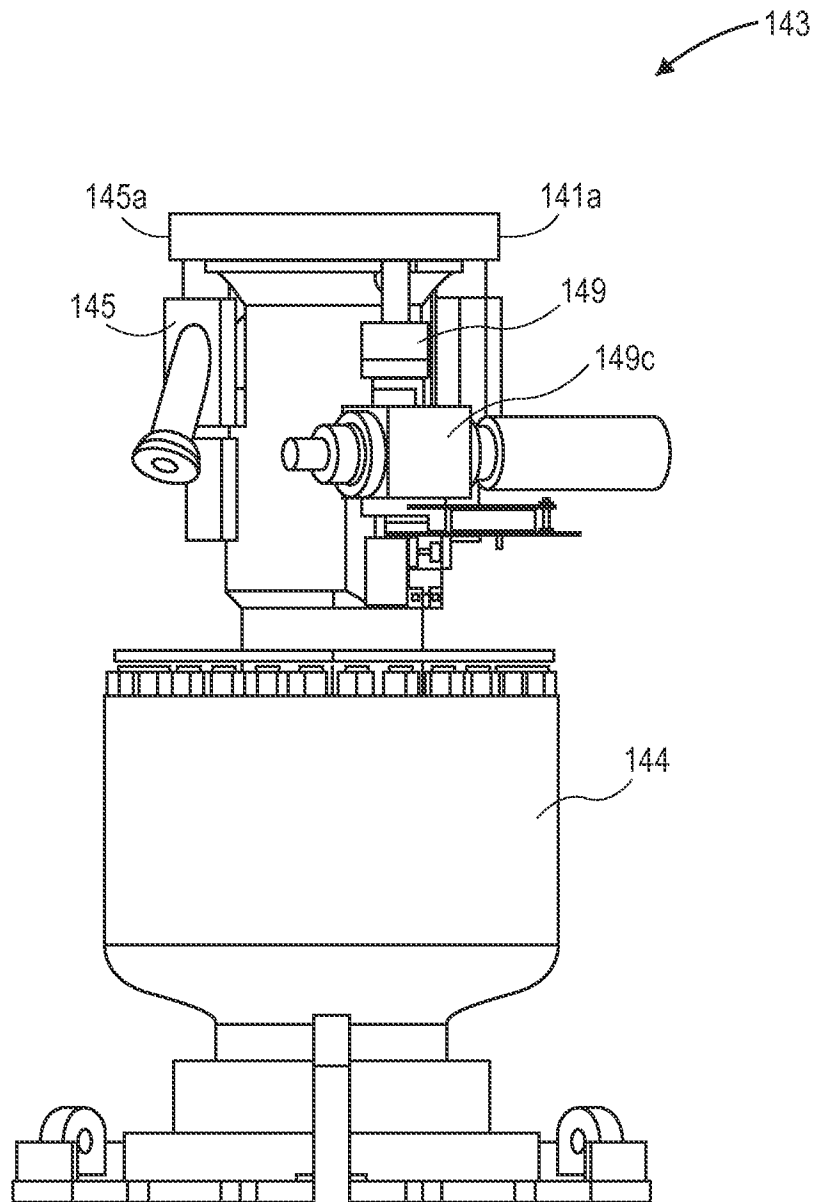


FIG. 2

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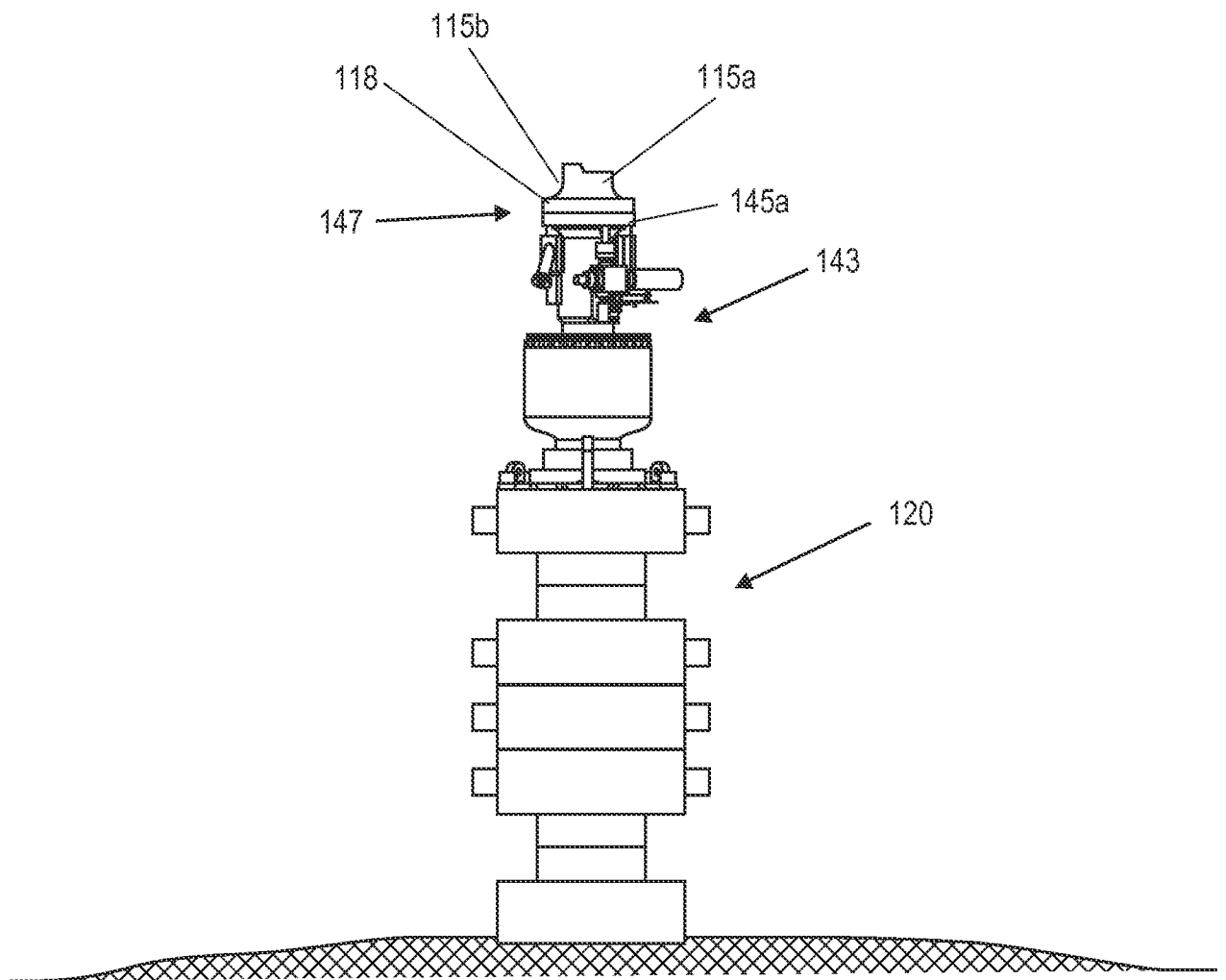


FIG. 3

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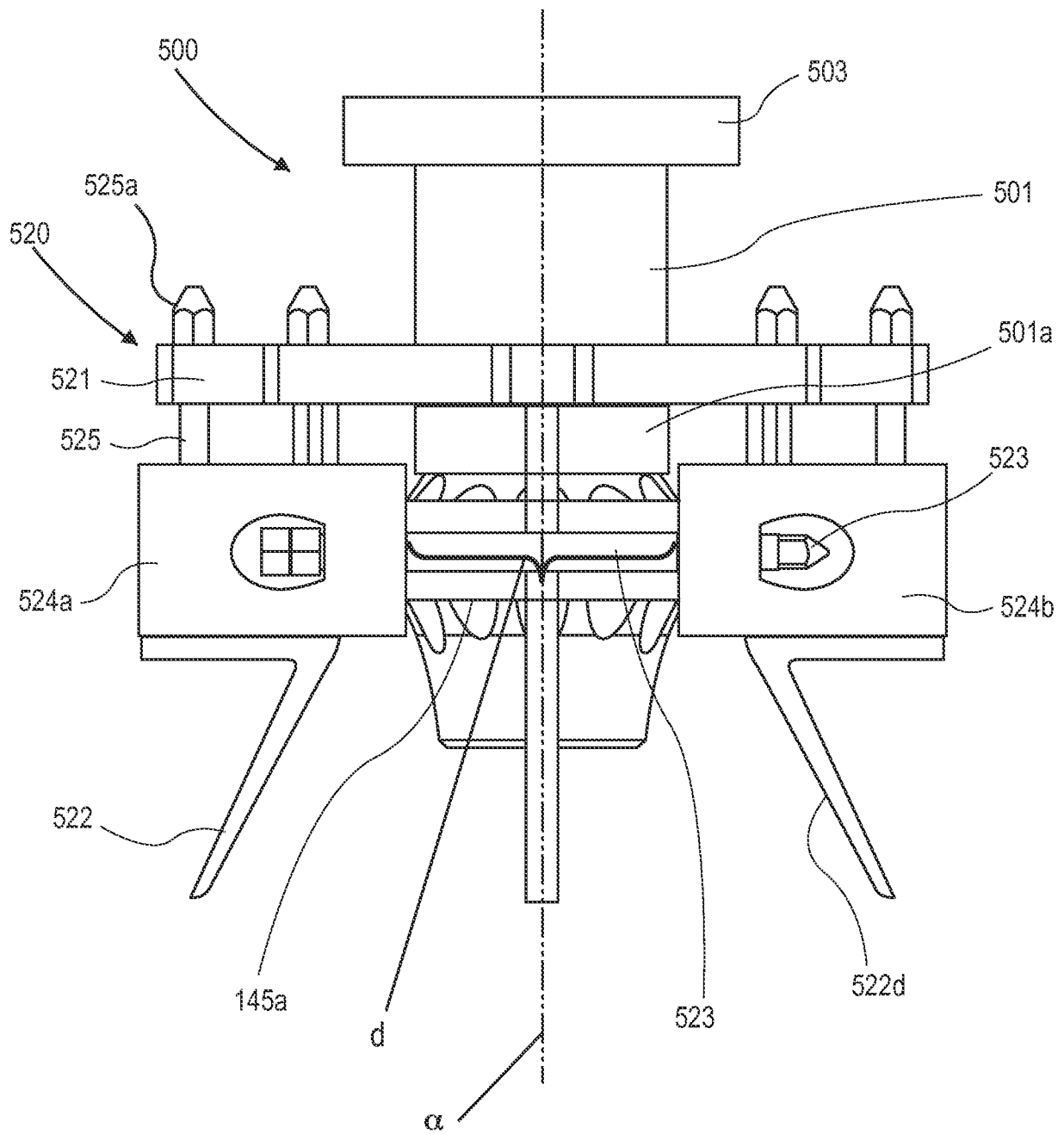


FIG. 4A

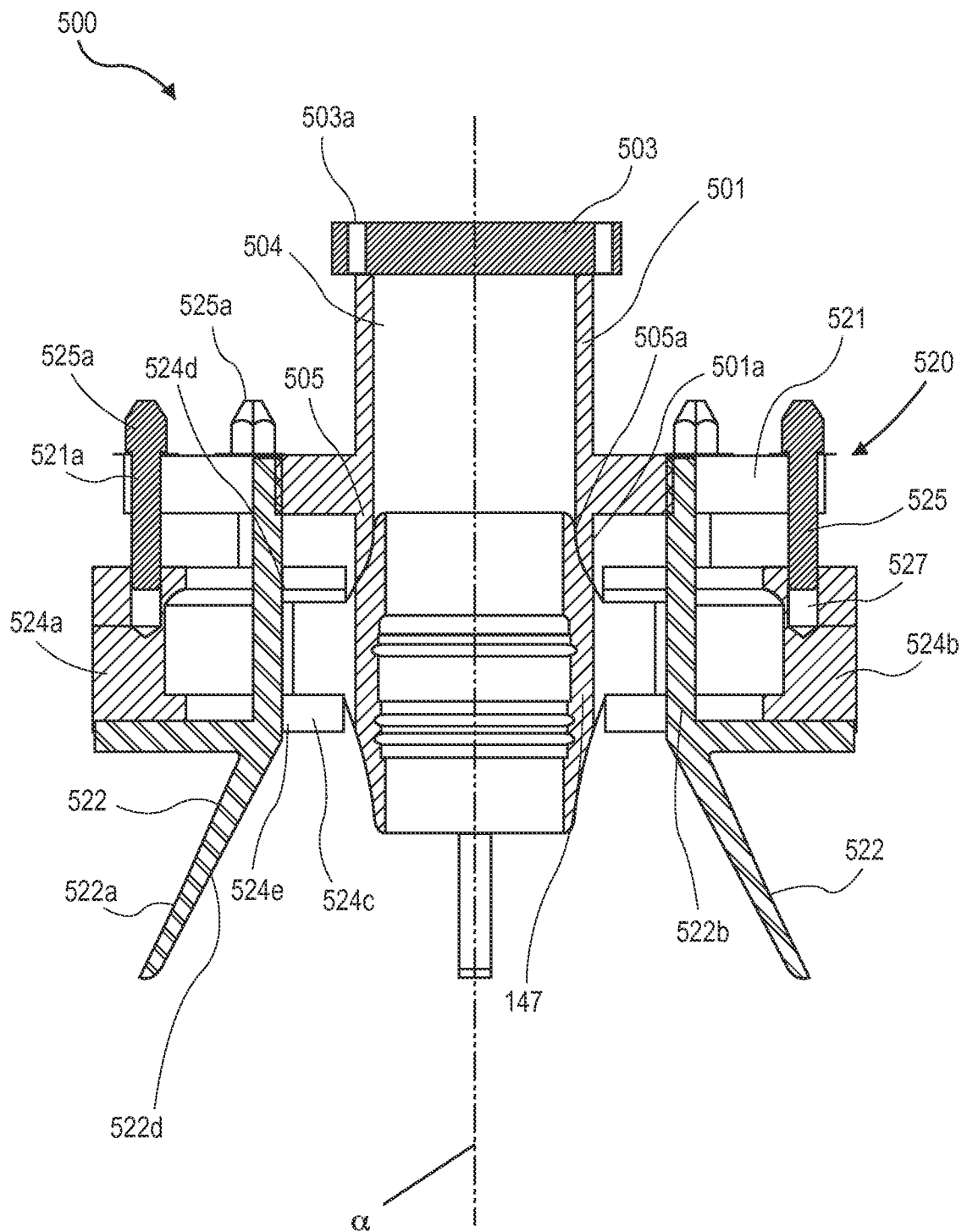


FIG. 4B

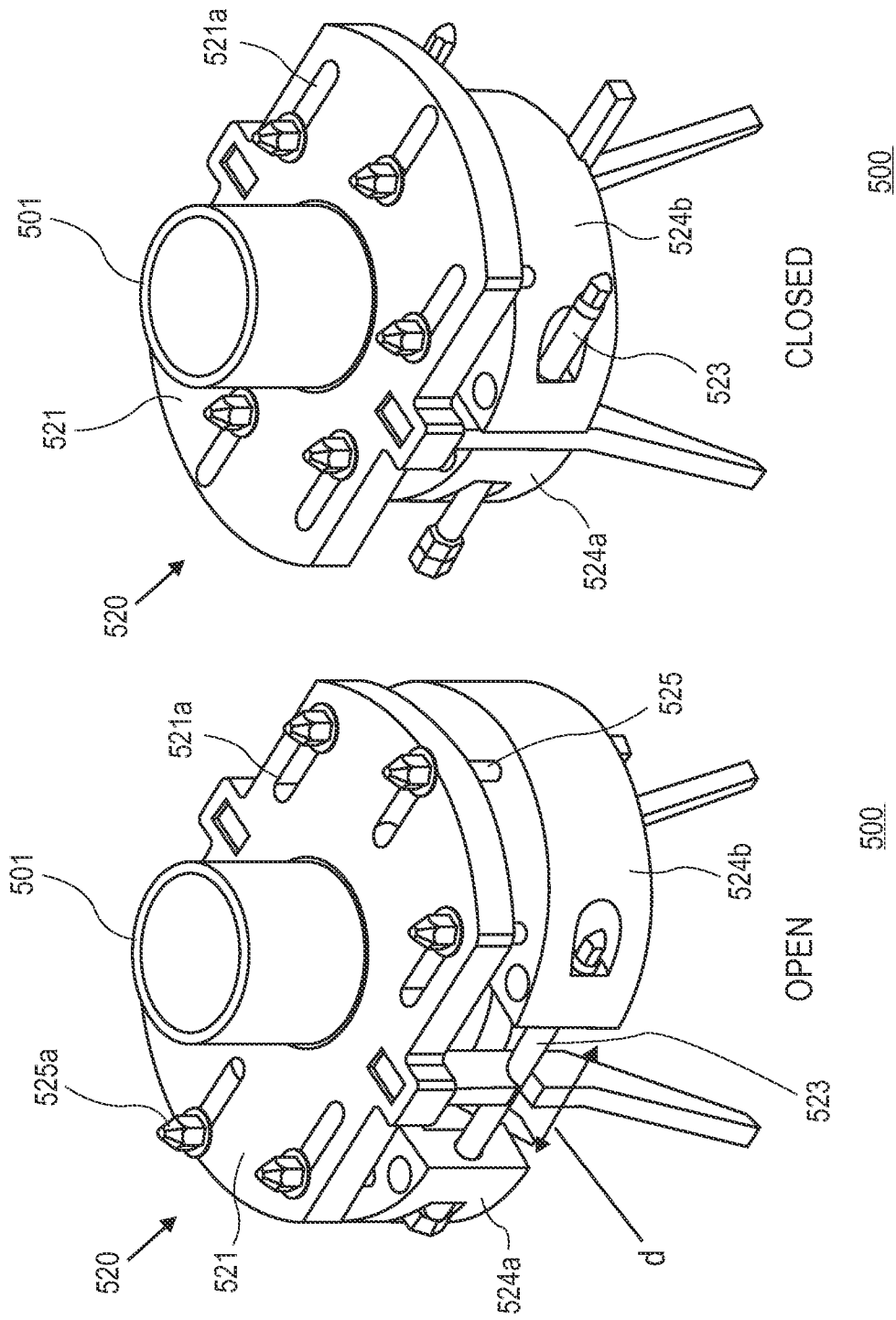


FIG. 4C

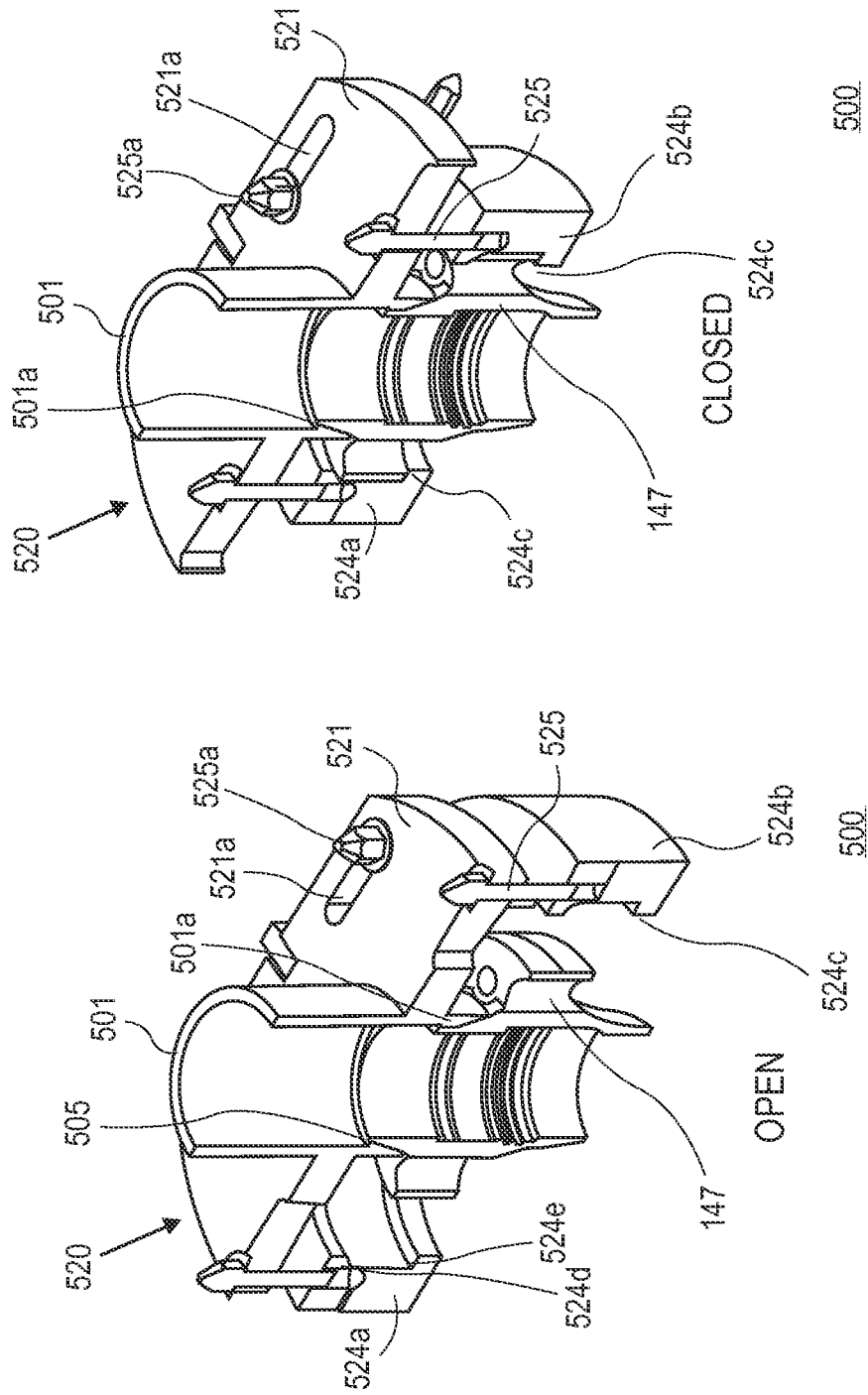


FIG. 4D

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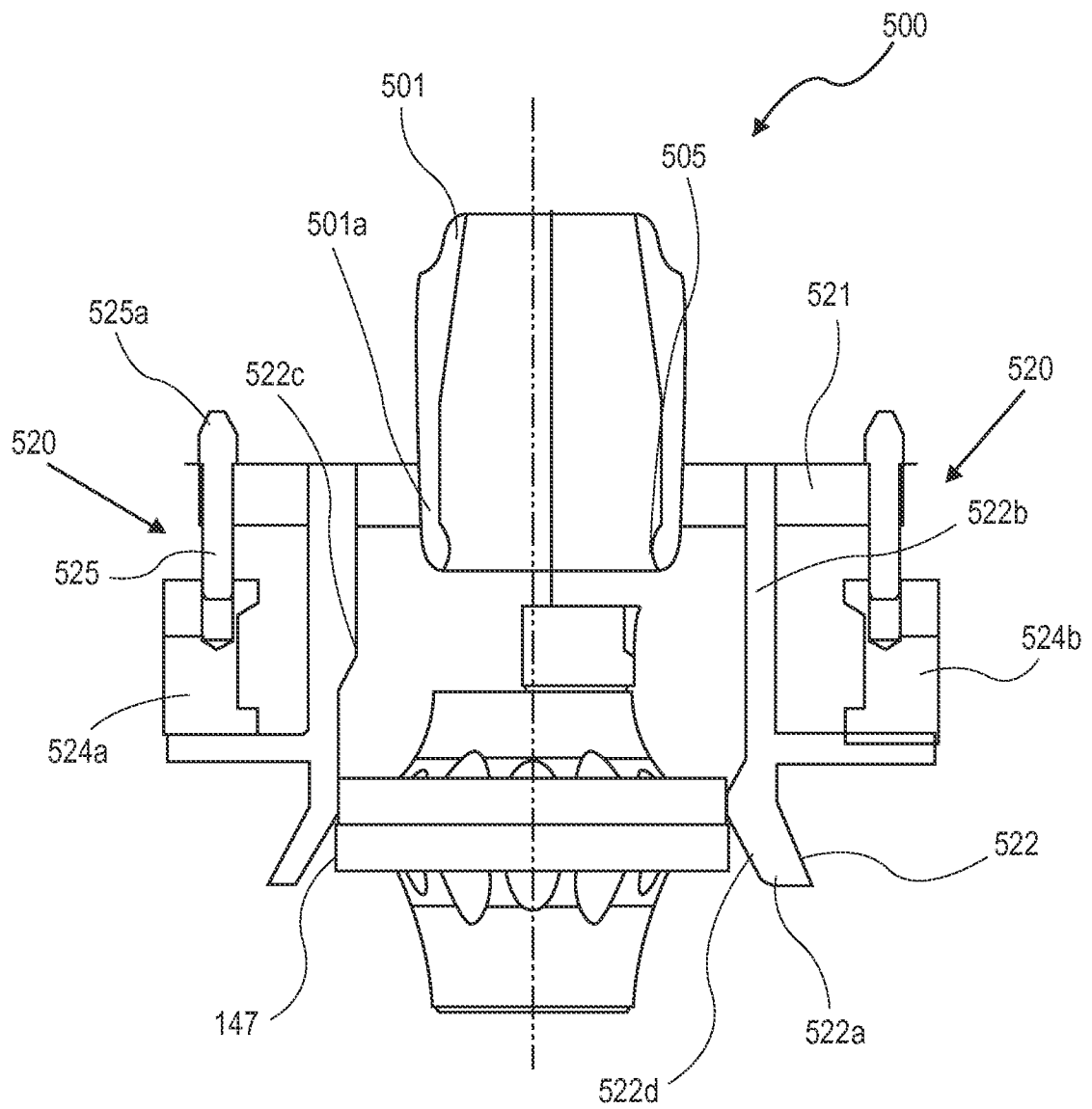


FIG. 4E

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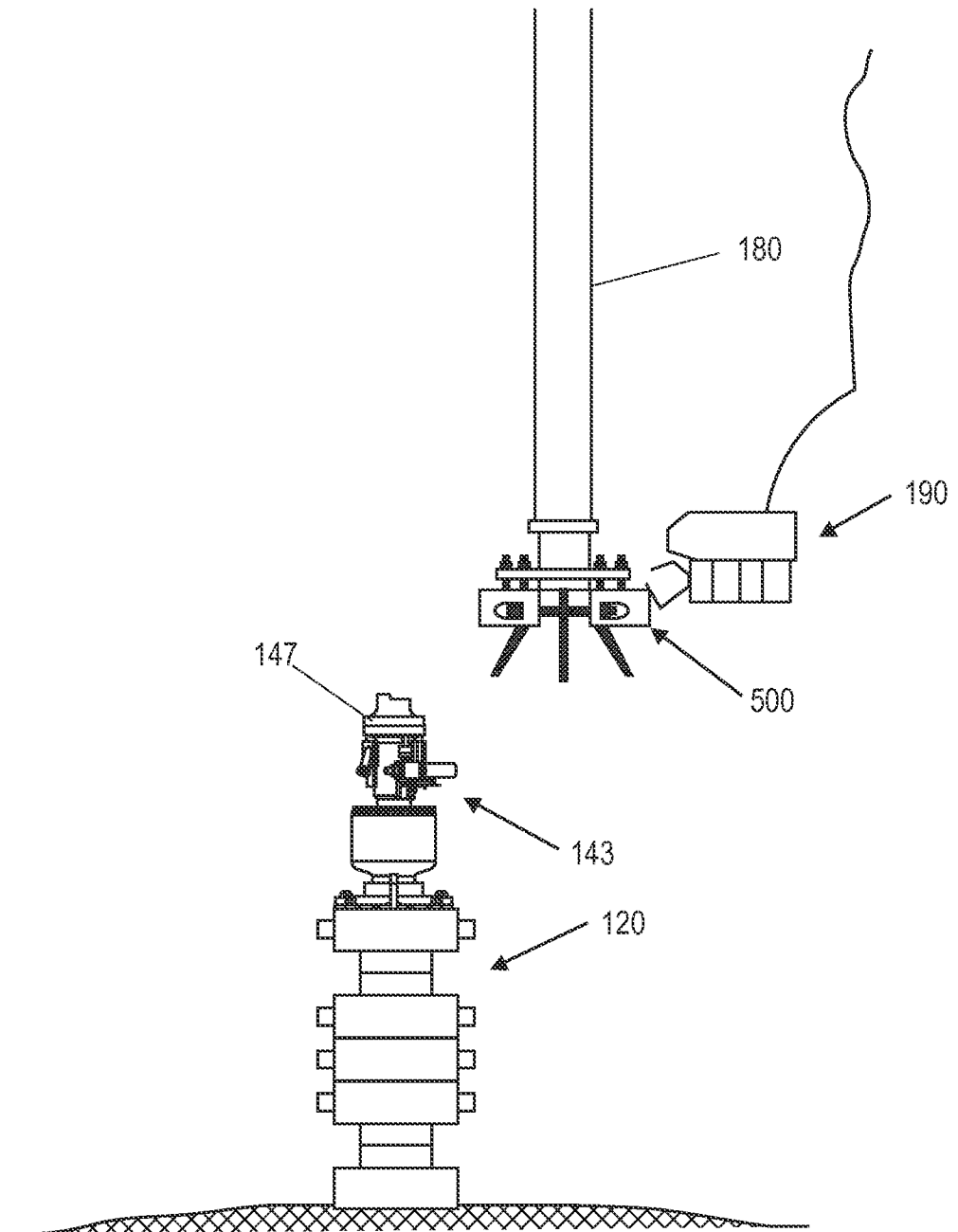


FIG. 5A

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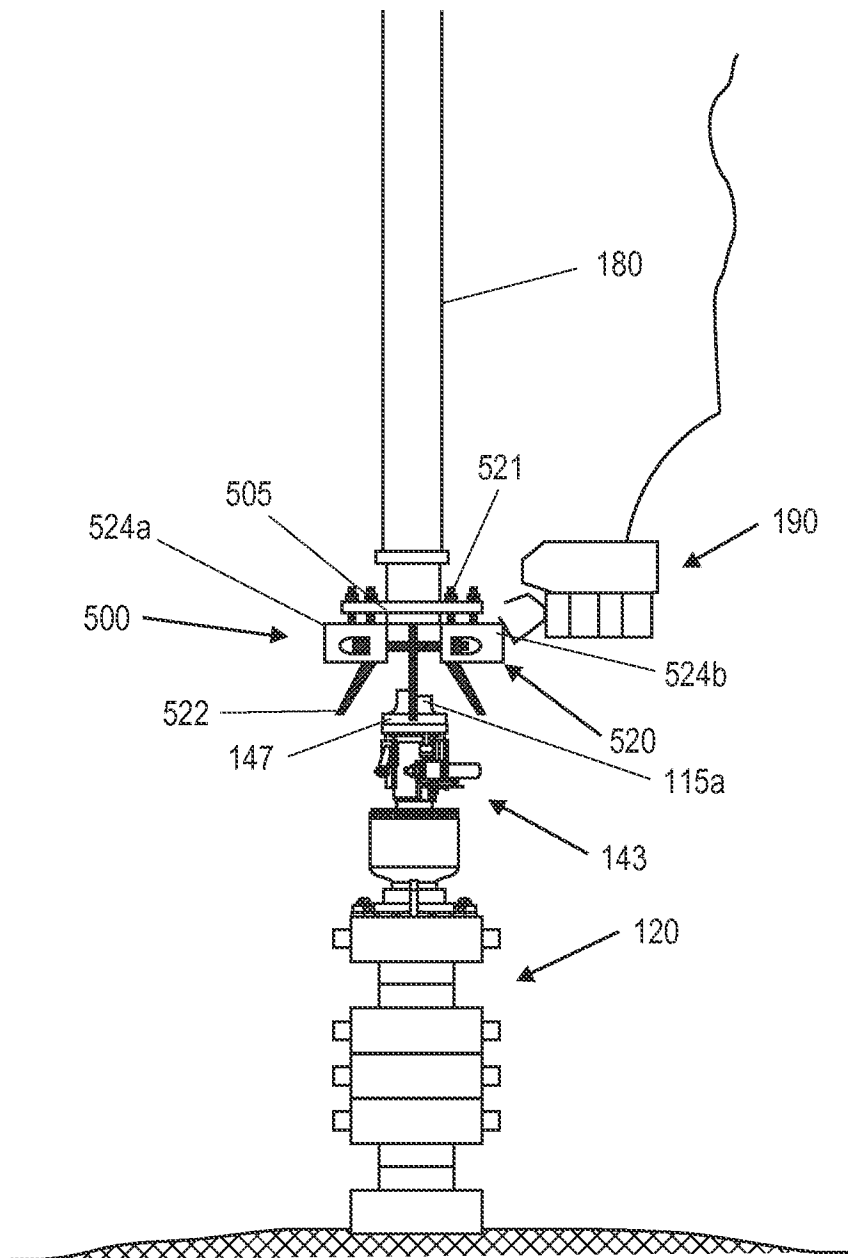


FIG. 5B

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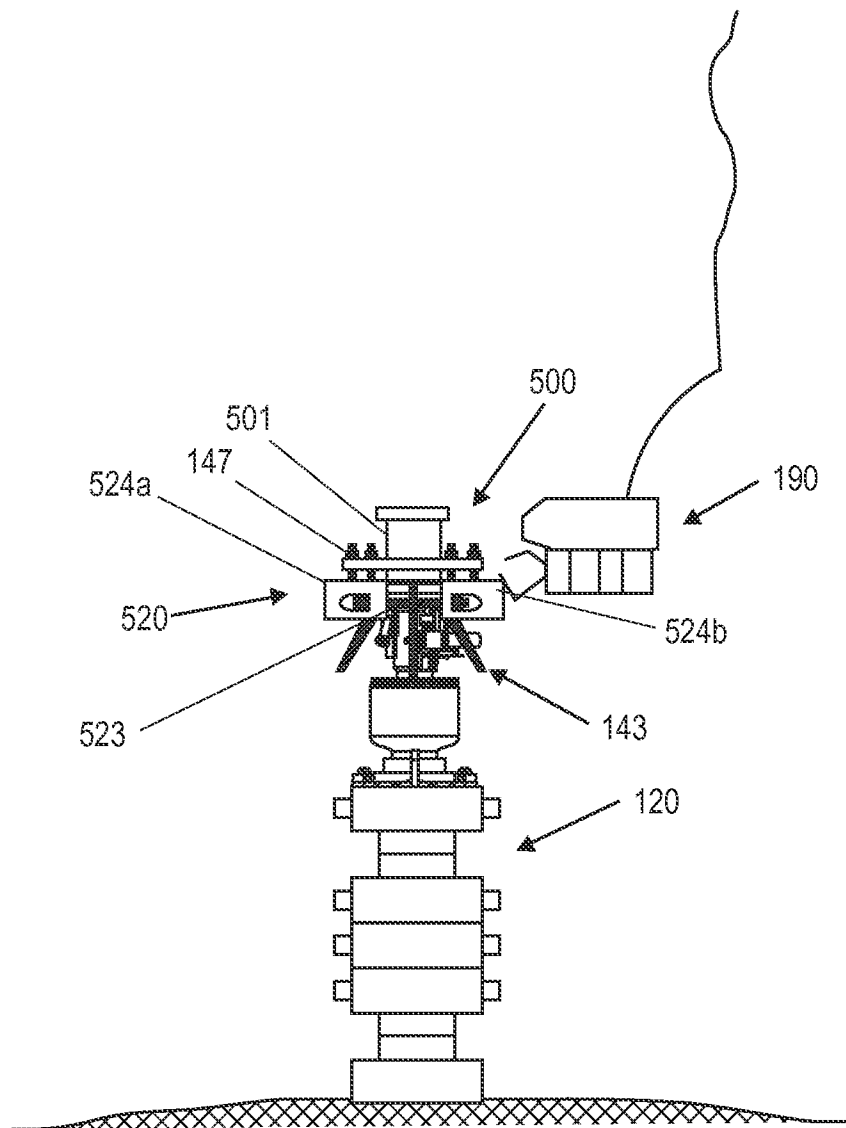


FIG. 5C

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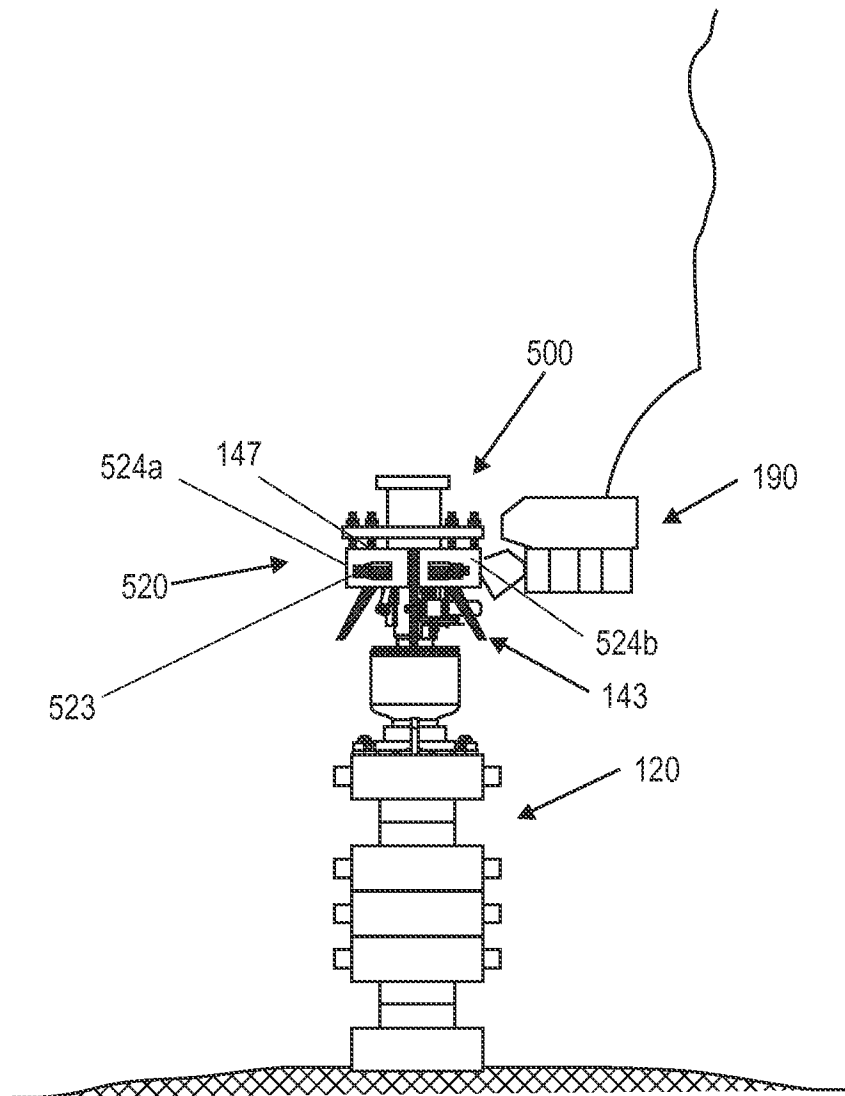


FIG. 5D

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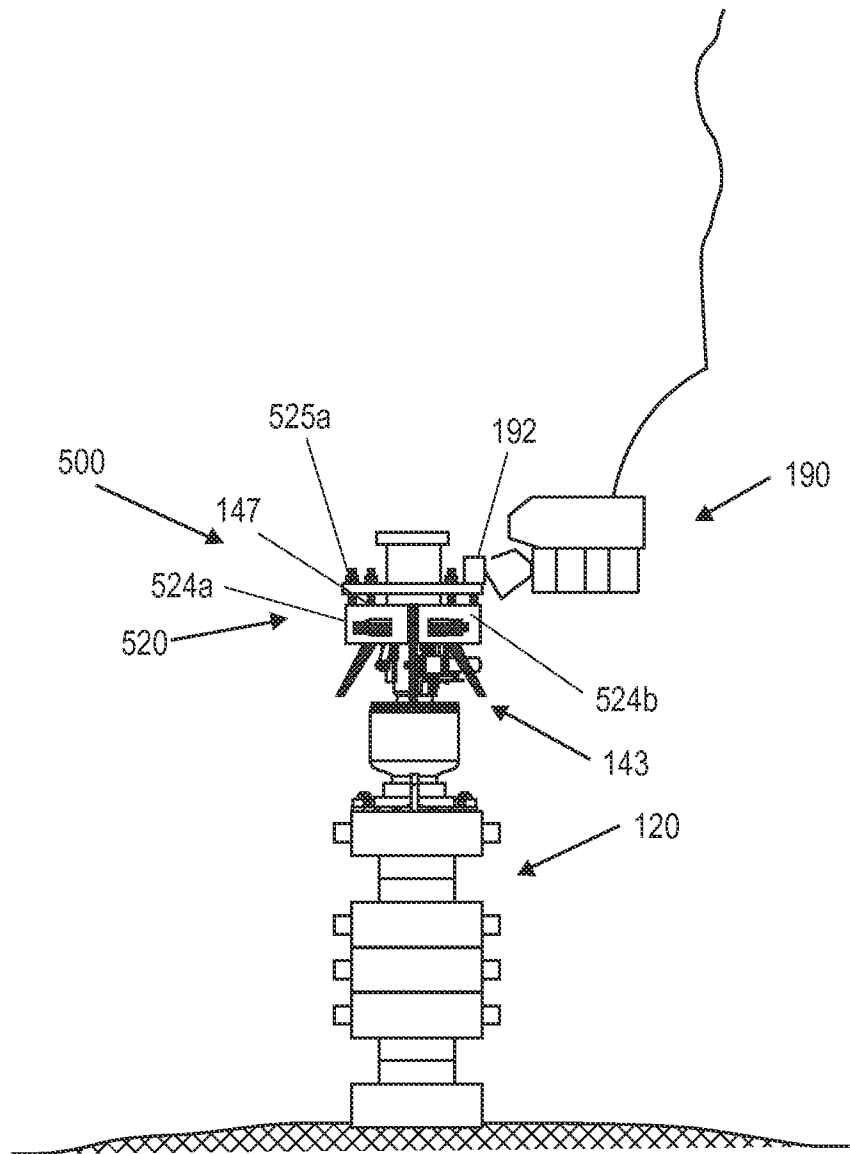


FIG. 5E

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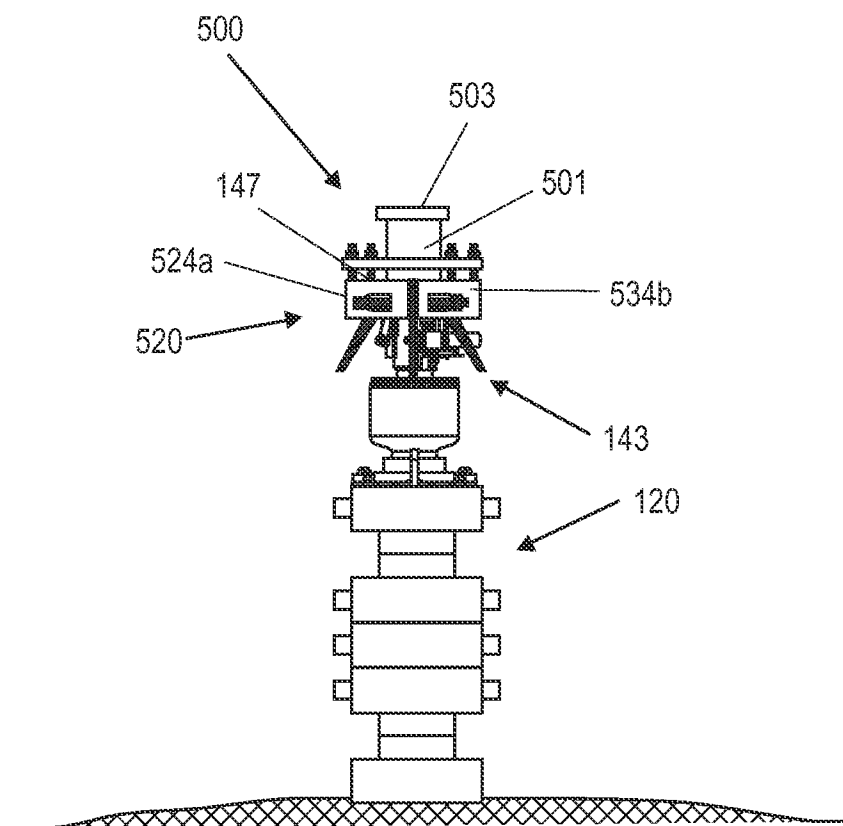


FIG. 5F

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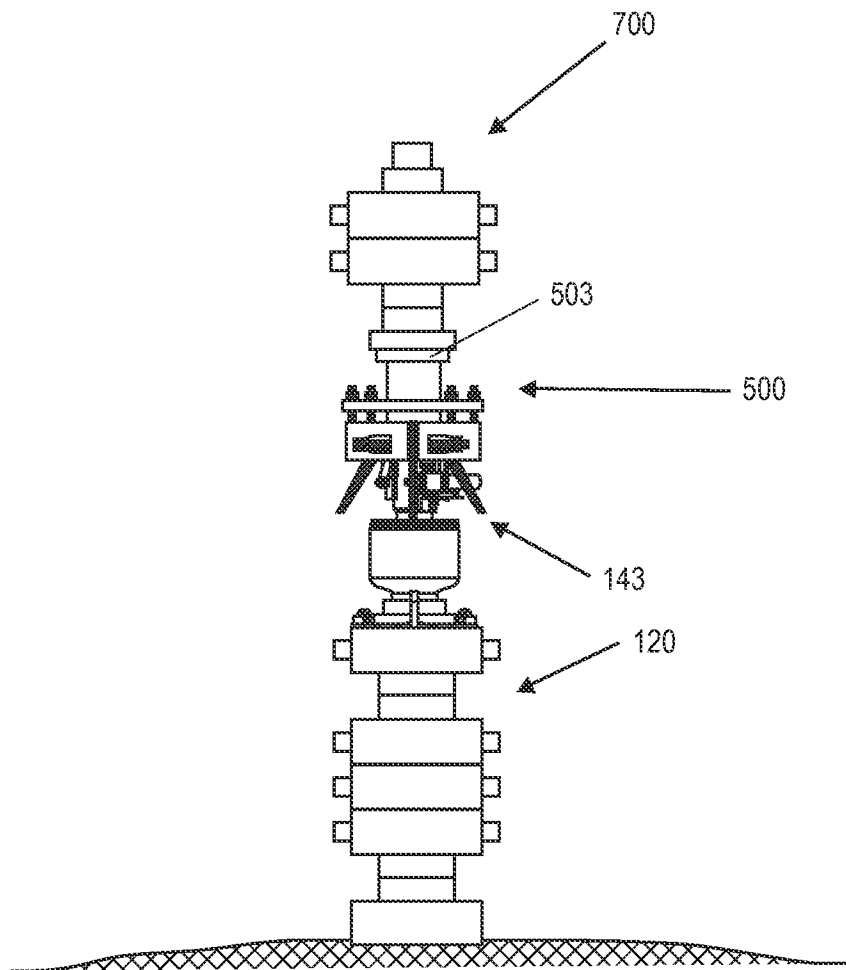


FIG. 6