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(54) **LOCKDOWN MECHANISM AND LOCKDOWN SYSTEM FOR WELLHEAD CONNECTOR**

SPERRMECHANISMUS UND SPERRSYSTEM FÜR BOHRLOCHKOPFVERBINDER

MÉCANISME DE VERROUILLAGE ET SYSTÈME DE VERROUILLAGE POUR UN CONNECTEUR
DE TÊTE DE PUITS

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Description

Technical Field

[0001] This invention relates in general to subsea oil and gas well production, and in particular to a mechanical connector for connecting members to a subsea wellhead assembly.

Background

[0002] A subsea wellhead assembly installed at the sea floor may be in water over three hundred meters (thousands of feet deep). During completion and certain production operations, components from a floating platform are lowered from the platform to engage the subsea wellhead assembly. A tieback connector generally connects a production riser between a subsea wellhead housing and the surface production platform. Typically, the tieback connector has locking elements that lock into a profile in the wellhead housing. A lockdown mechanism is sometimes used to resist upward movement of the tieback connector and prevent unintentional unlocking of the tieback connector that may occur due to thermal growth and external environmental forces during production.

[0003] Some current lockdown mechanism designs include multiple lockdown members that are spaced around the circumference of the lockdown mechanism. Installing the lockdown mechanism usually requires a remotely operated vehicle ("ROV") that manually manipulates a plate of each lockdown member with a grooved profile into engagement with a rod with a mating profile. In some subsea developments, the wells are located on a template, which provide limited access for a ROV and make it very difficult for the ROV to move around and between the wells to install the various lockdown members.

[0004] GB 2 488 648 B describes a drilling riser adapter connecting a riser to a subsea wellhead assembly. The adapter has a hydraulically actuated engagement assembly for selectively engaging and disengaging a lower end of the marine riser. The adapter also includes a control panel communicatively coupled to the engagement assembly for actuating the engagement assembly to engage and disengage the lower end of the marine riser. The adapter includes a hydraulic fluid pressure receptacle on the control panel for engagement by a remotely operated vehicle to supply hydraulic fluid pressure to the engagement assembly. The adapter can be actuated subsea to release a first riser from the wellhead assembly, and connect to a second riser. The system can include radially moving engagement members and may have a cam ring.

[0005] US 2012 0267116 A1 describes a flange over-shot retrieval tool. A tool for removing a first flange from a second flange comprises a housing having a central axis, a first end, and an open second end opposite the

first end. The housing also includes a first access port extending radially therethrough. In addition, the tool comprises an annular basket grapple coaxially disposed within the second end of the housing and configured to coaxially receive and engage a first flange. The basket grapple has a first end, a second end opposite the first end, and a cutout extending radially therethrough. The outer surface of the basket grapple includes external threads that engage mating internal threads on the inner surface of the housing. Further, the tool comprises a key releasably coupled to the housing. The key is configured to selectively prevent relative rotation between the basket grapple and the housing.

Summary

[0006] The present invention is defined in the accompanying claims.

[0007] The methods and systems of the current disclosure provide a mechanical lockdown system that can be easily operated and moved between a lockdown open position and a lockdown engaged position by an operator remotely from a surface location. The example methods and systems disclosed can be operated as many times as needed without the need for MLD components to be transported every time the connector assembly is locked and unlocked.

[0008] The invention provides a lockdown system for a subsea wellhead connector having the features of claim 1.

[0009] The invention further provides a method of connecting a tubular member to a subsea wellhead assembly having the features of claim 4.

[0010] Preferred embodiments of the system and the method are defined in the dependent claims.

Brief Description of the Drawings

[0011] So that the manner in which the features, advantages and objects of the invention, as well as others which will become apparent, are attained and can be understood in more detail, more particular description of the invention briefly summarized above may be had by reference to the embodiment thereof which is illustrated in the appended drawings, which drawings form a part of this specification. It is to be noted, however, that the drawings illustrate only example embodiments of the invention and are therefore not to be considered limiting of its scope as the invention is only limited by the scope of the appended claims.

Figure 1 is a cross-sectional view of a subsea wellhead connector assembly with a known mechanical lockdown system.

Figure 2 is a perspective view of the subsea wellhead connector assembly illustrated in Figure 1.

Figure 3A is a perspective view of a known lock down assembly.

Figure 3B is a cross sectional view of the lock down assembly shown in Figure 3A along the sectional line 3B-3B.

Figure 4 is a perspective view of a lock down assembly in accordance with one or more example embodiments of the disclosure.

Figure 5 is a sectional view of the lock down assembly of Figure 4, shown in a lockdown open position, in accordance with one or more example embodiments of the disclosure.

Figure 6 is a detail view of a portion of the lock down assembly of Figure 5, in accordance with one or more example embodiments of the disclosure.

Figure 7 is a sectional view of the lock down assembly of Figure 4, shown in a lockdown engaged position, in accordance with one or more example embodiments of the disclosure.

Detailed Description

[0012] Figure 1 illustrates a cross-sectional view of a subsea wellhead connector assembly 50 with a known mechanical lockdown ("MLD") system. The wellhead assembly 50 includes a tieback connector 36 with a bore 38 and an annular ring 60 that circumscribes the outer diameter of the tieback connector 36. The MLD system includes a MLD plate or member 12 and a lock handle 20. The plate 12 has an internal thread profile that engages with an external thread profile of a tie rod 32. A lower end of the tie rod 32 is attached to a connector cap 34, which in turn is secured to a stationary connector body 40, and to a non-stationary outer cylinder 42 of the tieback connector 36 connected to the subsea wellhead assembly 50. The tie rod 32 extends axially upward from the connector assembly 34, 40, 42 of the tieback connector 36 and through the annular ring 60 with at least some of the tie rod profile being located axially above the annular ring 60. A number of MLDs can be spaced around a circumference of the annular ring 60.

[0013] Figure 2 is a perspective view of the subsea wellhead assembly 50 illustrated in Figure 1. As illustrated, the annular ring 60 circumscribes the outer diameter of the tieback connector 36. The MLD plate 12 has an internal thread profile that engages with an external thread profile of the tie rod 32. A lower end of the tie rod 32 is attached to the connector cap 34, which in turn is secured to the non-stationary cylinder body 42 of the tieback connector 36 connected to the subsea wellhead assembly 50. The tie rod 32 extends axially upward from the connector assembly 42 of the tieback connector 36 and through the annular ring 60 with at least some of the tie rod profile being located axially above the annular ring 60. As it may be apparent to one of skill in the art, a number of MLDs can be spaced around a circumference of the annular ring 60.

[0014] Figure 3A illustrates in further detail the MLD system of Figures 1 and 2. MLD system 10 may include a lockdown member or plate 12 and a locking handle 20.

The MLD plate 12 has a recess portion 16 on one end, which includes a mating profile that corresponds with a tie rod profile on the tie rod 32. The other end of the MLD plate 12 has a handle bar 14 that is used by the ROV to carry the system 10. MLD plate 12 also includes a cylindrical slot support 18 with a through slot 24. When the connector assembly has to be locked, the ROV positions the MLD plate 12 such that the through slot 24 is in line with the corresponding slot on the annular ring. Then the ROV would insert a stem 322 of the lock handle 20 into the slot 24 such that the stem is at least partially inserted into the slot on the annular ring. The ROV then inserts lock pins 22, 26 into slots 28, 30 to lock the lock handle 20 in place. Figure 3B is a cross-sectional view of the MLD system 10 illustrated in Figure 3A along the line 3B-3B.

[0015] In systems similar to the those illustrated in Figures 3A and 3B, the ROV had to carry the MLD plates 12, lock handle 20 and lock pins 22, 26 from the surface and install them along the annular ring in order to lockdown the connector assembly. When the connector assembly is unlocked, the ROV had to store these components in a basket of items, and then carry the basket to a storage place and place the MLD components temporarily in the storage place until they were ready to be reused. If any of the MLD components were dropped during transportation, they had to be replaced.

[0016] The methods and systems of the present disclosure will now be described more fully hereinafter with reference to the accompanying drawings in which embodiments are shown. The methods and systems of the present disclosure may be in many different forms within the scope of the appended claims and should not be construed as limited to the illustrated embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey its scope to those skilled in the art. Like numbers refer to like elements throughout.

[0017] Turning now to Figure 4, illustrated is an example mechanical lockdown assembly 100 for a wellhead connector, according to one or more example embodiments of the present disclosure. The mechanical lockdown assembly 100 includes a lockdown plate or lockdown member 112. The lockdown member 112 has a vertical recess 110 on one end that includes a lockdown profile 116 for mating with a tie rod profile 104 of a tie rod 102. The recess 110 can be wider at an outer end of the recess 110 in order to allow for greater tolerance in the relative placement of the lockdown member 112 as the lockdown member 112 is being moved to receive the tie rod 102 within the recess 110. The tie rod 102 extends axially upward from a connector assembly (not shown), and through an annular ring 160 (shown in Fig. 5) around the tieback connector, with at least some of the tie rod profile 104 being located axially above the annular ring 160. A number of mechanical lockdown assemblies 100 can be spaced around a circumference of the annular ring 160. The mechanical lockdowns 100 can be a part

of the connector assembly and can be carried subsea as part of the connector assembly.

[0018] Lockdown assembly 100 may include the tie rod 102. A lower end 106 of the tie rod 102 is attached to a connector cap, which in turn is secured to stationary connector body of a tieback connector (not shown). Tie rod 102 extends in an axially upward direction from connector cap of the tieback connector and passes through a hole in the annular ring 160. Tie rod 102 has a tie rod profile 104 on a tie rod outer diameter of tie rod 102, which may be a set of threads or may include parallel grooves. Tie rod 102 can have two separate axial lengths of tie rod profile 104, or a single continuous length of tie rod profile 104. Lockdown assembly 100 can include a plurality of tie rods 102 spaced around a circumference of stationary connector body of the tieback connector. Each tie rod 102 can have components associated with the tie rod 102, as discussed herein.

[0019] A first handle 140 and a second 120 handle are associated with the lockdown member 112. The first handle 140 is connected to the lockdown member 112 by way of a rod 150 that extends radially outward from the lockdown member 112, at an end 122 of the lockdown member 112 opposite the recess 110. One end of the rod 150 is attached to the lockdown member 112 and the other end of the rod 150 is attached to the first handle 140. The rod 150 passes through an opening in a rod support 124 that is located between the lockdown member 112 and the first handle 140 such that the rod 150 can slide back and forth relative to the rod support 124. The rod support 124 is secured to the annular ring 160 using one or more screws 128 that may be inserted through holes 126 in the body of the rod support 124. Therefore, the rod support 124 is fixed to the annular ring 160 and not movable. A rod spring 130 circumscribes the rod 150 and has a first end that engages the lockdown member 112 and a second end that engages the rod support 124. The rod spring 130 urges the first handle 140 in the direction of the lockdown member 112 so that the recess 110 is urged towards, and in engagement with, the tie rod 102. Tie rod 102 may include a first portion 107 with a first diameter and a second portion 108 with a second diameter that may engage with at least part of the connector assembly and separate the two axial lengths of tie rod profile 104.

[0020] The first handle 140 extends generally axially and perpendicular to the rod 150. The first handle 140 is shaped to be manipulated by a remotely operated vehicle (ROV). In one example embodiment, the first handle 140 has a plurality of handle bars 114, 142, 118, which may be joined together to form the first handle 140. The first handle 140 can be moved radially relative to an axis of the tie rod 102 by the ROV, as will be explained below, to move the mechanical lockdown 112 between an open position where the lockdown profile 116 is spaced apart from the tie rod profile 104, and an engaged position where the lockdown profile 116 engages with the tie rod profile 104. In the open position, which is illustrated in

Figure 5 in further detail, the tie rod 102 can move axially relative to the mechanical lockdown 112 and the annular ring 160, and in the engaged position, which is illustrated in Figure 7 in further detail, the tie rod 102 is fixed axially relative to the mechanical lockdown 112 and the annular ring 160.

[0021] The second handle 120 also extends generally axially and perpendicular to the rod 150. The second handle 120 is shaped to be manipulated by a remotely operated vehicle (ROV) and is fixed relative to pin 166 (shown in Fig. 6). In one example embodiment, the second handle 120 has a plurality of handle bars 134, 136, 138, which may be joined together to form the second handle 120. The second handle 120 can be moved axially as well as radially by the ROV, as will be explained below, to move the mechanical lockdown 112 between an open position where the lockdown profile 116 is spaced apart from the tie rod profile 104, and an engaged position where the lockdown profile 116 engages with the tie rod profile 104. Lockdown assembly 100 may also include a plunger system or spring loaded system 132 that can lock and unlock the second handle 120 as needed. Details of the plunger system or spring loaded system 132 will be described in further detail in Figures 5-7.

[0022] Figure 5 illustrates an open position of the lockdown assembly 100 where the lockdown profile 116 is spaced apart from the tie rod profile 104. In the open position, the tie rod 102 can move axially relative to the mechanical lockdown 112 and the annular ring 160.

[0023] Turning now to Figure 6, which is a detail view of a portion of the lock down assembly 100 of Figure 5, the second handle 120 has a stem 146 that extends axially through a bore 152 of the mechanical lockdown 112. The second handle 120 extends generally axially, and coaxially with the stem 146. In the open position, a bottom end of the stem 146 is located within the through bore 164 in annular ring 160 and a stopper 168 can extend between a snap ring 162 of the annular ring 160 and the bottom of hole 172. The stopper 168 can lock the mechanical lockdown 112 in the open position. A stopper spring 170 is located in the hole 172 and urges the stopper 168 in an upward direction so that as the through bore 164 of the lockdown member 112 passes over the snapping 162, the stopper spring 170 will urge the stopper 168 into the through bore 164. Stopper 168 has a larger diameter portion 158 that is closely received in hole 172. Spring 170 urges the smaller diameter upper portion of stopper 168 upward to protrude above the flat surface of annular ring 160 as shown, for example, in Figure 5. The second handle 120 has a visual indicator 148 on the stem 146 so that an operator can visualize the axial position of the second handle 120 to determine if the mechanical lockdown 112 is in a lockdown open position or not.

[0024] Rod 150 extends radially outward from the lockdown member 112, and one end of the rod 150 is attached to the first handle 140. The rod 150 engages with the lockdown member 112 via slot 180 that is formed on a side opposite to the profile 116 and in which the threaded

end of rod 150 screws into. The rod spring 130 is biased against a flat wall surface of the lockdown member 112 and circumscribes the rod 150. It has a first end that is biased against the lockdown member 112 and a second end that engages the rod support 124. The rod spring 130 urges the lockdown member 112 towards the tie rod 102 so that the recess 110 is urged towards, and in engagement with, the tie rod 102. Hole 180 may have a conical shaped end 174 to avoid damage to other components of the lockdown assembly 100. A distal end 178 of the rod 150 is inserted into the slot 180 and rests on a surface 176 of the slot 180. In a lockdown open position, the rod spring 130 is energized and the stopper 168 stops the lockdown member 112 from engaging with the tie rod 102. In this open position the visual indicator 148 on the stem 146 is clearly seen so that an operator knows the mechanical lockdown 112 is in a lockdown open position. It should be noted, however, that in the open position of Figure 6, the upper end of stopper 168 enters bore 164 in lockdown member 112 and pushes stem 166 upward. In the engaged position of Figure 7, handle 120 is pushed downward to push stopper 168 down so that it is no longer in lockdown member through bore 164, which allows lockdown 112 to slide toward tie rod 102.

[0025] In an alternate embodiment, the stopper 168 can be omitted and a lower portion of the stem 146 can instead be used to retain the mechanical lockdown 112 in the lockdown open position. In such an embodiment, a stem spring (not shown) can circumscribe the stem 146 and urge the stem 146 downward, for example, by engaging an upward facing shoulder 154 of the stem 146 and a downward facing protrusion of the lockdown member 112. When the mechanical lockdown 112 is in the engaged position, the bottom end of the stem 146 will rest on an upper surface of the annular ring 160. As the stem 146 passes over the hole 172, the stem spring can urge the lower portion of the stem 146 into the hole 172 and lock the mechanical lockdown 112 in the lockdown open position.

[0026] Figure 7 illustrates an engaged position of the mechanical lockdown assembly 100, according to one or more example embodiments of the present disclosure. In an engaged position 300, a bottom end 166 of the stem 146 rests on a top surface of the annular ring 160. When the mechanical lockdown member 112 is in the engaged position, the stopper 168 will be located within the hole 172 and a bottom surface of the mechanical lockdown 112 will block the hole 172 so that the stopper 168 is retained within the hole 172.

[0027] The tie rod 102 can have a shear groove 109 located axially below the annular ring 160. The shear groove 109 is a region of reduced diameter of the tie rod 102. In the engaged position, the mechanical lockdown 112 can prevent movement of the annular ring 160 and mechanical lockdown 112 relative to the tie rod 102 and connector assembly. However, if the connector assembly is pressurized to unlock the connector assembly, with the mechanical lockdown 112 in an engaged position,

the tie rod 102 will shear at the shear groove 109 before other components, such as parts of the connector assembly, are damaged. The mechanical lockdown assembly 100 could then be retrieved, the tie rod 102 replaced, and the mechanical lockdown 112 assembly re-attached to the connection assembly.

[0028] In an example of operation, when the mechanical lockdown 112 is in the engaged position, the ROV can pull the first handle 140 radially outward to move the lockdown profile 116 away from the tie rod profile 104 so that the mechanical lockdown 112 is in an open position. As the through bore 164 passes over hole 172 while lockdown member 112 is sliding on annular ring 160, stopper 168 moves upward into engagement with through bore 164 in lockdown 112. Stopper 168 then pushes up stem 166, which moves handle 120 upward. Indicator 148 will then show that handle 120 is in the open position. The ROV can then release the first handle 140 and the mechanical lockdown 112 will remain in the lockdown open position. The mechanical lockdown 112 can then be moved relative to the tie rod 102.

[0029] In order to move the mechanical lockdown 112 back to an engaged position, the ROV can press axially downward on the second handle 120. This will cause the stopper 168 to be pressed back down into the hole 172. The mechanical lockdown 112 will then be urged by the rod spring 130 towards the tie rod 102 so that the lockdown profile 116 engages the tie rod profile 104. This process of moving the mechanical lockdown 112 between an engaged and open position can be repeated as often as desired or necessary. Additionally, the mechanical lockdown is permanently mounted to the connector assembly and is reusable with minimal ROV interface.

[0030] Therefore, embodiments of this disclosure can provide a mechanical backup for preventing, for example, a tie back connector from being disconnected from a well-head high pressure housing when tension and bending loads are imposed. This increases the overall reliability of the connector. Systems and methods of this disclosure can also serve as a mechanical fuse, avoiding damage on other expensive components, for example, if a main piston of the connection assembly creeps or is moved towards an unlocked position with the mechanical lockdown in an engaged position. Embodiments of this disclosure are entirely mechanical and do not require redundant hydraulic controls, which allows the equipment to be considered a low risk-level category. The mechanical lockdown can move between an engaged and an open position by the ROV in place so that there is no need to pull a riser or connector out to the surface to reset the lockdown, and the ROV's usage time can be minimized, which results direct cost savings for the operator.

[0031] The terms "vertical", "horizontal", "upward", "downward", "above", and "below" and similar spatial relation terminology are used herein only for convenience because elements of the current disclosure may be installed in various relative positions.

[0032] The system and method described herein, therefore, are well adapted to carry out the objects and attain the ends and advantages mentioned, as well as others inherent therein. While example embodiments of the system and method have been given for purposes of disclosure, numerous changes exist in the details of procedures within the scope of the appended claims for accomplishing the desired results. These modifications will readily suggest themselves to those skilled in the art.

Claims

1. A lockdown system (100) for a subsea wellhead connector connecting a tubular member to a subsea wellhead assembly (50), the lockdown system (100) comprising:

a tie rod (102) for extending in an axial direction from a stationary connector body (40) of a tie-back connector (36) through a lockdown support member being an annular ring (160), the annular ring (160) circumscribing the tubular member, the tie rod (102) having a tie rod profile (104) on a tie rod outer diameter;

a lockdown member (112) with an inner diameter profile (116) corresponding to the tie rod profile (104), the lockdown member (112) being moveable between a lockdown open position where the member is spaced radially outward from the tie rod (102), and a lockdown engaged position where the inner diameter profile (116) engages the tie rod profile (104) to axially couple the stationary connector body (40) and the lockdown support member;

a lockdown member rod (150) extending radially outward relative to an axis of the tie rod profile (104), the lockdown member rod (150) adapted to move the lockdown member (112) from the lockdown open position to the lockdown engaged position, wherein the lockdown member rod (150) is supported by a lockdown member rod support (124) that is adapted to be secured to the lockdown support member circumscribing the tubular member (42);

further comprising a first handle (140) installed on one end of the lockdown member rod (150), the first handle (140) being perpendicular to the lockdown member rod (150) such that a radially outward movement of the first handle (140) relative to the lockdown member rod support (124) moves the lockdown member (112) from the lockdown engaged position to the lockdown open position; and a lockdown member rod spring (130) circumscribing the lockdown member rod (150), the lockdown member rod spring (130) having a first end that engages the lockdown member (112) and a second end that en-

gages the lockdown member rod support (124), thereby biasing the lockdown member (112) away from the lockdown member rod support (124); and

a second handle (120) having a stem (146) that is inserted in a through bore (164) formed parallel to the axis of the lockdown member (112); and a stopper (168) located in a hole (172) in the lockdown support member wherein the lockdown support member comprises a stopper spring (170) located in the hole (172), wherein the stopper spring (170) urges the stopper (168) in an upward direction so that as the through bore (164) of the lockdown member (112) passes over the hole (172), the stopper spring (170) urges the stopper (168) into the through bore (164).

2. The lockdown system (100) according to claim 1, wherein the second handle (140) comprises a visual indicator (148) on the stem (146) to determine if the lockdown member (112) is in the lockdown open position or the lockdown engaged position.

3. The lockdown assembly (100) according to any preceding claim, wherein the inner diameter profile (116) engages the tie rod profile (104) to axially couple the stationary connector body (40) and the annular ring (160), the lockdown member (112) being slidable on the annular ring (160); and wherein the lockdown member rod (150) is supported by the lockdown member rod support (124) that is secured to the annular ring (160).

4. A method of connecting a tubular member to a subsea wellhead assembly (50) having a tie rod (102) extending along an axis from a stationary connector body (40) of a tieback connector (36), the tie rod (102) having a tie rod profile (104) on a tie rod outer diameter, the method comprising:

mounting an annular ring (160) to the stationary connector body (40) with the tie rod (102) extending through the annular ring (160);

mounting a lockdown member (112) with an inner diameter profile (116) corresponding to the tie rod profile (104) on the annular ring (160), the lockdown member (112) being moveable between a lockdown open position where the member is spaced radially outward from the tie rod (102), and a lockdown engaged position where the inner diameter profile (116) engages the tie rod profile (104) to axially couple the stationary connector body (40) and the annular ring (160);

extending a rod (150) radially outward from the lockdown member (112), the rod (150) adapted to move the lockdown member (112) from the

lockdown open position to the lockdown engaged position, wherein the rod (150) is supported by a rod support (124) that is secured to the annular ring (160) circumscribing the tubular member,

providing a first handle (140) on one end of the rod (150), the first handle (140) being perpendicular to the rod (150) such that a radially outward movement of the first handle (140) moves the lockdown member (112) from the lockdown engaged position to the lockdown open position; and

providing a rod spring (130) circumscribing the rod (150), the rod spring (130) having a first end that engages the lockdown member (112) and a second end that engages the rod support (124), thereby creating biasing the lockdown member (112) away from the rod support (124); pulling the rod (150) radially outward to radially move the lockdown member (112) relative to the annular ring (160);

inserting a stem (146) of a second handle (120) into a through bore (164) formed on one surface of the lockdown member (112), the stem (146) having a stopper (168) on a lower end of the stem (146); and

providing the annular ring (160) with a hole (172) configured to receive a stopper spring (170), wherein the stopper spring (170) urges the stopper (168) in an upward direction so that as the through bore (164) of the lockdown member (112) passes over the port (172), the stopper spring (170) urges the stopper (168) into the through bore (164).

5. The method according to claim 4, further comprising: providing the second handle (140) with a visual indicator (148) on the stem (146) to determine if the lockdown member (112) is in the lockdown open position or the lockdown engaged position.

Patentansprüche

1. Sperrsystem (100) für einen Unterwasser-Bohrlochkopfverbinder, der ein Rohrelement mit einer Unterwasser-Bohrlochkopfanordnung (50) verbindet, wobei das Sperrsystem (100) Folgendes umfasst:

eine Zugstange (102) zum Ausfahren in einer axialen Richtung von einem stationären Verbinderkörper (40) eines Zugankerverbinders (36) durch ein Sperrstützelement, das ein kreisförmiger Ring (160) ist, wobei der kreisförmige Ring (160) das Rohrelement umgibt, wobei die Zugstange (102) ein Zugstangenprofil (104) an einem Zugstangenaußendurchmesser aufweist;

ein Sperrelement (112) mit einem Innendurchmesserprofil (116), das dem Zugstangenprofil (104) entspricht, wobei das Sperrelement (112) zwischen einer offenen Sperrposition, in der das Element von der Zugstange (102) radial nach außen beabstandet ist, und einer eingreifenden Sperrposition beweglich ist, in der das Innendurchmesserprofil (116) in das Zugstangenprofil (104) eingreift, um den stationären Verbinderkörper (40) und das Sperrstützelement axial zu koppeln;

eine Sperrelementstange (150), die sich relativ zu einer Achse des Zugstangenprofils (104) radial nach außen erstreckt, wobei die Sperrelementstange (150) dazu ausgelegt ist, das Sperrelement (112) aus der offenen Sperrposition in die eingreifende Sperrposition zu bewegen, wobei die Sperrelementstange (150) durch eine Sperrelementstangenstütze (124) gestützt wird, die dazu ausgelegt ist, an dem Sperrstützelement befestigt zu werden, das das Rohrelement (42) umgibt;

ferner umfassend einen ersten Griff (140), der an einem Ende der Sperrelementstange (150) befestigt ist, wobei der erste Griff (140) senkrecht zu der Sperrelementstange (150) ist, so dass eine radial nach außen gerichtete Bewegung des ersten Griffs (140) relativ zu der Sperrelementstangenstütze (124) das Sperrelement (112) aus der eingreifenden Sperrposition in die offene Sperrposition bewegt; und eine Sperrelement-Stangenfeder (130), die die Sperrelementstange (150) umgibt, wobei die Sperrelement-Stangenfeder (130) ein erstes Ende, das mit dem Sperrelement (112) in Eingriff steht, und ein zweites Ende, das mit der Sperrelementstangenstütze (124) in Eingriff steht, aufweist, wodurch das Sperrelement (112) von der Sperrelementstangenstütze (124) weg vorgespannt wird; und

einen zweiten Griff (120) mit einem Schaft (146), der in eine Durchgangsbohrung (164) eingesetzt ist, die parallel zur Achse des Sperrelements (112) ausgebildet ist; und einen Verschluss (168), der sich in einer Bohrung (172) in dem Sperrstützelement befindet, wobei das Sperrstützelement eine Verschlussfeder (170) umfasst, die sich in der Bohrung (172) befindet, wobei die Verschlussfeder (170) den Verschluss (168) in eine Aufwärtsrichtung drängt, so dass, wenn die Durchgangsbohrung (164) des Sperrelements (112) über die Bohrung (172) läuft, die Verschlussfeder (170) den Verschluss (168) in die Durchgangsbohrung (164) drängt.

2. Sperrsystem (100) nach Anspruch 1, wobei der zweite Griff (140) eine visuelle Anzeige (148) auf dem

Schaft (146) umfasst, um zu bestimmen, ob sich das Sperrelement (112) in der offenen Sperrposition oder der eingreifenden Sperrposition befindet.

3. Sperranordnung (100) nach einem der vorstehenden Ansprüche, wobei das Innendurchmesserprofil (116) in das Zugstangenprofil (104) eingreift, um den stationären Verbinderkörper (40) und den kreisförmigen Ring (160) axial zu koppeln, wobei das Sperrelement (112) auf dem kreisförmigen Ring (160) verschiebbar ist und wobei die Sperrelementstange (150) durch die Sperrelementstangenstütze (124) gestützt wird, die an dem kreisförmigen Ring (160) befestigt ist.
4. Verfahren zum Verbinden eines Rohrelements mit einer Unterwasser-Bohrlochkopfanordnung (50), die eine Zugstange (102) aufweist, die sich entlang einer Achse von einem stationären Verbinderkörper (40) eines Zugankerverbinders (36) erstreckt, wobei die Zugstange (102) ein Zugstangenprofil (104) an einem Zugstangenaußendurchmesser aufweist, wobei das Verfahren Folgendes umfasst:

Montieren eines kreisförmigen Rings (160) an dem stationären Verbinderkörper (40), wobei sich die Zugstange (102) durch den kreisförmigen Ring (160) erstreckt;

Montieren eines Sperrelements (112) mit einem Innendurchmesserprofil (116), das dem Zugstangenprofil (104) entspricht, auf den kreisförmigen Ring (160), wobei das Sperrelement (112) zwischen einer offenen Sperrposition, in der das Element von der Zugstange (102) radial nach außen beabstandet ist, und einer eingreifenden Sperrposition beweglich ist, in der das Innendurchmesserprofil (116) in das Zugstangenprofil (104) eingreift, um den stationären Verbinderkörper (40) und den kreisförmigen Ring (160) axial zu koppeln;

Ausfahren einer Stange (150) radial nach außen von dem Sperrelement (112), wobei die Stange (150) dazu ausgelegt ist, das Sperrelement (112) von der offenen Sperrposition in die eingreifende Sperrposition zu bewegen, wobei die Stange (150) durch eine Stangenstütze (124) gestützt wird, die an dem kreisförmigen Ring (160) befestigt ist, der das Rohrelement umgibt, Bereitstellen eines ersten Griffs (140) an einem Ende der Stange (150), wobei der erste Griff (140) senkrecht zu der Stange (150) ist, so dass eine radial nach außen gerichtete Bewegung des ersten Griffs (140) das Sperrelement (112) aus der eingreifenden Sperrposition in die offene Sperrposition bewegt; und

Bereitstellen einer Stangenfeder (130), die die Stange (150) umgibt, wobei die Stangenfeder (130) ein erstes Ende, das mit dem Sperrele-

ment (112) in Eingriff steht, und ein zweites Ende, das mit der Stangenstütze (124) in Eingriff steht, aufweist, wodurch ein Vorspannen des Sperrelements (112) weg von der Stangenstütze (124) erzeugt wird;

Ziehen der Stange (150) radial nach außen, um das Sperrelement (112) relativ zu dem kreisförmigen Ring (160) radial zu bewegen;

Einführen eines Schafts (146) eines zweiten Griffs (120) in eine Durchgangsbohrung (164), die auf einer Oberfläche des Sperrelements (112) ausgebildet ist, wobei der Schaft (146) einen Verschluss (168) an einem unteren Ende des Schafts (146) aufweist; und

Bereitstellen des kreisförmigen Rings (160) mit einer Bohrung (172), die konfiguriert ist, um eine Verschlussfeder (170) aufzunehmen, wobei die Verschlussfeder (170) den Verschluss (168) in eine Aufwärtsrichtung drängt, so dass, wenn die Durchgangsbohrung (164) des Sperrelements (112) über den Anschluss (172) läuft, die Verschlussfeder (170) den Verschluss (168) in die Durchgangsbohrung (164) drängt.

5. Verfahren nach Anspruch 4, ferner umfassend: Bereitstellen des zweiten Griffs (140) mit einer visuellen Anzeige (148) auf dem Schaft (146), um zu bestimmen, ob sich das Sperrelement (112) in der offenen Sperrposition oder der eingreifenden Sperrposition befindet.

Revendications

1. Système de verrouillage (100) pour un connecteur de tête de puits sous-marin reliant un élément tubulaire à un ensemble de tête de puits sous-marin (50), le système de verrouillage (100) comprenant :

une tige de liaison (102) pour s'étendre dans une direction axiale à partir d'un corps de connecteur fixe (40) d'un connecteur de raccordement (36) à travers un élément de support de verrouillage qui est une bague annulaire (160), la bague annulaire (160) entourant l'élément tubulaire, la tige de liaison (102) présentant un profil de tige de liaison (104) sur un diamètre extérieur de la tige de liaison ;

un élément de verrouillage (112) avec un profil de diamètre intérieur (116) correspondant au profil de la tige de liaison (104), l'élément de verrouillage (112) étant mobile entre une position ouverte de verrouillage où l'élément est espacé radialement vers l'extérieur de la tige de liaison (102), et une position de prise de verrouillage dans laquelle le profil de diamètre intérieur (116) met en prise le profil de tige de liaison (104) afin de coupler axialement le corps

de connecteur fixe (40) et l'élément de support de verrouillage ;

une tige d'élément de verrouillage (150) s'étendant radialement vers l'extérieur par rapport à un axe du profil de tige de liaison (104), la tige d'élément de verrouillage (150) étant adaptée pour déplacer l'élément de verrouillage (112) de la position ouverte de verrouillage à la position en prise de verrouillage, dans lequel la tige de l'élément de verrouillage (150) est supportée par un support de tige d'élément de verrouillage (124) qui est conçu pour être fixé à l'élément de support de verrouillage entourant l'élément tubulaire (42) ;

comprenant en outre une première poignée (140) installée sur une extrémité de la tige d'élément de verrouillage (150), la première poignée (140) étant perpendiculaire à la tige d'élément de verrouillage (150) de sorte qu'un mouvement radialement vers l'extérieur de la première poignée (140) par rapport au support de tige d'élément de verrouillage (124) déplace l'élément de verrouillage (112) de la position en prise verrouillée à la position ouverte de verrouillage ; et un ressort de tige d'élément de verrouillage (130) entourant la tige d'élément de verrouillage (150), le ressort de tige d'élément de verrouillage (130) présentant une première extrémité qui met en prise l'élément de verrouillage (112) et une deuxième extrémité qui met en prise le support de tige d'élément de verrouillage (124), sollicitant ainsi l'élément de verrouillage (112) en l'éloignant du support de tige d'élément de verrouillage (124) ; et

une deuxième poignée (120) présentant une tige (146) qui est insérée dans un alésage traversant (164) formé parallèlement à l'axe de l'élément de verrouillage (112) ; et une butée (168) placée dans un trou (172) dans l'élément de support de verrouillage dans lequel l'élément de support de verrouillage comprend une ressort d'arrêt (170) situé dans le trou (172), dans lequel le ressort d'arrêt (170) pousse la butée (168) dans une direction vers le haut de sorte que pendant que l'alésage traversant (164) de l'élément de verrouillage (112) passe sur le trou (172), le ressort d'arrêt (170) pousse la butée (168) dans l'alésage traversant (164).

2. Système de verrouillage (100) selon la revendication 1, dans lequel la deuxième poignée (140) comprend un indicateur visuel (148) sur la tige (146) pour déterminer si l'élément de verrouillage (112) est dans la position ouverte de verrouillage ou dans la position en prise de verrouillage.

3. Ensemble de verrouillage (100) selon l'une quelconque des revendications précédentes, dans lequel :

le profil de diamètre interne (116) met en prise le profil de tige de liaison (104) afin de coupler axialement le corps de connecteur fixe (40) et la bague annulaire (160), l'élément de verrouillage (112) pouvant coulisser sur la bague annulaire (160) ; et dans lequel la tige d'élément de verrouillage (150) est supportée par le support de tige d'élément de verrouillage (124) qui est fixé à la bague annulaire (160).

4. Procédé de raccordement d'un élément tubulaire à un ensemble de tête de puits sous-marin (50) comportant une tige de liaison (102) s'étendant le long d'un axe d'un corps de connecteur fixe (40) d'un connecteur de raccordement (36), la tige de liaison (102) présentant un profil de tige de liaison (104) sur un diamètre extérieur de la tige de liaison, le procédé comprenant :

le montage d'une bague annulaire (160) sur le corps de connecteur fixe (40), la tige de liaison (102) s'étendant à travers la bague annulaire (160) ;

le montage d'un élément de verrouillage (112) avec un profil de diamètre interne (116) correspondant à un profil de la tige de liaison (104) sur la bague annulaire (160), l'élément de verrouillage (112) étant mobile entre une position ouverte de verrouillage où l'élément est espacé radialement vers l'extérieur depuis la tige de liaison (102), et une position en prise de verrouillage où le profil de diamètre interne (116) est en prise avec le profil de la tige de liaison (104) afin de coupler axialement le corps de connecteur fixe (40) et la bague annulaire (160) ;

l'extension d'une tige (150) radialement vers l'extérieur à partir de l'élément de verrouillage (112), la tige (150) étant adaptée pour déplacer l'élément de verrouillage (112) de la position ouverte de verrouillage vers la position en prise de verrouillage, dans lequel la tige (150) est supportée par un support de tige (124) qui est fixé à la bague annulaire (160) entourant l'élément tubulaire,

la fourniture d'une première poignée (140) à une extrémité de la tige (150), la première poignée (140) étant perpendiculaire à la tige (150) de sorte qu'un mouvement radialement vers l'extérieur de la première poignée (140) déplace l'élément de verrouillage (112) de la position de prise de verrouillage vers la position ouverte de verrouillage ; et

la fourniture d'un ressort de tige (130) entourant la tige (150), le ressort de tige (130) présentant une première extrémité qui met en prise l'élément de verrouillage (112) et une deuxième extrémité qui met en prise le support de tige (124), créant ainsi la sollicitation de l'élément de verrouillage (112) en l'éloignant du support de tige

(124) ;

la traction de la tige (150) radialement vers l'extérieur pour déplacer radialement l'élément de verrouillage (112) par rapport à la bague annulaire (160) ;

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l'insertion d'une tige (146) d'une deuxième poignée (120) dans un alésage traversant (164) formé sur une surface de l'élément de verrouillage (112), la tige (146) présentant une butée (168) sur une extrémité inférieure de la tige (146) ; et la fourniture de la bague annulaire (160) avec un trou (172) configuré pour recevoir un ressort de butée (170), dans lequel le ressort de butée (170) pousse la butée (168) dans une direction vers le haut de sorte que pendant que l'alésage traversant (164) de l'élément de verrouillage (112) passe sur l'orifice (172), le ressort de butée (170) pousse la butée (168) dans l'alésage traversant (164).

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5. Procédé selon la revendication 4, comprenant en outre :

la fourniture de la deuxième poignée (140) avec un indicateur visuel (148) sur la tige (146) pour déterminer si l'élément de verrouillage (112) est dans la position ouverte de verrouillage ou dans la position en prise de verrouillage.

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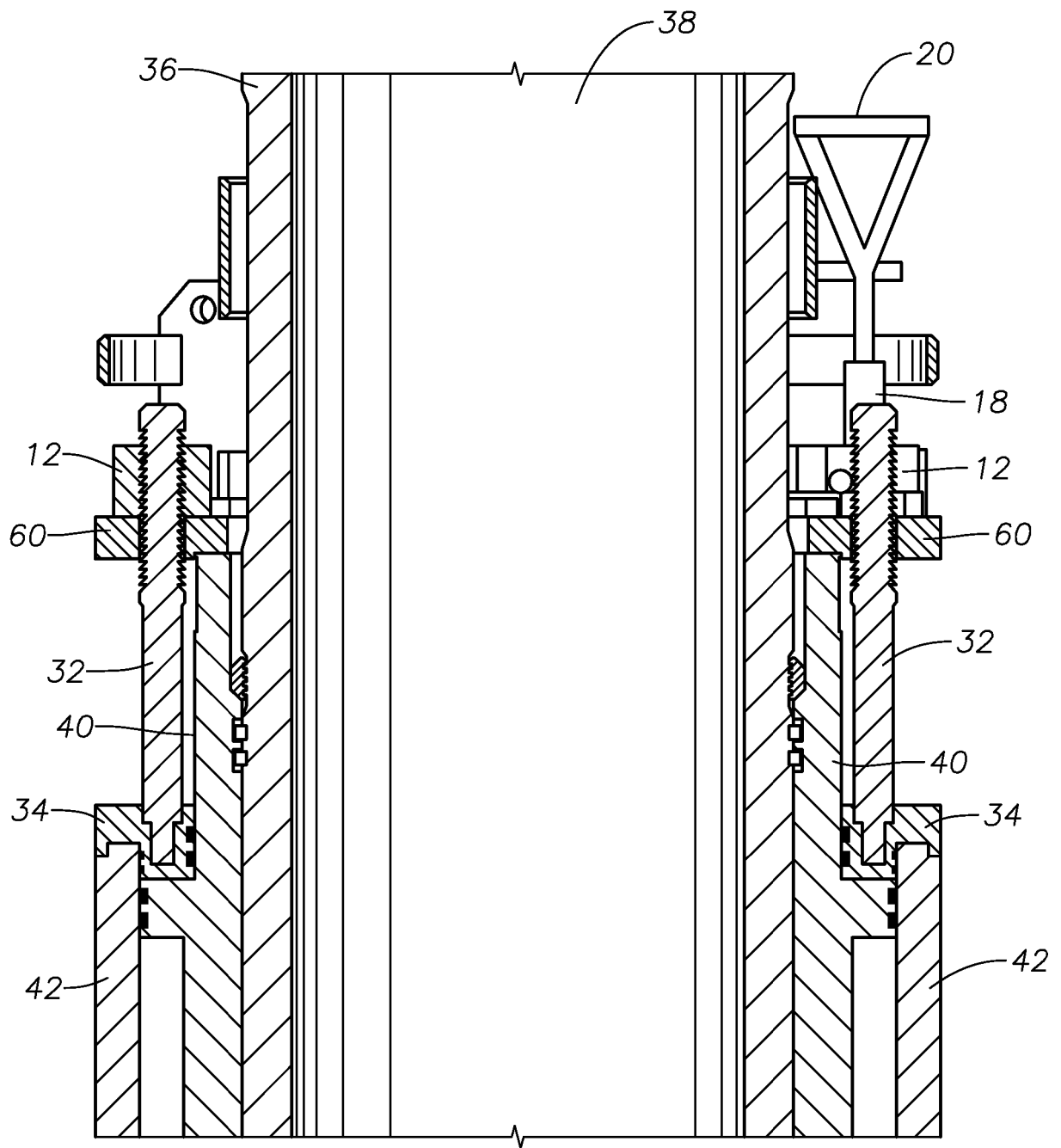


FIG. 1

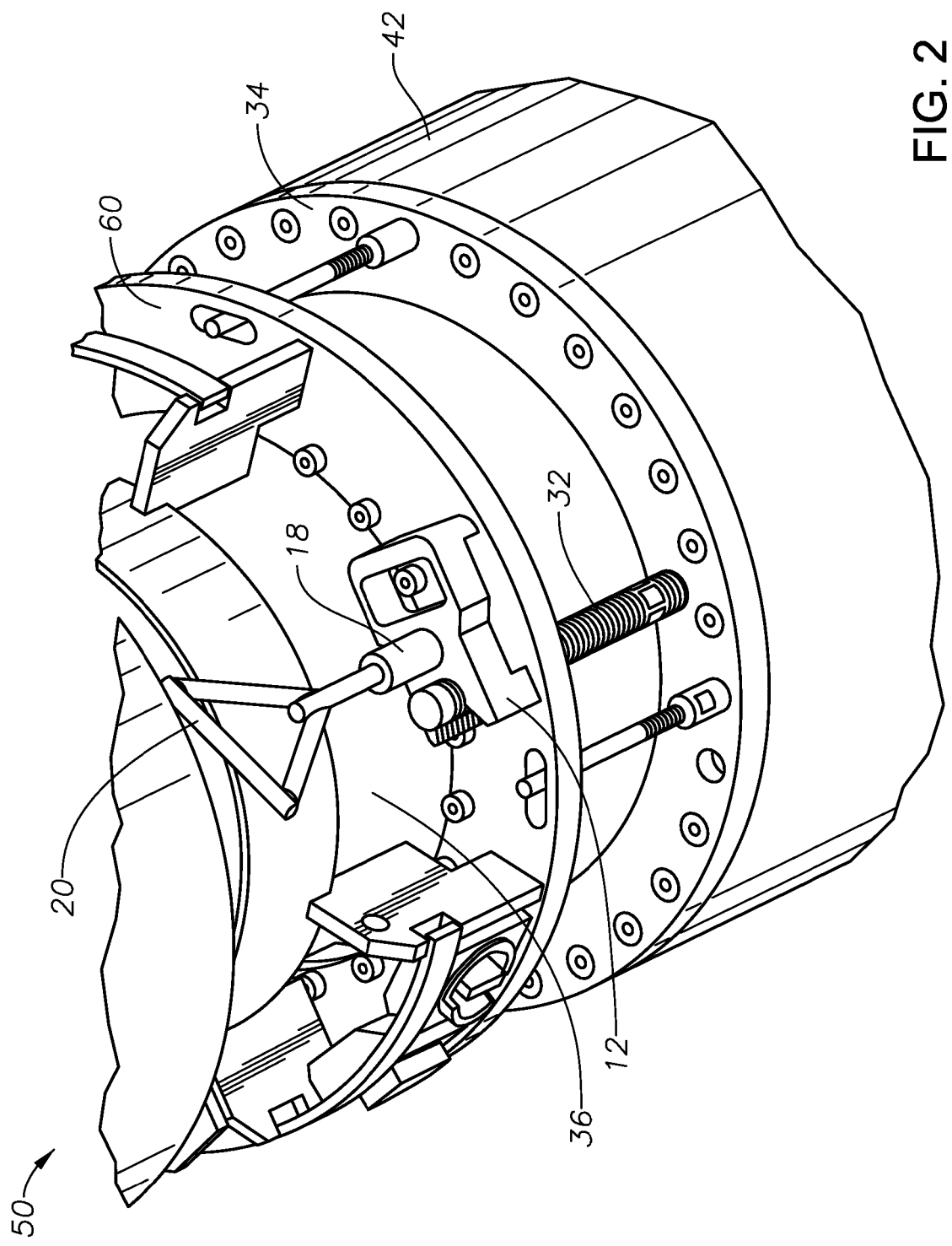


FIG. 2

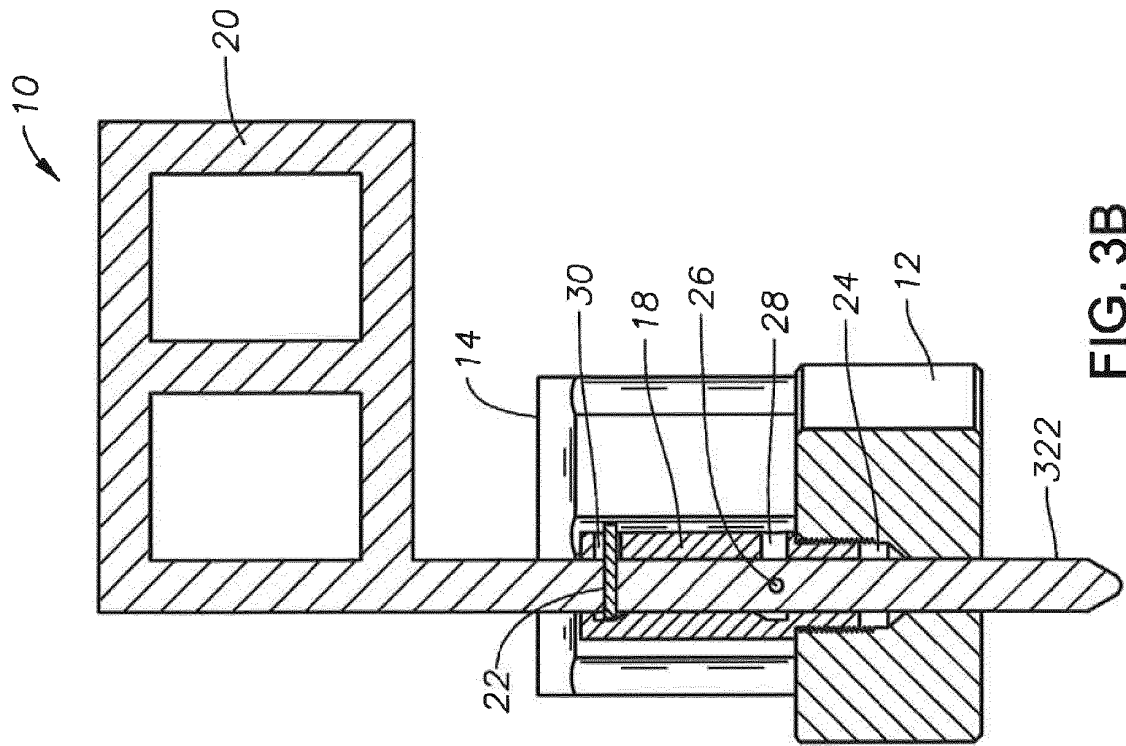


FIG. 3B
(Prior Art)

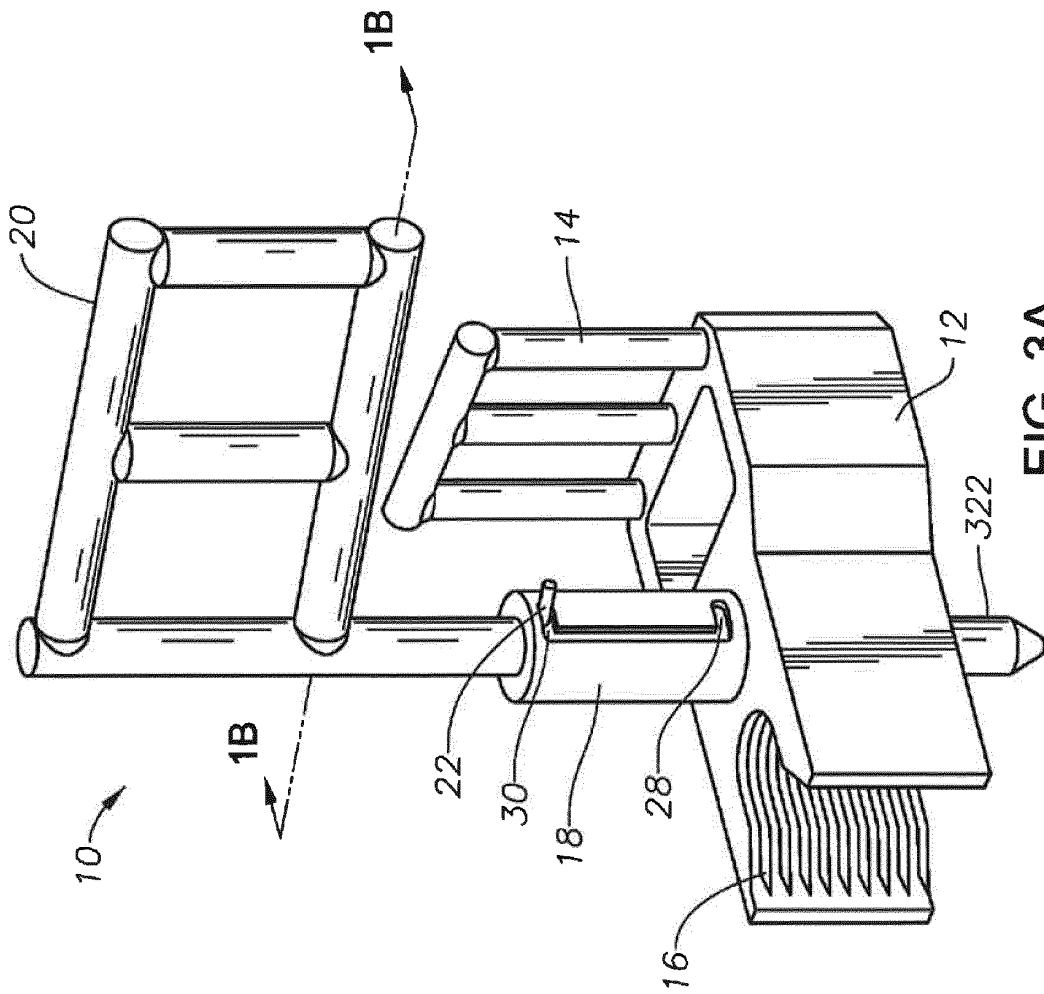


FIG. 3A
(Prior Art)

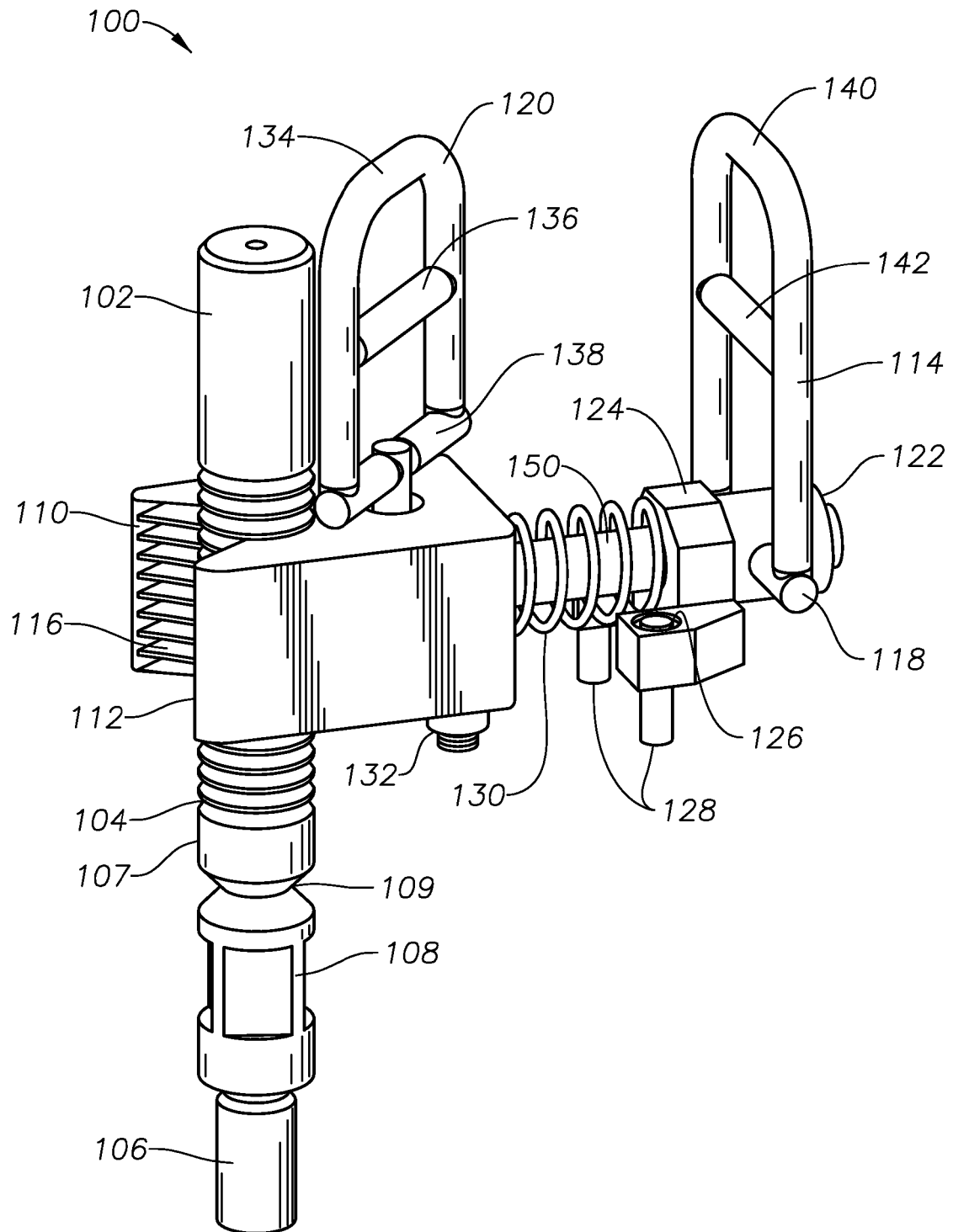


FIG. 4

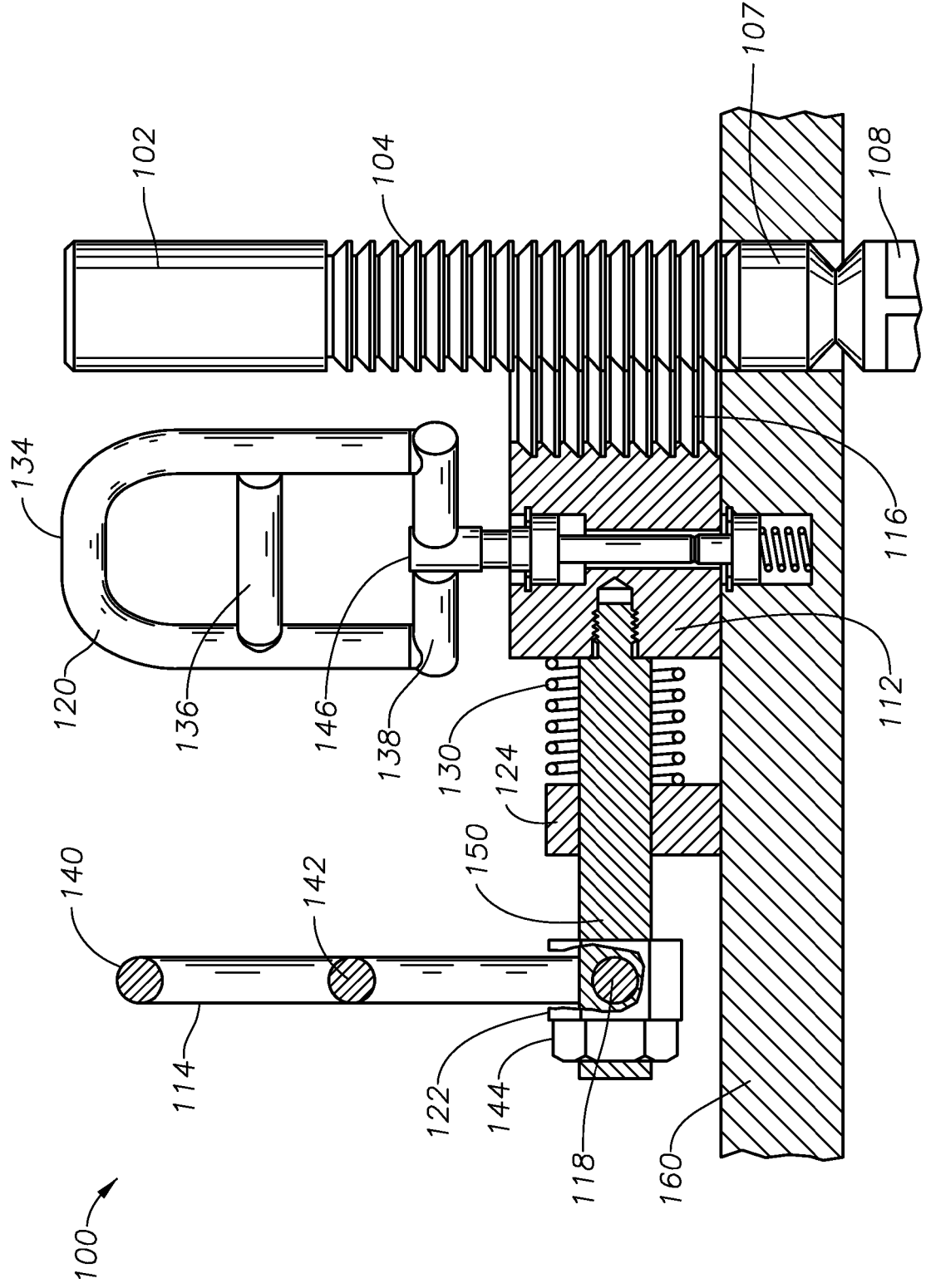


FIG. 5

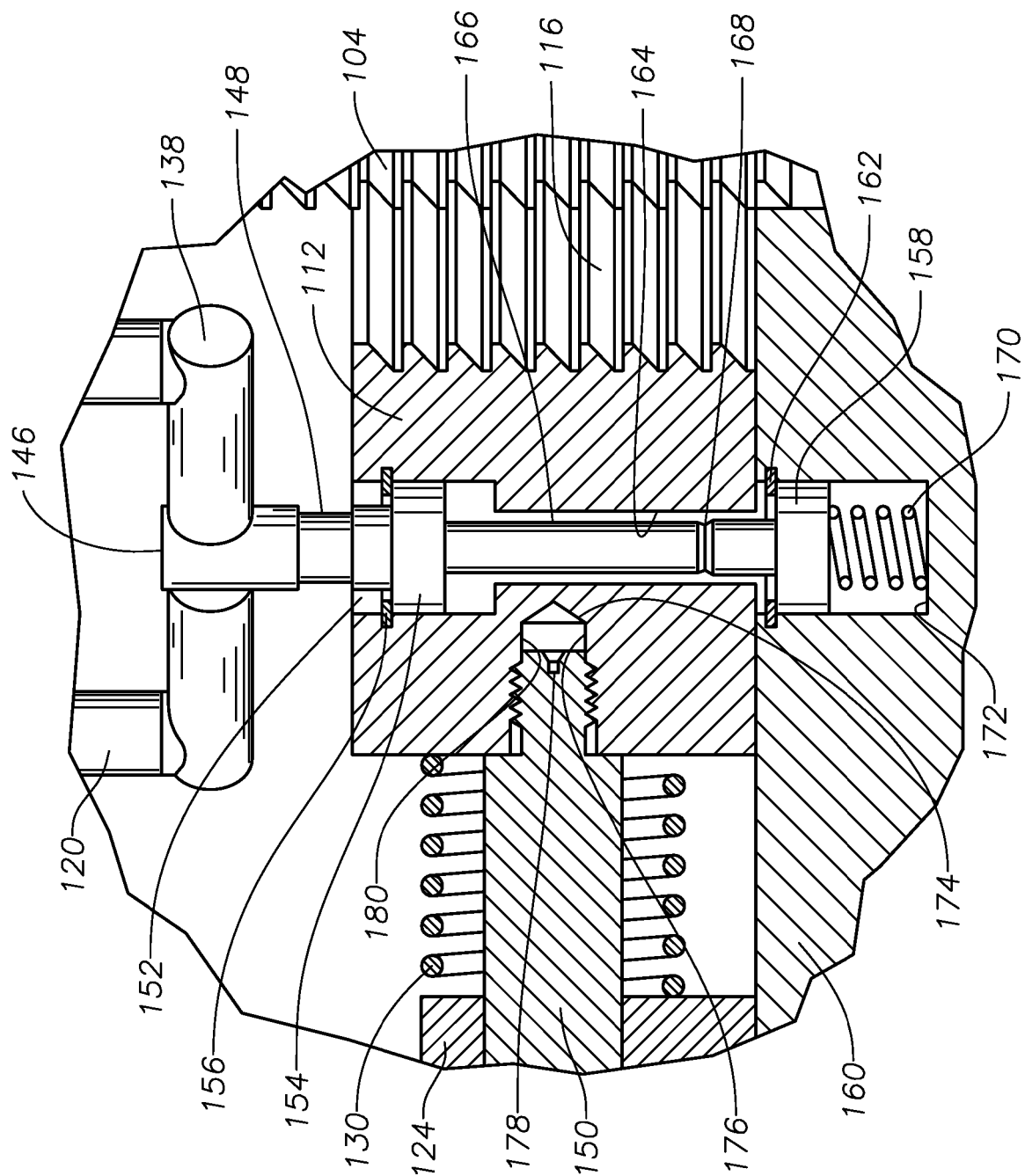
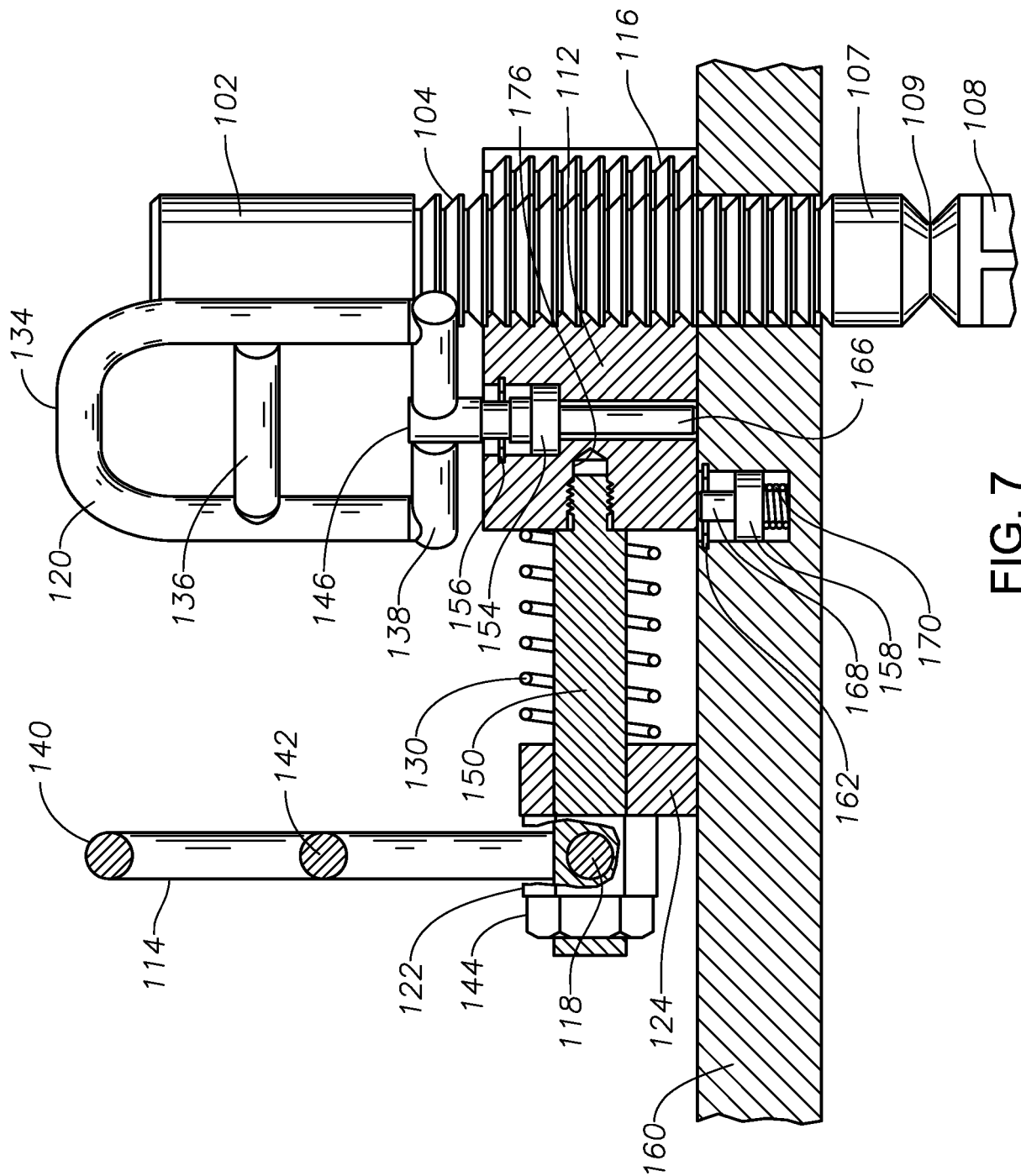


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

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