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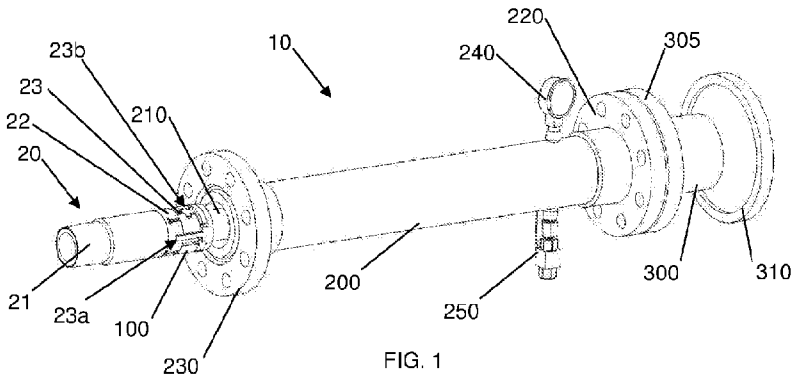

FIG. 1

(57) Abstract: A wellhead tool for use with a wellhead sleeve comprises a gripper head for engaging the wellhead sleeve. The gripper head comprises an actuator, a stationary engaging member connected to the actuator and a rotary engaging member connected to the actuator. The wellhead tool also comprises at least two engaging arms connected to the gripper head. The engaging arms engage complementarily shaped recesses located on the wellhead sleeve.

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WELLHEAD TOOL

FIELD OF THE INVENTION

[0001] The invention relates to a wellhead tool for use with a wellhead sleeve and associated methods. In particular, the invention relates, but is not limited, to a wellhead tool used to remove, install and adjust a wellhead sleeve as the wellhead sleeve wears to reduce and mitigate erosion damage to a specific portion of the wellhead sleeve typically caused by wellhead outflow abrasion. It is envisaged that the invention is particularly well suited for use with wellhead sleeves for coal seam gas (CSG) outflow, but it should be appreciated that it could similarly be used for other fluid outflows in different applications.

BACKGROUND TO THE INVENTION

[0002] Reference to background art herein is not to be construed as an admission that such art constitutes common general knowledge.

[0003] Wellheads are a common component used in oil and gas operations to provide a structural interface for production equipment. Over time, however, abrasive oil and gas fluids erode portions of the wellhead. One area of notable wear that has been identified is at or around the wellhead annulus. Rates of wear of approximately 30mm in steel over a 7 month period have been observed. This wear can cause various undesirable effects, including reduced structural integrity, reliability, efficiency and safety, and increased pressure resistance, etc.

[0004] Once wear of significance has occurred it is necessary to replace the unit which is costly and time consuming. As production typically needs to be completely stopped to replace the unit, the cost is high both in terms of replacement parts and production losses due to downtime.

OBJECT OF THE INVENTION

[0005] It is an aim of this invention to provide a wellhead tool for use with a wellhead sleeve and/or a method which overcomes or at least ameliorates one or more of the disadvantages or problems described above, or which at least provides a useful commercial alternative.

[0006] Other preferred objects of the present invention will become apparent from the following description.

SUMMARY OF THE INVENTION

[0007] A wellhead tool for use with a wellhead sleeve, the wellhead tool comprising:

a gripper head for engaging the wellhead sleeve, the gripper head comprising:

an actuator;

a stationary engaging member connected to the actuator; and

a rotary engaging member connected to the actuator; and

at least two engaging arms connected to the gripper head, wherein the engaging arms engage complementarily shaped recesses located on the wellhead sleeve.

[0008] Preferably, the rotary engaging member comprises a substantially rectangular plate.

[0009] Preferably, at least one engaging arm is connected to the substantially rectangular plate of the rotary member. More preferably, at least two engaging arms are connected to the substantially rectangular plate of the rotary engaging member. Even more preferably, two engaging arms are connected to the substantially rectangular plate of the rotary engaging member and are located at opposing ends of the substantially rectangular plate.

[0010] Preferably, one or more set screws are mounted to the rotary engaging member. More preferably, the one or more set screws are mounted to a side of the rectangular plate of the rotary engaging member.

[0011] Preferably, the stationary engaging member comprises a substantially circular plate.

[0012] Preferably, at least one engaging arm is connected to the substantially circular plate of the stationary engaging member. More preferably, at least two engaging arms are connected to the substantially circular plate of the stationary engaging member. Even more preferably, two engaging arms are connected to the substantially circular plate of the stationary engaging member and are located at opposing sides of the substantially circular plate.

[0013] Suitably, two engaging arms are connected to the substantially circular plate of the stationary engaging member and are located at opposing sides of the substantially circular plate and two engaging arms are connected to the substantially rectangular plate of

the rotary engaging member and are located at opposing sides of the substantially rectangular plate, wherein the four engaging arms are spaced equidistantly about a perimeter of the actuator.

[0014] Preferably, the stationary engaging member is located between the actuator and the rotary engaging member. More preferably, the stationary member abuts the actuator and the rotary engaging member.

[0015] Preferably, the stationary engaging member is fixedly connected to the actuator.

[0016] Preferably, the rotary engaging member is rotatably connected to the actuator.

[0017] Preferably, each engaging arm of the stationary engaging member and each engaging arm of the rotary engaging member comprises a connecting portion, and an elongate body. More preferably, each engaging arm further comprises a gripping portion located at an end of the elongate body. Even more preferably, the gripping portion is hooked or flared. Alternatively, the elongate body and gripping portion are of a uniform width.

[0018] Preferably, a hooked gripping portion of a first engaging arm of the stationary engaging member extends in an opposite direction to a hooked gripping portion of a second engaging arm of the stationary engaging member.

[0019] Preferably, a hooked gripping portion of a first engaging arm of the rotary engaging member extends in an opposite direction to a hooked gripping portion of a second engaging arm of the rotary engaging member.

[0020] Preferably, the at least two engaging arms are removably connected to the circular plate. Alternatively, the engaging arms are integrally formed with the circular plate.

[0021] Preferably, the gripper head comprises two rotary engaging arms and two stationary engaging arms. More preferably, a length of each of the rotary engaging arms is equal to a length of each of the two stationary engaging arms. Alternatively, a length of each of the rotary engaging arms is less than a length of each of the stationary engaging arms.

[0022] Preferably, the engaging arms extend from an outer perimeter of the circular plate.

[0023] Preferably, the at least two engaging arms are removably connected to the rectangular plate. Alternatively, the engaging arms are integrally formed with the rectangular plate.

[0024] Preferably, the engaging arms extend from an outer perimeter of the rectangular plate.

[0025] Preferably, the tool comprises an adaptor connected to the actuator for engaging an extension member. Preferably, the adaptor is a speed reducing gearbox.

[0026] Preferably, the tool and the extension member c are housed in a sleeve . More preferably, the sleeve is a pipe. Even more preferably, the pipe comprises a first flange for

connecting to a wellhead and a second flange for connecting to an insertion assembly.

[0027] Preferably, the tool comprises a handle rotatably connected to the extension member. Preferably, the handle is rotatable to rotate the extension member and extend the tool from the sleeve to attach to a wellhead.

[0028] Preferably, the actuator comprises a gearbox and a shaft. More preferably, the gearbox is substantially cylindrical.

[0029] Preferably, the shaft is connected to an end of the gearbox. Alternatively, the shaft is connected to the adaptor.

[0030] Preferably, the adaptor is connected to the gearbox.

[0031] Preferably, the rotary engaging member is connected to the shaft of the actuator. More preferably, the rectangular plate of the rotary engaging member comprises an aperture for receiving the shaft of the actuator.

[0032] Preferably, the gearbox comprises a raised lip for engaging an aperture of the circular plate of the stationary engaging member.

[0033] Preferably, the circular plate includes an aperture for receiving the raised lip of the gearbox of the actuator.

[0034] Preferably, the tool further comprises an elongate extension member connected to the gearbox or adaptor. More preferably, the elongate extension member comprises a splined bush drive.

[0035] Preferably, the tool further comprises an insertion assembly in communication with the gearbox or adaptor. More preferably, the insertion assembly is connected to the elongate extension member. Even more preferably, the insertion assembly is connected to an end of the sleeve and the extension member extends through the sleeve.

[0036] Preferably, the insertion assembly comprises:

a hand wheel operatively connected to the extension member, wherein rotation of the hand wheel telescopically and rotatably extends or retracts the gripper head and the elongate extension member from an end of the sleeve; and

a locking lever for locking the gripper head and preventing rotation of the rotary engaging member. More preferably, the locking lever is rotatable.

[0037] Preferably, the locking lever is operatively connected to the rotary engaging member such that, in operation, rotating the locking lever rotates the rotary engaging member. More preferably, the locking lever is operatively connected to the rotary engaging member by a drive member. Even more preferably, the locking lever is operatively connected to the rotary engaging member by a splined bush drive.

[0038] Preferably, the tool comprises steel. More preferably, the tool comprises stainless or carbon steel.

[0039] A method for using a wellhead tool with a wellhead sleeve, the method comprising the steps of:

inserting a gripper head of a wellhead tool into a locking ring for a wellhead;

rotating the gripper head to rotate the locking ring for the wellhead, wherein rotating the gripper head causes the locking ring to engage with or disengage from the wellhead.

[0040] Preferably, rotating the gripper head clockwise engages the locking ring with the wellhead.

[0041] Preferably, inserting the gripper head comprises inserting at least one engaging arm of a stationary engaging member of the gripper head into a complementary recess of the locking ring.

[0042] Preferably, inserting the gripper head comprising inserting at least one engaging arm of a rotary engaging member of the gripper head into a complementary recess of the locking ring.

[0043] Preferably, rotating the gripper head rotates the stationary engaging member and the at least one engaging arm of the stationary engaging member into engagement with the complementary recess of the locking ring.

[0044] Preferably, rotating the gripper head anticlockwise disengages the locking ring from the wellhead.

[0045] Preferably, the method comprises the further step of telescopically extending the gripper head from a sleeve. More preferably, the method comprises the further step of rotating a hand wheel connected to the gripper head to telescopically extend the gripper head from a sleeve.

[0046] Preferably, the method comprises the further step of locking the gripper head to the locking ring once the gripper head engages the locking ring. More preferably, the method comprises the further step of locking the gripper head to the locking ring via a locking lever once the gripper head engages the locking ring. Even more preferably, the locking lever is a rotatable locking lever.

[0047] Preferably, the method further comprises the step of locking the locking lever allowing rotation of the rotary engaging member and the at least one engaging arm of the rotating engaging member; and

rotating the locking lever to rotate the at least one engaging arm of the rotary engaging member into engagement with the complementary recess of the locking ring.

[0048] Preferably, the method comprises the further step of rotating the locking lever 20º in an anticlockwise direction to rotate the rotary engaging member and lock the gripper head to the locking ring.

[0049] Preferably, the method comprises the further step of rotating the locking lever 30º in a clockwise direction to rotate the rotary engaging member to disengage the at least one engaging arm of the rotary engaging member from the locking ring; and

[0050] rotating the hand wheel to disengage the at least one arm of the stationary engaging member from the locking ring.

[0051] In some embodiments, the stationary engaging member houses a pawl that engages a clutch mechanism to limit the torque applied to the rotary engaging member by an operator via locking handle.

[0052] Suitably, the pawl pivots about a pair of locating pins and is kept engaged with the clutch mechanism 262 via a biasing member.

[0053] Suitably, a mechanism to engage and disengage the pawl comprises a ratchet bar housed within the stationary engaging member and a cam slidably affixed to the actuator.

[0054] Suitably, in a first position, the cam is disengaged from the ratchet bar and the pawl is engaged with the clutch mechanism and in a second position the cam engages with the ratchet bar causing sideways movement of the ratchet bar and the pawl to disengage the clutch mechanism.

[0055] Suitably, a biasing member keeps the ratchet bar in the first position or the second position.

[0056] Suitably, a cylindrical portion of the rotating engaging member comprises one or more apertures for receiving a respective adjustable detent.

[0057] Further aspects and/or features of the present invention may become apparent from the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0058] By way of example only, preferred embodiments of the invention will be described more fully hereinafter with reference to the accompanying figures, wherein:

[0059] FIG. 1 illustrates a perspective view of a wellhead tool engaged with a wellhead sleeve according to an embodiment of the present invention;

[0060] FIG. 2 illustrates a perspective view of a gripper head of the wellhead tool shown in FIG. 1;

[0061] FIG. 3 illustrates a side view of the gripper head of the wellhead tool shown in FIG. 2;

[0062] FIG. 4 illustrates a top view of the gripper head of the wellhead tool shown in FIG. 2;

[0063] FIG. 5 illustrates an exploded view of the gripper head of the wellhead tool shown

in FIG. 1-5;

[0064] FIG. 6 illustrates a perspective view of the wellhead tool mounted to a wellhead;

[0065] FIG. 7 illustrates a cross-section view of the wellhead tool mounted to the wellhead shown in FIG. 6;

[0066] FIG. 8 illustrates an internal detail of the wellhead tool engaged with the wellhead sleeve of the wellhead shown in FIG. 7;

[0067] FIG. 9 illustrates a perspective view of a wellhead tool engaged with a wellhead sleeve according to an embodiment of the present invention;

[0068] FIG. 10 illustrates a perspective view of a gripper head of the wellhead tool shown in FIG. 9;

[0069] FIG. 11 illustrates a side view of the gripper head of the wellhead tool shown in FIG. 10;

[0070] FIG. 12 is a perspective view of a wellhead tool engaged with a wellhead sleeve according to another embodiment of the present invention;

[0071] FIG. 13 is a perspective view of the wellhead tool engaged with the wellhead sleeve shown in FIG 12 from the end comprising an insertion assembly;

[0072] FIG. 14 is a perspective view of the gripper head engaged with the wellhead sleeve shown in FIG. 12;

[0073] FIG. 15 is an exploded view of the gripper head and wellhead sleeve shown in FIGS. 12-14;

[0074] FIG. 16 is a plan view of the gripper head and wellhead sleeve shown in FIGS. 12-15;

[0075] FIG. 17 is a side view of the gripper head and wellhead sleeve shown in FIGS. 12-16;

[0076] FIG. 18 is a partially exploded view of the gripper head and wellhead sleeve shown in FIGS. 12-14;

[0077] FIG. 19 is a perspective view of the wellhead tool shown in FIG. 12 mounted to a wellhead;

[0078] FIG. 20 is a cross-section view of the wellhead tool mounted to the wellhead shown in FIG. 19; and

[0079] FIG. 21 illustrates internal detail of the wellhead tool engaged with the wellhead sleeve of the wellhead shown in FIG. 20.

DETAILED DESCRIPTION OF THE DRAWINGS

[0080] Elements of the invention are illustrated in concise outline form in the drawings, showing only those specific details that are necessary to understanding the embodiments of the present invention, but so as not to clutter the disclosure with excessive detail that will be obvious to those of ordinary skill in the art in light of the present description.

[0081] Illustrated in FIG. 1 is a wellhead gripping tool 10 for use with a wellhead sleeve 20 having a body 21, a skirt 22 and a locking ring 23. In particular, the wellhead gripping tool 10 can be used to install, remove or adjust the wellhead sleeve as portions of the wellhead sleeve wear and degrade due to wellhead outflow abrasion.

[0082] The wellhead gripping tool 10 includes a gripper head 100, a sleeve 200 and an insertion assembly 300.

[0083] The gripper head 100 (which can be more clearly seen in FIGS. 2-5) includes an actuator 120, a stationary gripper or engaging member 140 and a rotating gripper or engaging member 160. The gripper head 100 shown in FIG. 2-5 also includes an optional adaptor in the form of a speed reducing gearbox 180, which is not present in FIG. 1.

[0084] The actuator 120 includes a gearbox 121 and a shaft 122, which can be clearly seen in FIG. 5.

[0085] The stationary engaging member 140 includes a substantially circular plate 141 connected to two hooked engaging arms 142a, 142b which are shaped to engage gripping portions of a locking ring of a wellhead sleeve. The two arms 142a, 142b extend perpendicularly from the circular plate 141 and are connected to the outside of raised portions 143, 144 projecting from the circular plate 141 by screws 145. The raised portions 143, 144 are located at diametrically opposed sides of the circular plate 141.

[0086] It can be seen in FIG. 2 that the substantially circular plate 141 of the stationary body 140 includes a flat edge 146 and is such that the perimeter of the circular plate 141 forms an arcuate portion between the opposing ends of the flat edge 146.

[0087] The rotating engaging member 160 includes a substantially rectangular plate 161 having curved or arcuate opposing edges 162a, 162b to which two hooked engaging arms 163a, 163b, similar to engaging arms 142a, 142b, are connected. The engaging arms 163a, 163b extend perpendicularly from the rectangular plate 161 in the same direction as the two engaging arms 142a, 142b of the circular plate 141 and are shaped to engage gripping portions of a locking ring of a wellhead sleeve.

[0088] The engaging arms 142a, 142b, 163a, 163b are spaced equidistantly around a face of the actuator 120 at a circumferential spacing of 90º. The hooks of the engaging arms 142a, 163a face in an opposite direction to the hooks of the engaging arms 142b, 163b.

[0089] Extending from rectangular plate 161 is a cylindrical portion 164 which receives

the shaft 122 of the actuator 120. While the engaging arms shown in the illustrated embodiments are hooked, it will be appreciated that the engaging arms could be of any shape.

[0090] The wellhead gripping tool 10 is typically constructed from stainless steel, carbon steel or polyoxymethylene (also known as acetal, polyacetal and polyformaldehyde) but may be constructed from any suitably resilient material.

[0091] With reference to FIG. 3, it is shown that the rectangular plate 161 extends beyond the flat edge 146 of the circulate plate 141.

[0092] Turning to FIG. 4, it can be seen that the engaging arms 163a, 163b connected to the rectangular plate 161 are shorter than the engaging arms 142a, 142b connected to the circular plate 141.

[0093] With reference to FIG. 5 which illustrates an exploded view of the gripper head 100, it is shown that an aperture 147 formed in the circular plate 141 aligns with a raised lip 123 of the gearbox 121. The circular plate 141 also includes four screw holes 148 which align with four screw holes 124 formed in the gearbox 121. Once the circular plate 141 is fitted around the raised lip 123 of the gearbox 121, the circular plate 141 is secured to the gearbox 121 using four screws 102 inserted through the screw holes 124, 145.

[0094] The rectangular plate 161 of the rotating engaging member 160 includes an aperture 165 extending through the rectangular plate 161 and the cylindrical portion 164, which is of a shape complementary to the shaft 122 of the actuator 120. The rectangular plate 161 is fitted over the shaft 122 until the rectangular plate 161 rests against, or abuts, the circular plate 141 of the stationary engaging member 140. The rectangular plate 161 is then secured to the shaft 122 by a washer 104 and screw 106.

[0095] Referring briefly back to FIG. 1, the speed reducing gearbox 180 of the gripper head 100 can be connected to an elongate member in the form of a shaft 210 housed within a pipe body 205 of the sleeve 200.

[0096] At the opposite end, shaft 210 is internally connected to the insertion assembly 300. Externally, a flange 305 of the insertion assembly is bolted to a flange 220 of the sleeve 200 to secure the two components together.

[0097] In the illustrated embodiment, the sleeve 200 additionally includes a pressure gauge 240 for indicating pressure within the sleeve 200 and an outlet valve 250 for venting pressure within the sleeve 200 once installation, removal or maintenance of the wellhead sleeve 20 is complete.

[0098] Turning now to the perspective view from the end comprising the insertion assembly shown in FIG. 6, the insertion assembly 300 can be seen to include a hand wheel

310 used to rotate and control the shaft 210 and a locking lever 320 which is used to engage an internal locking mechanism (not shown).

[0099] For use in installation, the hand wheel 310 of the insertion assembly 300 is rotated in a clockwise direction, for example, which causes the gripper head 100 and shaft 210 to telescopically and rotatably extend from the sleeve 200 to engage the locking ring 23. As the shaft 210, used to rotate the rotary engaging member 160 and the engaging arms 163a, 163b which engage and actuate the locking ring 23, is typically long and thin, the shaft 210 will twist which, in effect, reduces the turning because it adds 'backlash'. The speed reducing gearbox 180, if attached, increases the torque which the shaft 210 can apply and mitigates the effect of the backlash. In an example, the speed reducing gearbox 180 increases the torque by a factor of 4. The result is that the hand wheel 310 is rotated to cause the engaging arms 163a, 163b to rotate the desired amount. Four times as much torque is generated, which prevents the shaft 210 from twisting excessively.

[00100] The hand wheel 310 is then rotated anticlockwise until the gripper head 100 and sleeve 20 are retracted into the sleeve 200. The flange 230 of sleeve 200 is then bolted onto an isolation valve 30 of a wellhead 40, which can be seen in FIGS. 6-8. The hand wheel 310 is again rotated clockwise to extend the gripper head 100 which is connected to the wellhead sleeve 20 until the wellhead sleeve 20 is fully seated. The locking lever 320 of the insertion assembly 300 can then be pressed or pushed in to allow the rotary engaging member 160 to be rotated.

[00101] In this particular example, once engaged, the locking lever 320 is rotated in a clockwise direction by 30º which rotates the rotary engaging member 160 to disengage the two engaging arms 163a, 163b from complementary grooves 23a, 23b in the locking ring 23 shown in FIG 8. The extended length of the rectangular plate 161 in this illustrated embodiment acts as a stop to limit rotation movement of the rectangular plate 161 when the locking mechanism is engaged. However, it will be appreciated that excessive movement can also be restricted through the use of other means, such as abutment of the rectangular plate 161 with raised portions 143, 144, optionally with the additional use of set screws (as shown in the embodiment illustrated in FIG. 9).

[00102] Once the engaging arms 163a, 163b of the rotary engaging member 160 have been disengaged, the hand wheel 310 is rotated anticlockwise to withdraw the gripper head 100 and shaft 210 from the wellhead 20. The isolation valve 30 is then closed and the pressure discharged from the sleeve 200 through outlet valve 250. The wellhead gripper tool 10 can then be removed from the wellhead 40 by rotating the hand wheel 310 in an anticlockwise direction. While not shown in the illustrated embodiment, the hand wheel 310

can include indicators or markings, such as numbers or lock/unlock symbols, to visually guide a user when rotating the hand wheel.

[00103] In a second example, if the locking ring 23 is to be removed, the tool 10 is mounted to the isolation valve 30 and wellhead head 40. Next, the hand wheel 310 of the insertion assembly 300 is rotated in a clockwise direction to extend the gripper head 100 and shaft 210 from the sleeve 200 until the engaging arms 142a, 142b of the stationary engaging member 140 engage the grooves 23a of the locking ring 23. Once the engaging arms 142a, 142b are engaged with the locking ring 23, the locking lever 320 is activated to allow the rotary engaging member 160 to rotate. The locking lever 320 is then rotated in a clockwise direction by 20º to engage the engaging arms 163a, 163b of the rotary engaging member 160 with the complementary grooves 23b of the locking ring 23.

[00104] Once the gripper head 100 is fully engaged with the locking ring 23 of the wellhead sleeve 20, the hand wheel 310 is rotated anticlockwise to withdraw the wellhead sleeve 20 from the wellhead 40.

[00105] In yet another example of use, once the wellhead sleeve 20 has been withdrawn from the wellhead 40, the tool 10 can be used to rotate the sleeve 20 to a position of less wear.

[00106] As fluids, typically hydrocarbon fluids, flow through the wellhead 40 the sleeve 20 erodes and wears in place of the wellhead 40 itself, or related hardware of the wellhead 40, wearing. Thus, in another example, after a certain amount of wear the wellhead gripping tool 10 allows the sleeve 20 to be removed replaced in its entirety or, as the wear typically only occurs on a small region of the body of the sleeve 20, rotated so that an 'unworn' portion of the sleeve 20 is at the position of wear. Alternatively, the locking ring 23 can be rotated out of the skirt 22 and replaced or rotated to a position of less wear.

[00107] Advantageously, it is envisaged that the tool 10 can rotate the body by 180º or 120° to enable it to be used at least twice or three times before needing to be replaced. It should be appreciated that, depending on the wear characteristics of the fluid and wellhead 40, it may even be possible to achieve more rotations, such as four rotations at 90° out of a single sleeve 20.

[00108] Illustrated in FIG. 9 is another embodiment of a wellhead gripping tool 10A for use with a wellhead sleeve 20 having a body 21, a skirt 22 and a locking ring 23.

[00109] The wellhead gripping tool 10A is substantially similar to wellhead gripping tool 10 and includes a gripper head 100A, a sleeve 200 and an insertion assembly 300 (having the same features as described above).

[00110] The gripper head 100A (which can be more clearly seen in FIG. 10) includes an

actuator 120A, a stationary gripper or engaging member 140A and a rotating gripper or engaging member 160A. The gripper head 100A shown in FIG. 10 also includes an optional adaptor in the form of a speed reducing gearbox 180A.

[00111] The actuator 120A includes a gearbox 121A and a shaft 122A.

[00112] The stationary engaging member 140A includes a circular plate 141A and two integrally formed hooked engaging arms 142A, 142B extending from the circular plate 141A. These two arms 142A, 142B extend perpendicularly from the circular plate 141. The raised portions 143A, 144A projecting from the circular plate 141A are located at diametrically opposed sides of the circular plate 141A.

[00113] The rotating engaging member 160A includes a substantially rectangular plate 161 having curved or arcuate opposing edges 162A, 162B from which two integrally formed hooked engaging arms 163A, 163A, similar to engaging arms 142A, 142B, extend. These engaging arms 163A, 163B extend perpendicularly from the rectangular plate 161 in the same direction and are the same length as the two engaging arms 142A, 142B of the circular plate 141, which can be more clearly sign in FIG. 11.

[00114] Extending from rectangular plate 161A is a raised cylindrical portion 164A which engages the shaft 122A of the actuator 120A. While the engaging arms shown in the illustrated embodiments are hooked, it will be appreciated that the engaging arms could be of any shape.

[00115] The wellhead gripping tool 10A is typically constructed from stainless steel, carbon steel or polyoxymethylene (also known as acetal, polyacetal and polyformaldehyde) but may be constructed from any suitably resilient material.

[00116] With reference to FIG. 10 and 11, it is shown that the rectangular plate 161A includes two set screws 166A mounted into the side of the rectangular plate 161A. The screws 166A limit the rotation movement of the rotary engaging member 160A by abutting the sides of the raised portion 143A, 144A. While the embodiment shown uses sets screw 166A mounted in the rectangular plate 161A, it will be appreciated that the set screws may be protrusions which are integrally formed with the rectangular plate.

[00117] FIGS. 12-21 illustrate a wellhead tool 10B according to another embodiment of the present invention although some features are common with other embodiments described herein.

[00118] With reference to FIGS. 12 and 13, the outlet valve 250 for venting pressure within the sleeve 200 once installation, removal or maintenance of the wellhead sleeve 20 is complete is coupled to the sleeve 200 via an elbow fitting 251. Valve 250 can be locked in a closed, safe position to prevent the accidental release of stored energy. Another elbow fitting 252 is coupled to the outlet valve 250 to discharge residual gas in a safe direction toward the

ground and away from personnel. The arrangement of the outlet valve 250 and elbow valves 251, 252 provide safe use and enable an operator to 'tag-out' the equipment.

[00119] A pair of feet 253 are coupled in a spaced apart arrangement to an underside of the sleeve 200, for example, by welding or any other suitable means of attachment. The feet 253 are used for transport and storage to stabilise the wellhead tool. The feet 253 are also used for stability during servicing and repair. Each foot 253 can comprise holes 254 in a base portion of the foot 253 to enable fixing, for example, to a site vehicle for transportation. Each foot 253 can comprise cut out portions 255 to reduce mass and usage of material or can be solid, as shown in FIG 9.

[00120] The sleeve 200 can comprise one or more lifting points in the form of lifting eyes 256. One lifting eye can be used to lift the wellhead tool 10B into position whilst in use, and for transit, for example from a work vehicle to the wellhead. The other lifting eye is used for service/repair when the end portion has been removed.

[00121] The wellhead tool 10B comprises a counter 257 coupled between the hand wheel 310 and the insertion assembly 300. The counter 257 can be in the form of a mechanical counter and indicates the installation position and the current location of the gripper assembly for positioning and removing the sleeve 200. The counter 257 enables the operator to determine the location of internal moving parts which are not visible while the tool 10B is in use.

[00122] The wellhead tool 10B comprises a locking handle 320 used to lock the sleeve grippers when the sleeve 200 is in the correct position within the wellhead. The locking handle 320 is used to unlock the sleeve grippers for the purpose of removing the sleeve 200.

[00123] With reference to FIGS. 14 to 18, the gripper head 100B of the wellhead tool 10B in this embodiment comprises a speed reducing gearbox 180B coupled to an actuator 120B, which comprises a gearbox 121B and a shaft 122B. Gripper head 100B comprises a stationary gripper or engaging member 140B and a rotating gripper or engaging member 160B. The stationary engaging member 140B comprises a substantially circular plate 141B having an aperture 147B which is received around raised lip 123B of the adaptor 120B. The stationary engaging member 140B comprises a raised perimeter or periphery 144B extending from the circular plate 141B. In this embodiment, the stationary engaging member 140B comprises two hooked engaging arms 142B extending from the raised perimeter or periphery 144B. Hooked engaging arms 142B comprise hooked portions extending in opposite directions. The rotating engaging member 160B comprises a substantially circular plate 170 and a cylindrical portion 164B extending therefrom with a central aperture therethrough. The rotating engaging member 160B comprises five hooked engaging arms 163B extending from the substantially circular plate 170 with the hooked portions extending

in the same clockwise direction.

[00124] The stationary engaging member 140B houses a pawl 260 that engages a clutch mechanism 262 to limit the torque applied to the rotary engaging member 160B by an operator via locking handle 320. Pawl 260 pivots about a pair of locating pins 264 and is kept engaged with the clutch mechanism 262 via a biasing member, such as a spring strip 266. A mechanism to engage and disengage the pawl 260 comprises a ratchet bar 268 housed within the stationary engaging member 140B and a cam 270 slidably affixed to the actuator or the gearbox 180B. Ratchet bar 268 comprises a profiled underside 272. With the ratchet bar 268 and cam 270 in respective first positions, as shown in FIG. 18, pawl 260 is engaged with the clutch mechanism 262. When the cam 270 is pushed or slid forward into a second position, an end of the cam 270 engages a recess in a topside of the ratchet bar 268 causing sideways movement of the ratchet bar 268. The sideways movement of the profiled underside 272 of the ratchet bar 268 causes the pawl 260 to disengage the clutch mechanism 262. Biasing member, such as overcenter-spring 274 keeps ratchet bar 268 in one of two possible positions.

[00125] In this embodiment, gripper head 100B comprises a sleeve support 276 which supports the sleeve 20 to reduce the axial load on the sleeve skirt 22. Sleeve 20 is coupled to the rotating engaging member 160B, and in particular the cylindrical portion 164B thereof, via fixing screws 278.

[00126] Cylindrical portion 164B of rotating engaging member 160B comprises one or more apertures 280 for receiving a respective adjustable detent. In the embodiment shown, cylindrical portion 164B comprises eight apertures 280 for receiving 8 adjustable detents 282, which can be in the form of, for example, adjustable ball spring plungers.

[00127] Gripper head 100B comprises a washer 104B and a fixing screw 106B to secure the arrangement to the shaft 122B.

[00128] The embodiment shown in FIGS 12-18 provides a method of actuating a mechanism to physically restrain the sleeve in position whist the sleeve is in service, and a method of disengaging the restraint when removal of the sleeve is required. This embodiment also allows gripping of the sleeve to allow for locating of the sleeve during installation and withdrawing the sleeve upon removal. This embodiment also limits the applied torque to the required value to ensure mechanical restraint whilst preventing damage to the sleeve or other components of the wellhead installation tool.

[00129] With reference to FIGS. 19 and 20, the alternative embodiment of the wellhead tool 10B is shown mounted to a wellhead 40. FIG. 20 illustrates internal detail of the wellhead tool 10B engaged with the wellhead sleeve 20 within isolation valve 30 and in particular shaft 210 coupled to gripper head 100B. Region A shown in FIG.20 is shown enlarged in FIG. 21.

Wellhead sleeve 20 comprises body 21, skirt 22 and inner locking ring 23. An elastic restraining band 284 is provided between the skirt 22 and the body 21 of the sleeve 20 along with a carrier guide for gripping elements 286. Four gripping elements are provided circumferentially about the sleeve 20. The elastic restraining band is not affected by hydrocarbons and can be used at temperatures up to around 120°C.

[00130] Advantageously the tool of the present invention allows a sleeve to be installed or adjusted without requiring any reworking of the wellhead. The tool can be used to install the sleeve under pressure utilising known, safe, and reliable 'hot top' method of installation.

[00131] In another particular advantage, the sleeve is easily inserted, adjusted, and replaced using the tool without damaging any of the wellhead 'parent' equipment.

[00132] Further advantageously, the tool can be used while the wellhead remains in use, mitigating the need to stop production entirely, i.e. "hot tapping".

[00133] In this specification, adjectives such as first and second, left and right, top and bottom, and the like may be used solely to distinguish one element or action from another element or action without necessarily requiring or implying any actual such relationship or order. Where the context permits, reference to an integer or a component or step (or the like) is not to be interpreted as being limited to only one of that integer, component, or step, but rather could be one or more of that integer, component, or step, etc.

[00134] The above description of various embodiments of the present invention is provided for purposes of description to one of ordinary skill in the related art. It is not intended to be exhaustive or to limit the invention to a single disclosed embodiment. As mentioned above, numerous alternatives and variations to the present invention will be apparent to those skilled in the art of the above teaching. Accordingly, while some alternative embodiments have been discussed specifically, other embodiments will be apparent or relatively easily developed by those of ordinary skill in the art. The invention is intended to embrace all alternatives, modifications, and variations of the present invention that have been discussed herein, and other embodiments that fall within the spirit and scope of the above described invention.

[00135] In this specification, the terms 'comprises', 'comprising', 'includes', 'including', or similar terms are intended to mean a non-exclusive inclusion, such that a method, system or apparatus that comprises a list of elements does not include those elements solely, but may well include other elements not listed.

CLAIMS:

1. A wellhead tool for use with a wellhead sleeve, the wellhead tool comprising:
a gripper head for engaging the wellhead sleeve, the gripper head comprising:
an actuator;
a stationary engaging member connected to the actuator; and
a rotary engaging member connected to the actuator; and

at least two engaging arms connected to the gripper head, wherein the engaging arms engage complementarily shaped recesses located on the wellhead sleeve.

2. The wellhead tool of claim 1, wherein the rotary engaging member comprises a substantially rectangular plate.

3. The wellhead tool of claim 2, wherein the at least one engaging arm is connected to the substantially rectangular plate of the rotary member.

4. The wellhead tool of claim 2, wherein at least two engaging arms are connected to the substantially rectangular plate of the rotary engaging member.

5. The wellhead tool of claim 2, wherein two engaging arms are connected to the substantially rectangular plate of the rotary engaging member and are located at opposing ends of the substantially rectangular plate.

6. The wellhead tool of any one of claims 2 to 5, wherein one or more set screws are mounted to the rotary engaging member, particularly to a side of the rectangular plate of the rotary engaging member.

7. The wellhead tool of any preceding claim, wherein the stationary engaging member comprises a substantially circular plate.

8. The wellhead tool of claim 7, wherein at least one engaging arm is connected to the substantially circular plate of the stationary engaging member.

9. The wellhead tool of claim 7, wherein at least two engaging arms are connected to the substantially circular plate of the stationary engaging member.

10. The wellhead tool of claim 7, wherein two engaging arms are connected to the substantially circular plate of the stationary engaging member and are located at opposing sides of the substantially circular plate.

11. The wellhead tool of claim 1, wherein two engaging arms are connected to a substantially circular plate of the stationary engaging member and are located at opposing sides of the substantially circular plate; and

two engaging arms are connected to a substantially rectangular plate of the rotary engaging member and are located at opposing sides of the substantially rectangular plate,

wherein the four engaging arms are spaced equidistantly about a perimeter of the actuator.

12. The wellhead tool of any preceding claim, wherein the stationary engaging member is located between the actuator and the rotary engaging member and more particularly, the stationary engaging member abuts the actuator and the rotary engaging member.

13. The wellhead tool of any preceding claim, wherein the stationary engaging member is fixedly connected to the actuator.

14. The wellhead tool of any preceding claim, wherein the rotary engaging member is rotatably connected to the actuator.

15. The wellhead tool of any preceding claim, wherein each engaging arm of the stationary engaging member and each engaging arm of the rotary engaging member comprises a connecting portion and an elongate body.

16. The wellhead tool of claim 15, wherein each engaging arm further comprises

a gripping portion located at an end of the elongate body.

17. The wellhead tool of claim 16, wherein the gripping portion is hooked or flared.

18. The wellhead tool of claim 16, wherein the elongate body and gripping portion are of a uniform width.

19. The wellhead tool of claim 17, wherein a hooked gripping portion of a first engaging arm of the stationary engaging member extends in an opposite direction to a hooked gripping portion of a second engaging arm of the stationary engaging member.

20. The wellhead tool of claim 17 or 19, wherein a hooked gripping portion of a first engaging arm of the rotary engaging member extends in an opposite direction to a hooked gripping portion of a second engaging arm of the rotary engaging member.

21. The wellhead tool of any preceding claim, wherein the at least two engaging arms are removably connected to the circular plate or are integrally formed with the circular plate.

22. The wellhead tool of any preceding claim, wherein the gripper head comprises two rotary engaging arms and two stationary engaging arms, wherein a length of each of the rotary engaging arms is equal to a length of each of the two stationary engaging arms, or a length of each of the rotary engaging arms is less than a length of each of the stationary engaging arms.

23. The wellhead tool of any one of claims 7 to 22, wherein the engaging arms extend from an outer perimeter of the circular plate.

24. The wellhead tool of any one of claims 2 to 23, wherein the at least two engaging arms are removably connected to the rectangular plate or are integrally formed with the rectangular plate.

25. The wellhead tool of any one of claims 2 to 22, wherein the engaging arms

extend from an outer perimeter of the rectangular plate.

26. The wellhead tool of any preceding claim, wherein the tool comprises an adaptor, in particular a speed reducing gearbox, connected to the actuator for engaging an extension member.

27. The wellhead tool of claim 26, wherein the extension member and the tool are housed in a sleeve, in particular a pipe.

28. The wellhead tool of claim 26, wherein the pipe comprises a first flange for connecting to a wellhead and a second flange for connecting to an insertion assembly.

29. The wellhead tool of any one of claims 26 to 28, comprising a handle rotatably connected to the extension member to rotate the extension member and extend the tool from the sleeve to attach to a wellhead.

30. The wellhead tool of any preceding claim, wherein the actuator comprises a gearbox and a shaft.

31. The wellhead tool of claim 30, wherein the shaft is connected to an end of the gearbox or to an adaptor connected to the gearbox.

32. The wellhead tool of claim 31, wherein the rotary engaging member is connected to the shaft of the actuator.

33. The wellhead tool of claim 2, wherein the substantially rectangular plate of the rotary engaging member comprises an aperture for receiving a shaft of the actuator.

34. The wellhead tool of any one of claims 30 to 33, wherein the gearbox comprises a raised lip for engaging an aperture of the circular plate of the stationary engaging member.

35. The wellhead tool of claim 34, wherein the circular plate includes an aperture

for receiving the raised lip of the gearbox of the actuator.

36. The wellhead tool of claim 34, further comprising an elongate extension member, in particular, a splined bush drive, connected to the gearbox or adaptor.

37. The wellhead tool of claim 36, further comprising an insertion assembly in communication with the gearbox or adaptor, in particular, connected to the elongate extension member, and more particularly, connected to an end of the sleeve such that the extension member extends through the sleeve.

38. The wellhead tool of claim 37, wherein the insertion assembly comprises: a hand wheel operatively connected to the extension member, wherein rotation of the hand wheel telescopically and rotatably extends or retracts the gripper head and the elongate extension member from an end of the sleeve; and

a locking lever for locking the gripper head and preventing rotation of the rotary engaging member.

39. The wellhead tool of claim 38, wherein the locking lever is operatively connected, in particular by a drive member, to the rotary engaging member such that, in operation, rotating the locking lever rotates the rotary engaging member.

40. A method for using a wellhead tool with a wellhead sleeve, the method comprising the steps of:

inserting a gripper head of a wellhead tool into a locking ring for a wellhead; and

rotating the gripper head to rotate the locking ring for the wellhead,

wherein rotating the gripper head causes the locking ring to engage with or disengage from the wellhead.

41. The method of claim 40, wherein rotating the gripper head clockwise engages the locking ring with the wellhead.

42. The method of claim 40 or 41, wherein inserting the gripper head comprises

inserting at least one engaging arm of a stationary engaging member of the gripper head into a complementary recess of the locking ring.

43. The method of claim 40, 41 or 42, wherein inserting the gripper head comprises inserting at least one engaging arm of a rotary engaging member of the gripper head into a complementary recess of the locking ring.

44. The method of any one of claims 40 to 43, wherein rotating the gripper head rotates the stationary engaging member and the at least one engaging arm of the stationary engaging member into engagement with the complementary recess of the locking ring.

45. The method of any one of claims 40 to 44, wherein rotating the gripper head anticlockwise disengages the locking ring from the wellhead.

46. The method of any one of claims 40 to 45, wherein the method comprises telescopically extending the gripper head from a sleeve, particularly by rotating a hand wheel connected to the gripper head to telescopically extend the gripper head from a sleeve.

47. The method of any one of claims 40 to 46, wherein the method comprises locking the gripper head to the locking ring once the gripper head engages the locking ring, particularly via a rotatable locking lever, once the gripper head engages the locking ring.

48. The method of claim 47, wherein the method comprises:

locking the locking lever allowing rotation of the rotary engaging member and the at least one engaging arm of the rotary engaging member; and

rotating the locking lever to rotate the at least one engaging arm of the rotary engaging member into engagement with the complementary recess of the locking ring.

49. The method of any one of claims 40 to 48, wherein the method comprises the further step of rotating the locking lever 20º in an anticlockwise direction to rotate the rotary engaging member and lock the gripper head to the locking ring.

50. The method of any one of claims 40 to 49, wherein the method comprises the further step of rotating the locking lever 30º in a clockwise direction to rotate the rotary engaging member to disengage the at least one engaging arm of the rotary engaging member from the locking ring; and

rotating the hand wheel to disengage the at least one arm of the stationary engaging member from the locking ring.

51. The wellhead tool of claim 1, wherein the stationary engaging member houses a pawl that engages a clutch mechanism to limit the torque applied to the rotary engaging member by an operator via locking handle.

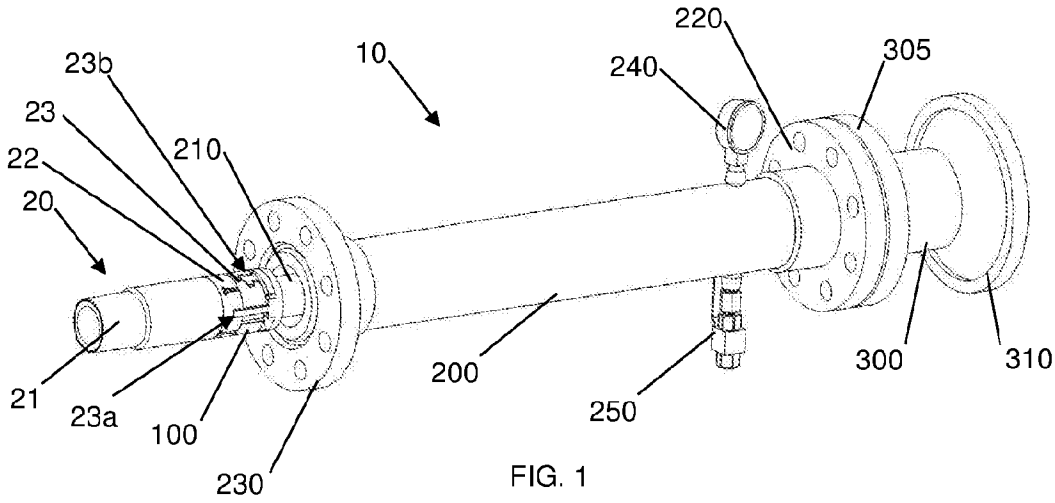
52. The wellhead tool of claim 51, wherein the pawl pivots about a pair of locating pins and is kept engaged with the clutch mechanism 262 via a biasing member.

53. The wellhead tool of claim 51 or 52, wherein a mechanism to engage and disengage the pawl comprises a ratchet bar housed within the stationary engaging member and a cam slidably affixed to the actuator.

54. The wellhead tool of claim 53, wherein, in a first position, the cam is disengaged from the ratchet bar and the pawl is engaged with the clutch mechanism and in a second position the cam engages with the ratchet bar causing sideways movement of the ratchet bar and the pawl to disengage the clutch mechanism.

55. The wellhead tool of claim 54, wherein a biasing member keeps the ratchet bar in the first position or the second position.

56. The wellhead tool of any one of claims 51 to 55, wherein a cylindrical portion of the rotating engaging member comprises one or more apertures for receiving a respective adjustable detent.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23b
23
22
210
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21
23a
100
230
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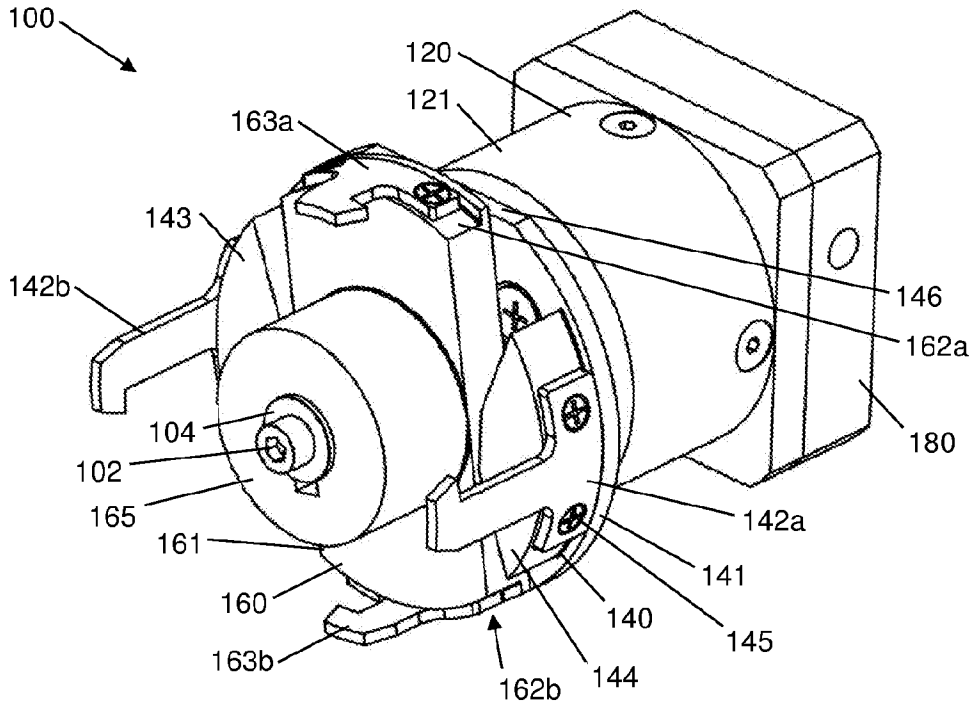
300
310

FIG. 1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163a
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142b
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104
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165
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163b
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141
142a

FIG. 2

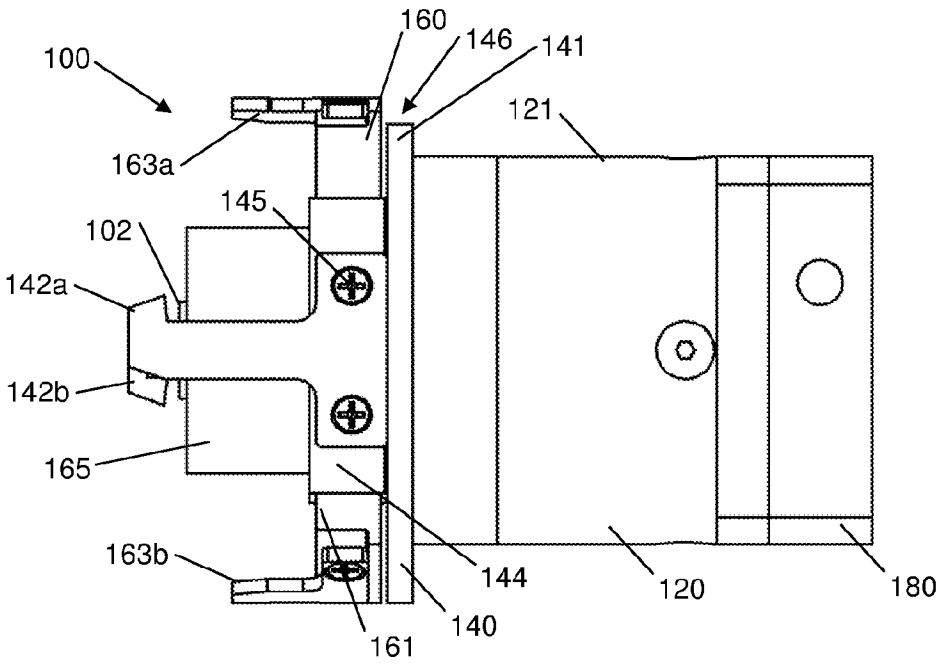
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FIG. 3

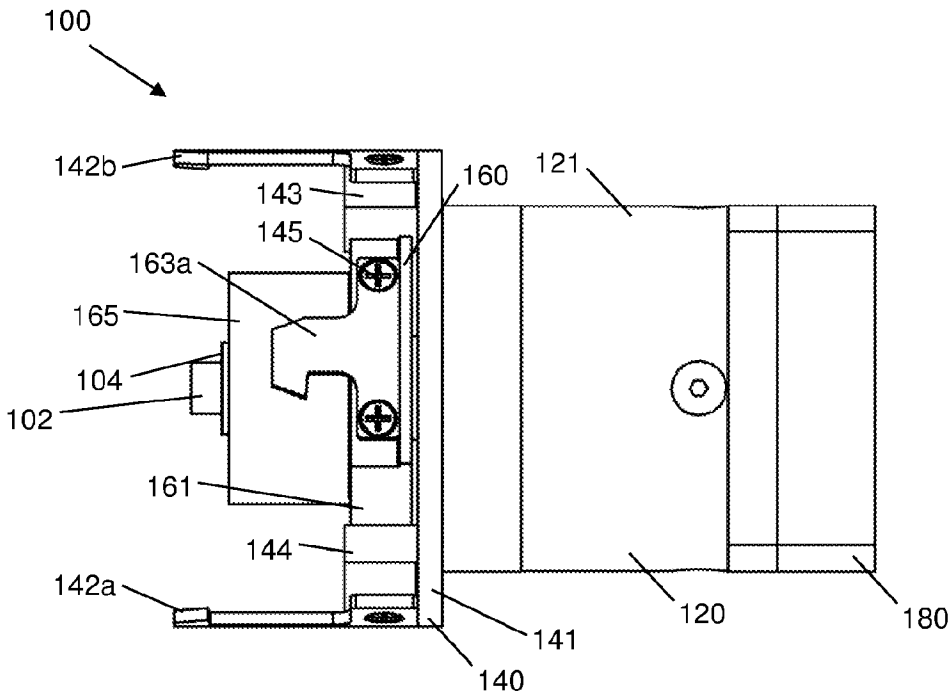
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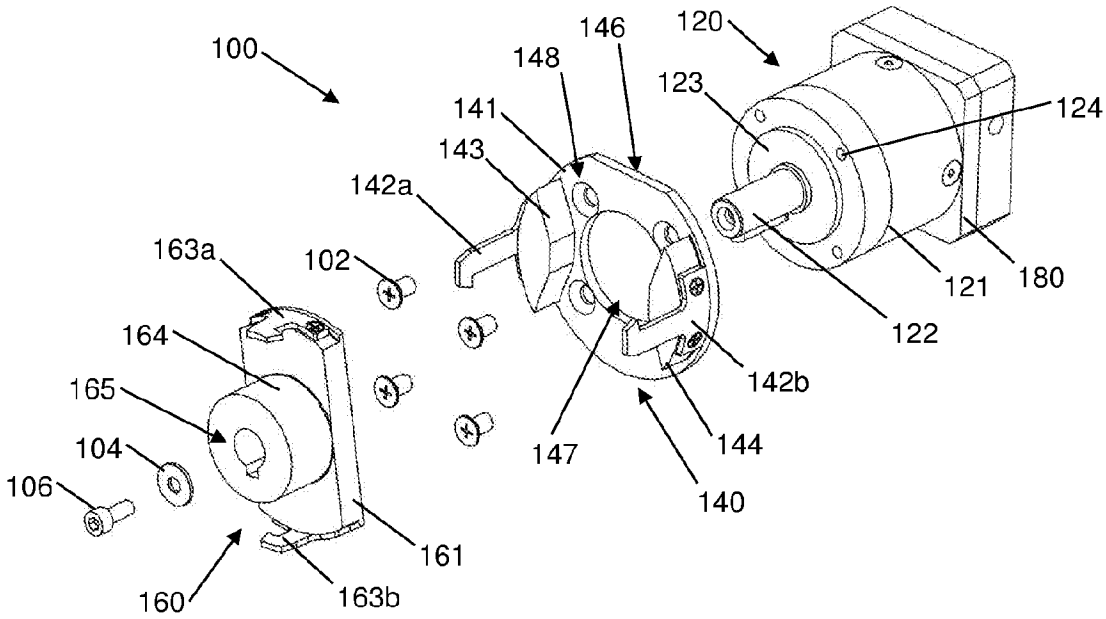
FIG. 4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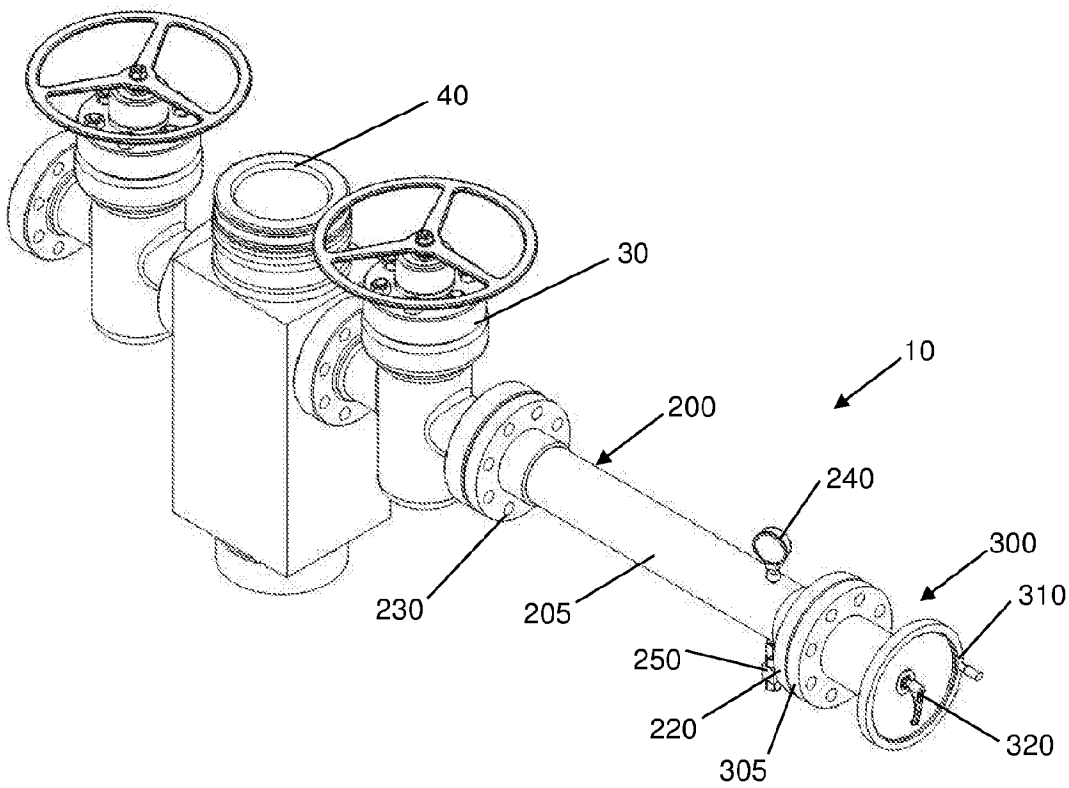
142b
121
180
122

FIG. 5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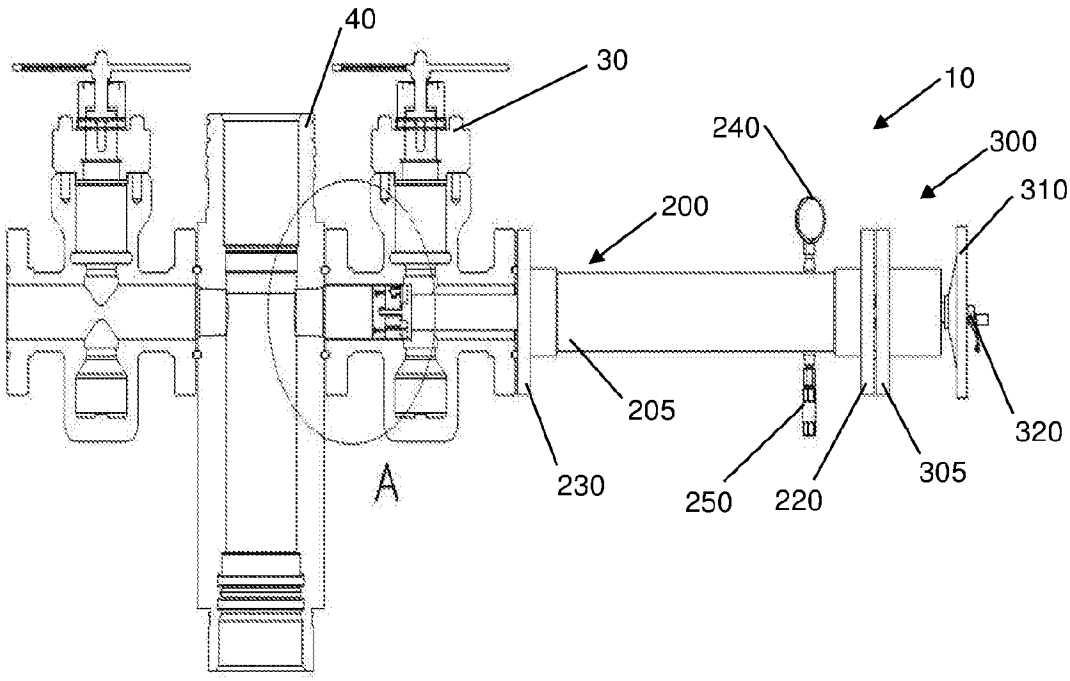
220
305
320

FIG. 6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A
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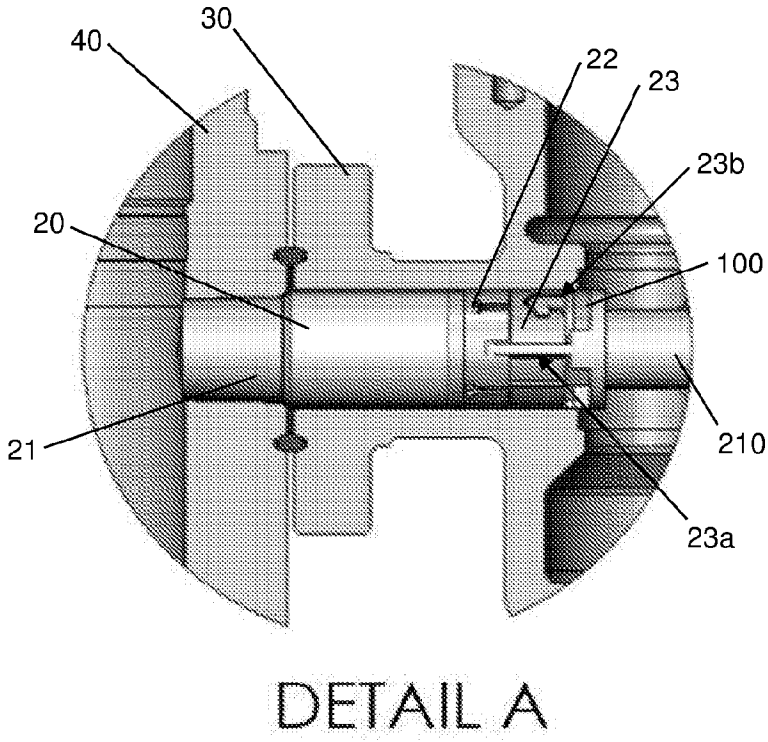
305

FIG. 7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30
22
23
23b
20
100
21
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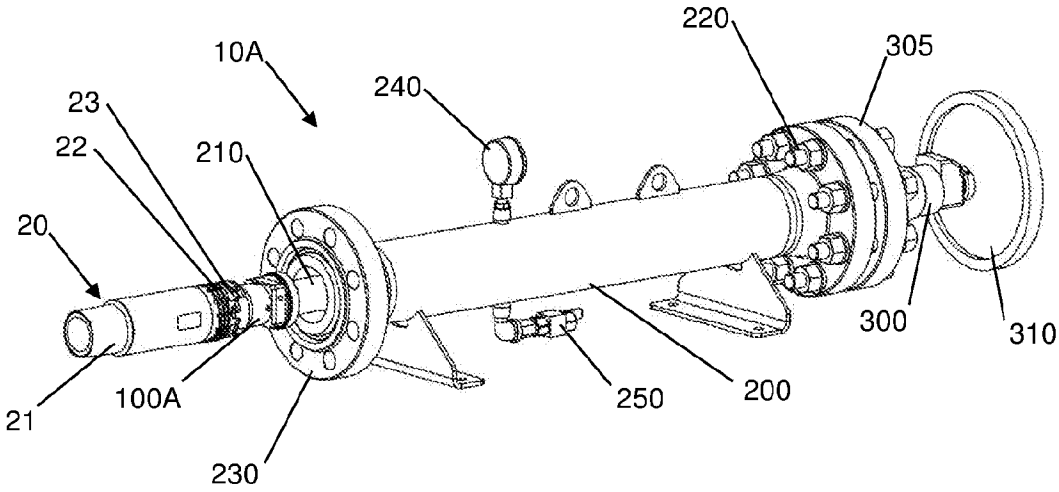
23a
DETAIL A

FIG. 8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10A
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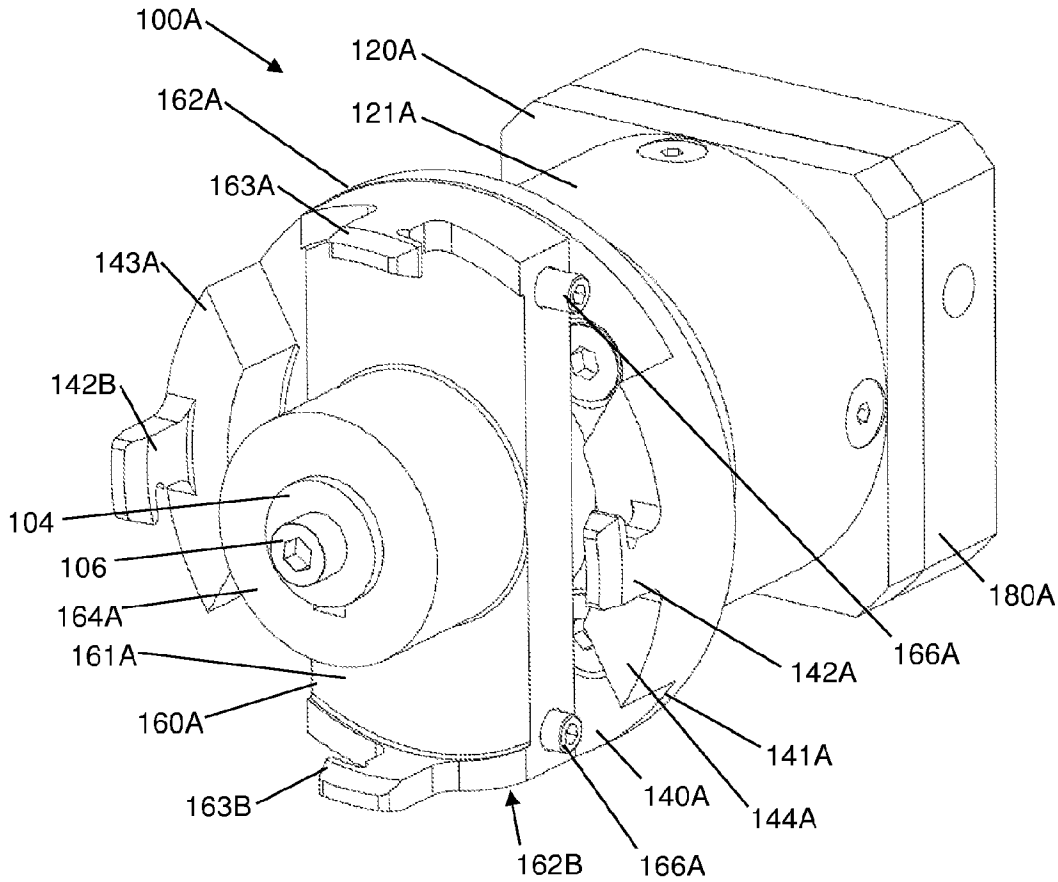
23
22
210
20
300
310
21
100A
250
200
230

FIG. 9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162A
121A
163A
143A
142B
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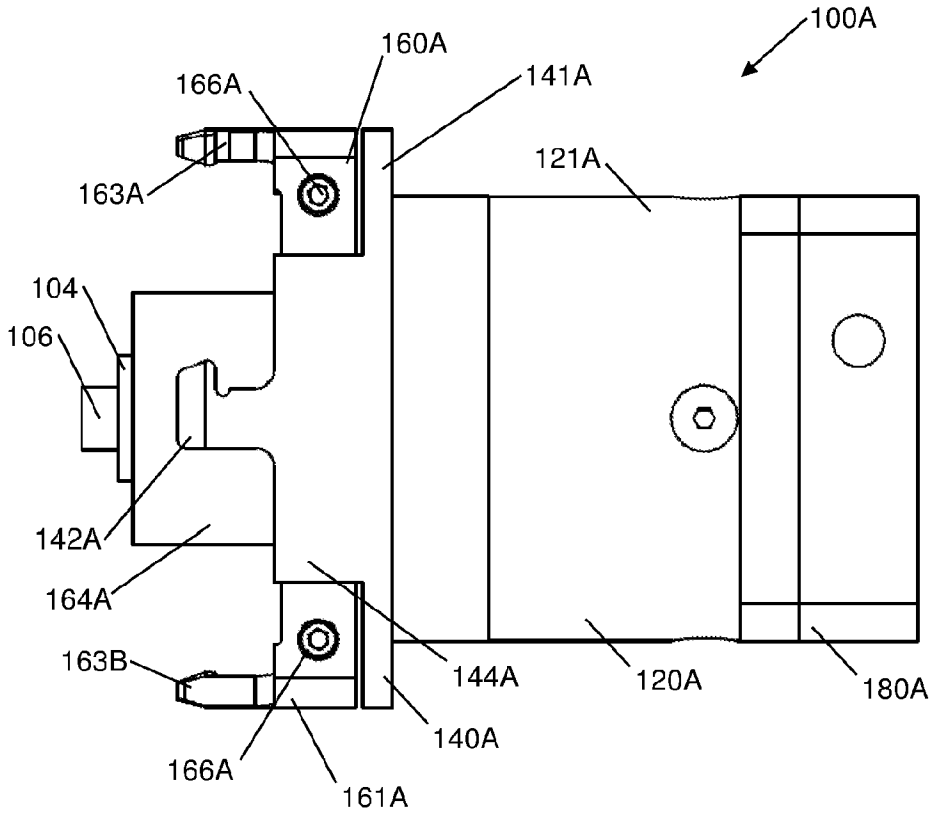
106
164A
161A
160A
163B
162B
166A
142A
141A
140A
144A
180A
166A

FIG. 10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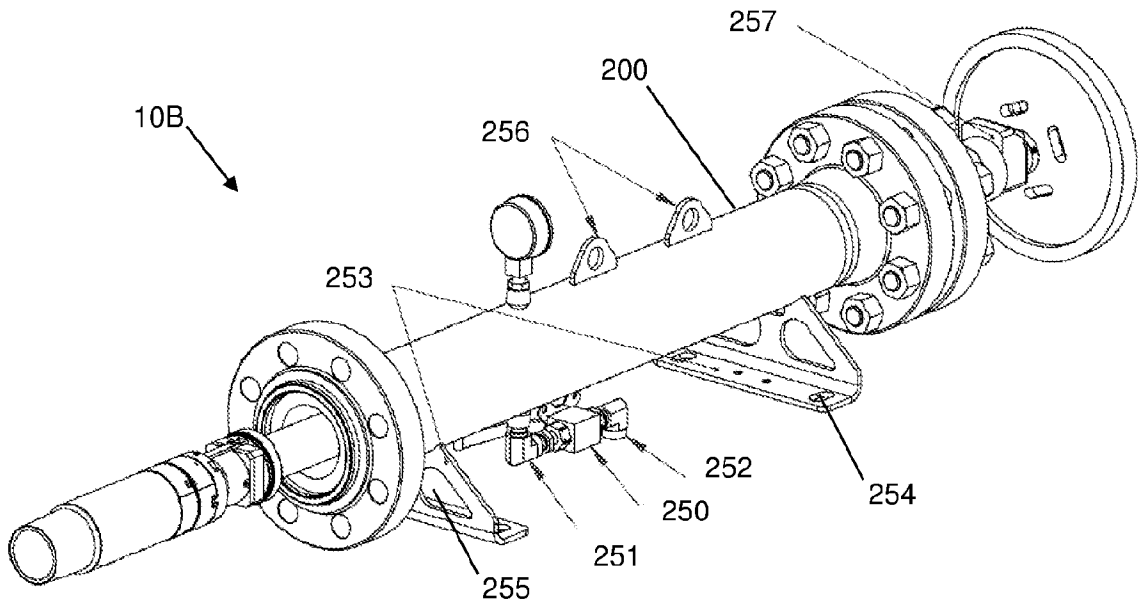
142A
164A
163B
144A
120A
180A
140A
166A
161A

FIG. 11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10B
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253
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254
250
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255

FIG. 12

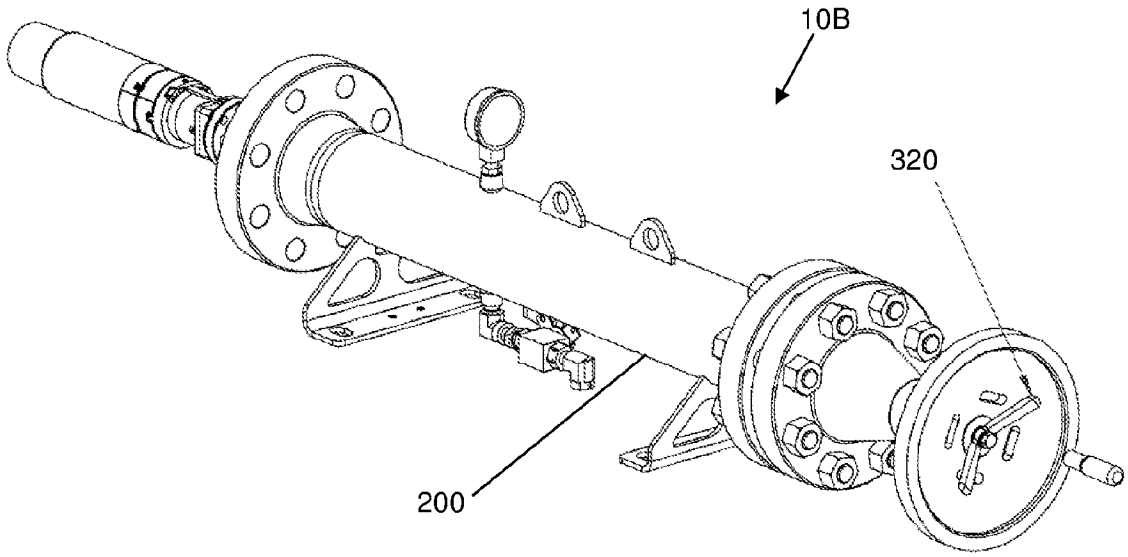


FIG. 13

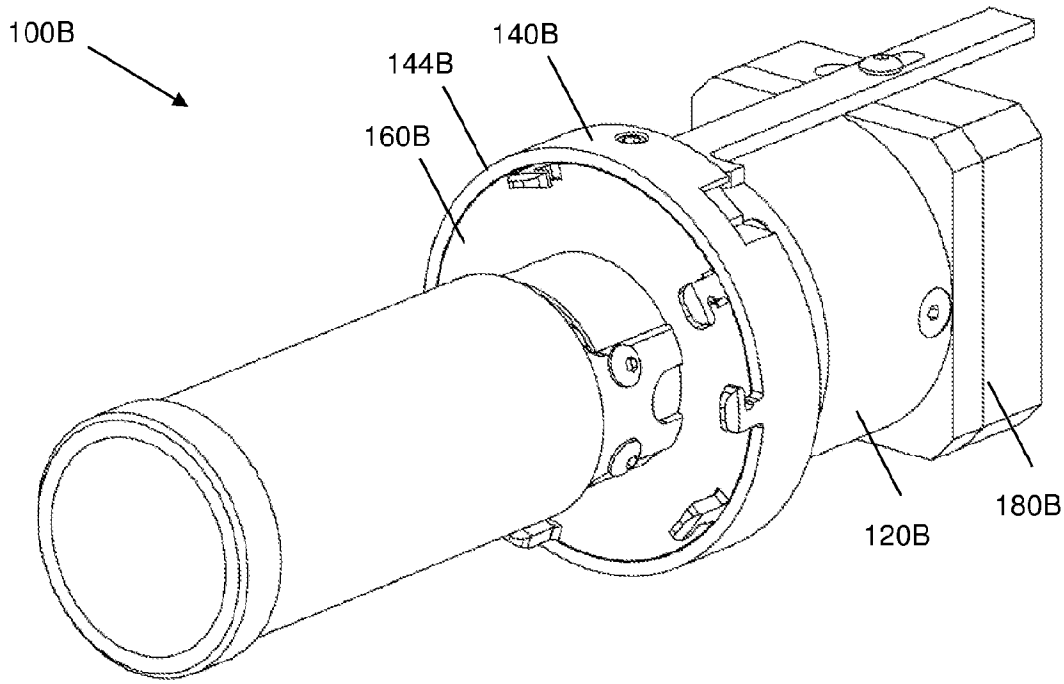
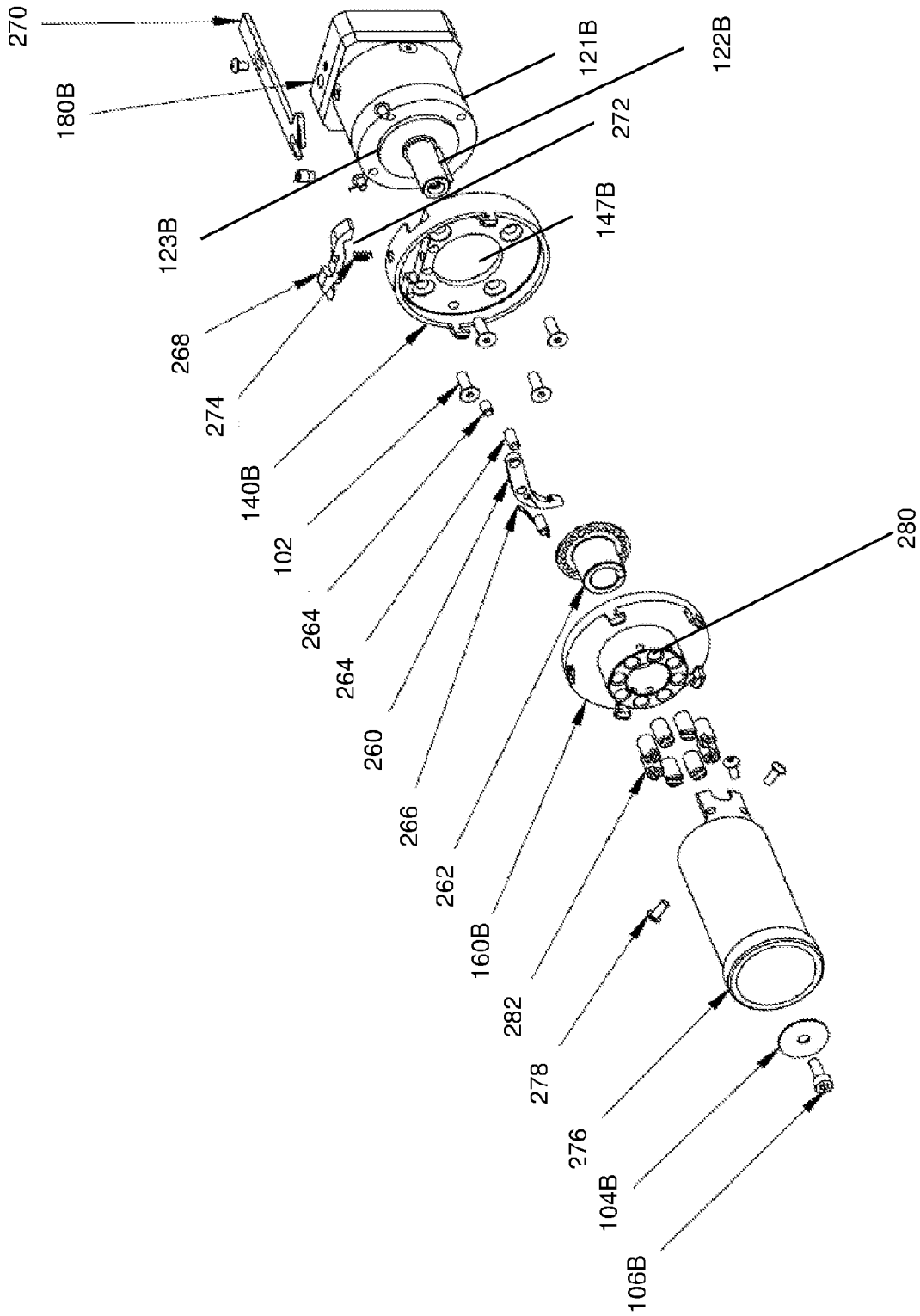


FIG. 14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180B
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122B
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123B
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266
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282
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276
104B
106B
280

FIG. 15

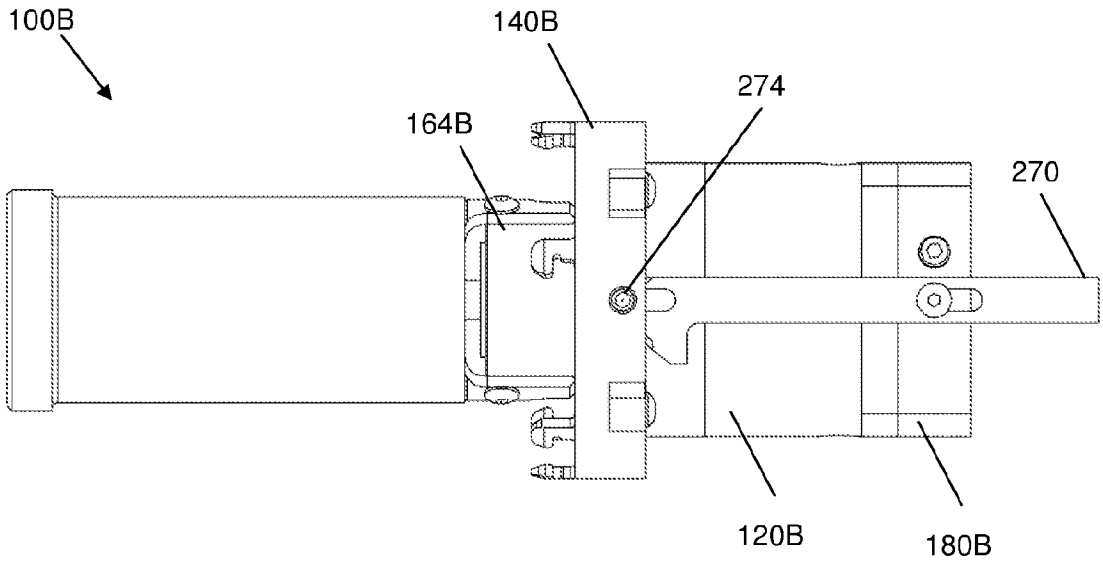

FIG. 16

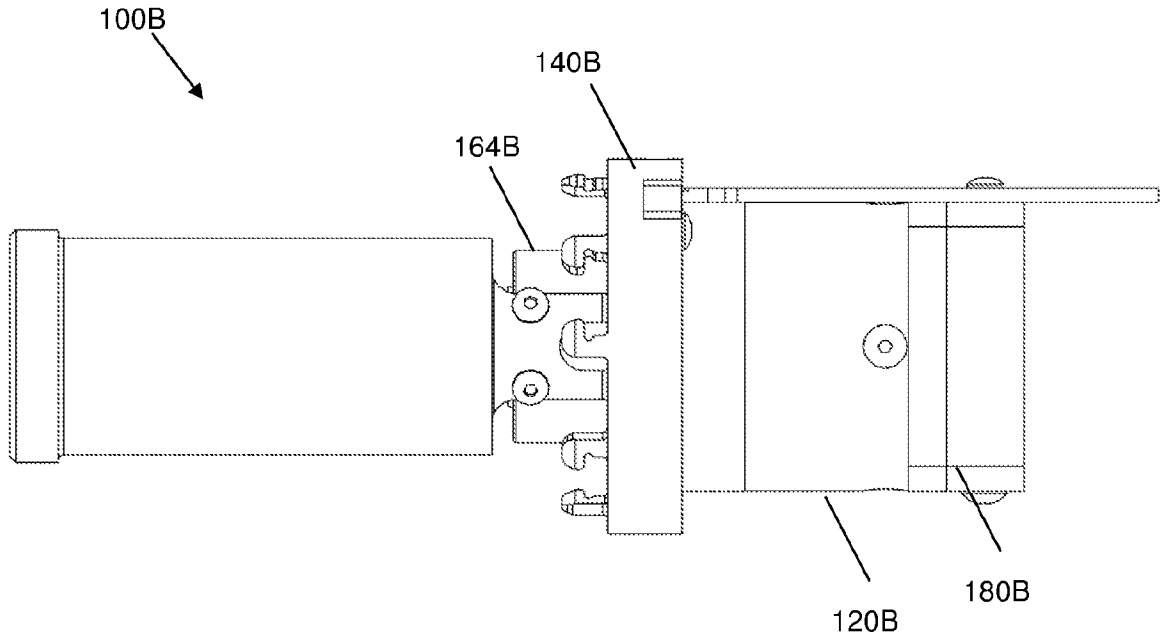

FIG. 17

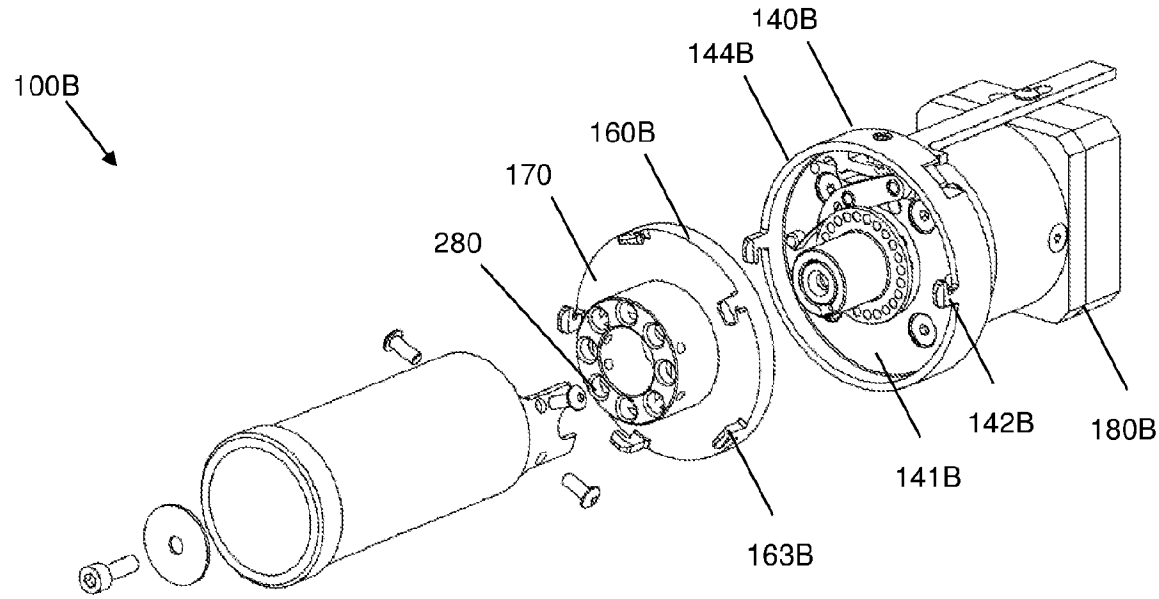

FIG. 18

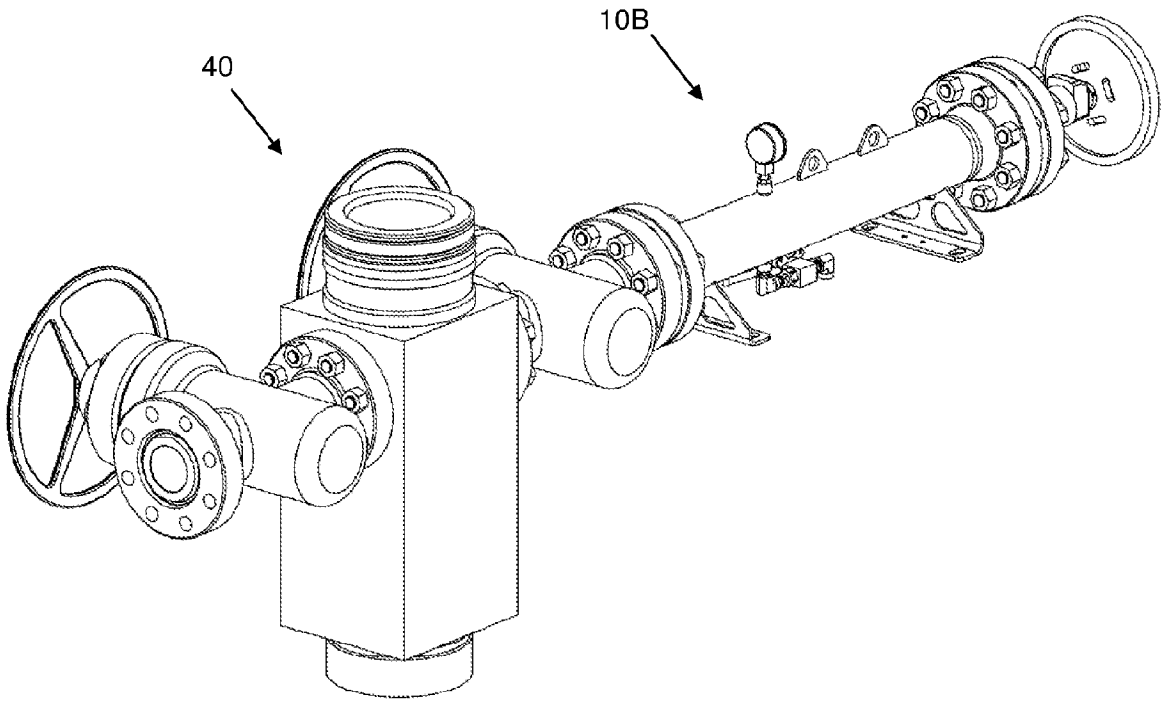

FIG. 19

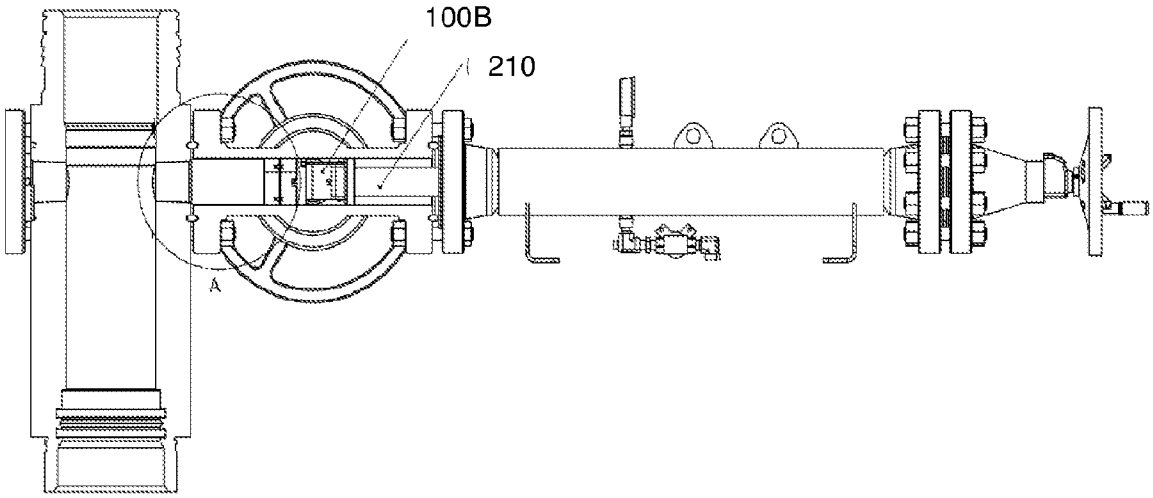

FIG. 20

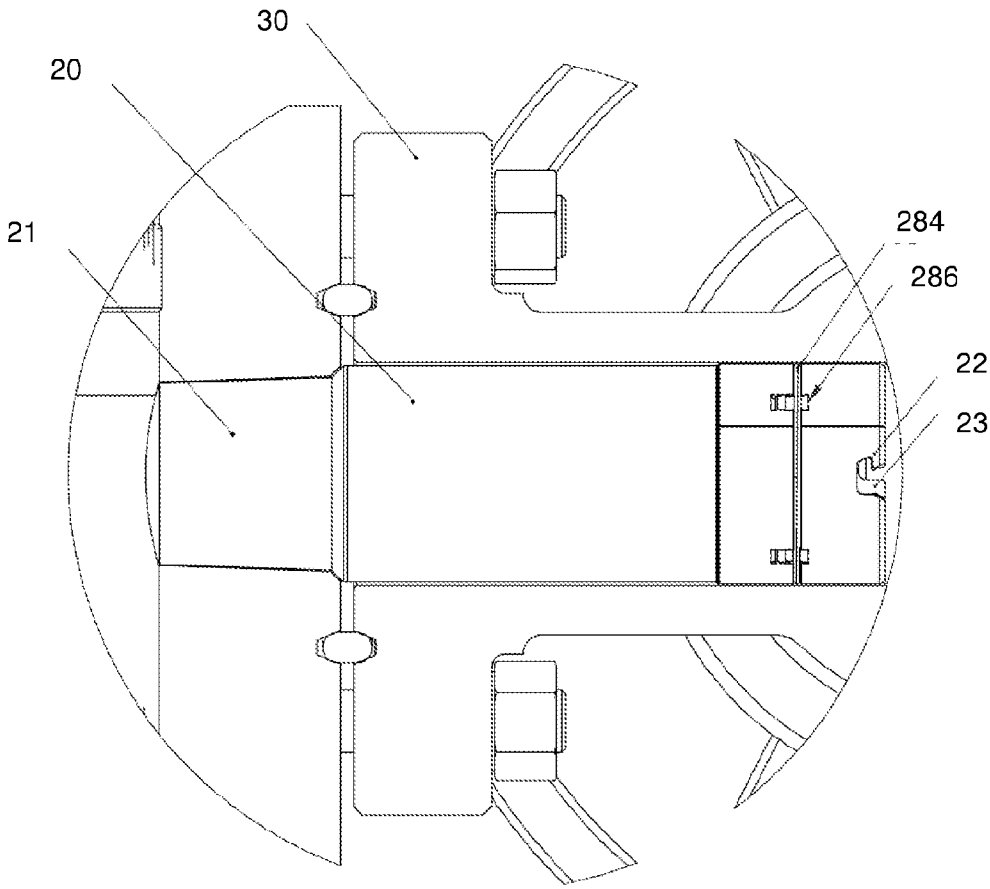

FIG. 21

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2018/050755

A. CLASSIFICATION OF SUBJECT MATTER

E21B 33/03 (2006.01) E21B 19/16 (2006.01) B25B 13/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPOQUE INTERNAL (PATENW) & Espacenet: IC/C/CC E21B33/03, E21B23, E21B19/16 or B25B & KW(Wellhead, Sleeve, Pipe, Lock ring, Grip, Grab, Jaw, Hook, Stationary, Fixed, Rotary, Spin, Install, Remove, Adjust, Disengage, Arm, Finger, Recess, Cavity, Spanner, Tool and similar terms. Applicant & Inventor name search

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 November 2018	13 November 2018

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 8235104 B1 (SIGMAR et al.) 07 August 2012 Figs 2, 6-8 & Col 13 line 39-40, Col 14 lines 16-20, Col 17 lines 63-67, Col 19 lines 67- Col 20 lines 1-2	1-6, 11-20, 22, 24-40, 42 & 47-56
X	US 6401827 B1 (FERGUSON et al.) 11 June 2002 Figs 1-2, Col 3 lines 17-21, 57-61	1, 7-17, 19-21, 23, 40, 43-44 & 46-47
X	US 3668949 A (WALKER) 13 June 1972 Figs 1-3, Col 2 lines 56-65, Col 3 line 48.	1 & 40
X	US 2014/0096651 A1 (RANGELAND DRILLING AUTOMATION INC.) 10 April 2014 Figs 10-11,Para [0040]	40-42, 45 & 47

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2018/050755**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
US 8235104 B1	07 August 2012	US 8235104 B1	07 Aug 2012
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End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.