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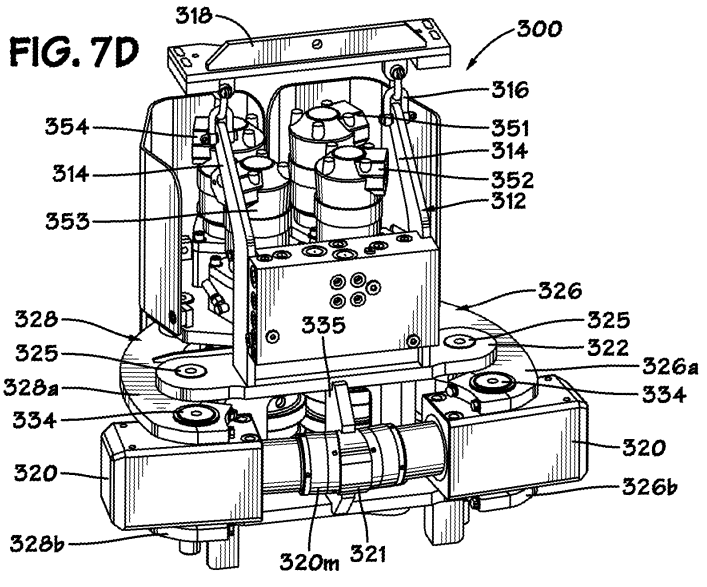
(54) Spinner apparatus

(57) A spinner apparatus for facilitating connection and disconnection of threaded tubulars, the spinner apparatus comprising a first roller (361) on a first arm (326) and a second roller (363) on a second arm (328), said first and second arms (326,328) movably linked to a body (312) **characterised in that**, a first and second piston and cylinders (320) are arranged between said first and second arms, wherein ends (320f) of said piston and cylinders meeting at a free-floating union (321), in use said piston and cylinders are activated to move said arms to move said first and second rollers into and out of engagement with a tubular to be spun.



EP 2 287 437 A1

Description

[0001] The present invention is directed to spinner apparatus for connecting and disconnecting tubular members (for example casing, tubing, pipe, or drill pipe) and, in certain particular aspects to spinners, spinning wrenches, spinning tongs, iron roughnecks and methods of their use.

[0002] Drill pipe introduced into a well during oil and gas wellbore drilling is assembled in lengths joined with threaded joints. As the pipe is fed into a well, the sections of pipe are threaded together. When removing pipe, the threaded sections are disconnected and the sections of pipe stored. Inserting and removing the sections of drill pipe into a well is called "tripping." Threading and unthreading sections of pipe on tripping in and out of the well can be a difficult and cumbersome job. To make up the threads (or unscrew or break the threads) requires relatively high torque (rotational force). "Spinning" the pipe section after breaking (or before making up) the joints requires much less torque and is accomplished at much higher speed. Tightening and breaking joints requires a wrench to be tightly clamped on the pipe. In the early days, tightening and breaking was done manually with hand wrenches (more recently with power assisted wrenches). Spinning is a separate operation, long ago and in some places today done by wrapping a chain around a pipe and pulling the chain with a winch. Today power tong wrenches are used. Certain of these tongs have an open slot for pipe insertion and hydraulically powered clamps to grip the pipe. The pipe is rotated by a motor mechanically attached to the wrench. Such wrenches can develop high torque and work very well for making and breaking thread joints. Usually these wrenches work in combination with a backup wrench that holds the other section of threaded joint. A gripping device known as a spider in a floor of an oil or gas platform is primarily used to prevent the string of tubulars from falling down the well. However, in some circumstances, the spider can be used as a backup to react against the torque of a wrench making or breaking a joint and spinning. The wrench is removed after making or breaking the threads, and a spinner (or top drive unit) spins out the threaded joint. Such wrenches are exemplified by the description in U.S. Patent 4,348,920. Some types of these wrenches lack the capacity of handling different diameter pipe without changing pipe clamps. Since drill pipe, couplings, tapered pipe and joints are of different diameters, some wrenches handle widely varying diameters from about 9cm to about 25cm (3.5 to about 9.5 inches) in diameter. It is a great advantage for a wrench to be able to accommodate a range of diameters without having to change the clamps. U.S. Patent 4,979,356 is an example of a power tong wrench which can not only accommodate the desired range of pipe diameters, but is also capable of making and breaking pipe sections and spinning the pipe. The ability to do both with the same wrench is highly desirable since it accomplishes with one connection step what previously required two or more connections with a wrench and spinner.

[0003] "Iron roughnecks," which combine a torque wrench and a spinning wrench, have been used for connecting and disconnecting various tubulars, for example drilling components, such as drill pipe, in running a string of drill pipe or other pipe into or out of a well. The prior art includes a variety of iron roughnecks; see for example U.S. Patents 4,023,449; 4,348,920; 4,765,401; 6,776,070, all of which are incorporated herein by reference in their entirety.

[0004] Various prior art iron roughnecks have a spinning wrench and a torque wrench mounted together on a carriage. For making or breaking threaded connections between two tubulars, for example joints of drill pipe, certain iron roughnecks have a torque wrench with two jaw levels. An upper jaw of the torque wrench is used to clamp onto a portion of an upper tubular, and a lower jaw clamps onto a portion of a lower tubular, for example upper and lower threadedly connected pieces of drill pipe. After clamping onto a tubular, the upper and lower jaws are turned relative to each other to break or make a connection between the upper and lower tubulars. A spinning wrench, mounted on the carriage above the torque wrench, engages the upper tubular and spins it until it is disconnected from the lower tubular (or in a connection operation, spins two tubulars together prior to final make-up by the torque wrench).

[0005] Certain iron roughnecks are mounted for movement from a wellbore center to a retracted position which does not interfere with or block performance of other operations relative to the well and rotating or driving apparatuses. Such a prior art system can be used for making and breaking joints in a main string or for connecting to or disconnecting from a tubular section located apart from a wellbore center, for example in a mousehole (or rathole) at a side of a well.

[0006] Certain prior art iron roughneck systems include a carriage for rolling on the surface of the rig floor along a predetermined path. In certain prior art systems a spinner and torque wrench are mounted for upward and downward movement relative to a carriage, for proper engagement with tubulars, and for tilting movement between a position in which their axis extends directly vertically for engagement with a vertical well pipe and a position in which the axis of the spinner and torque wrench is disposed at a slight angle to true vertical to engage and act against a pipe in an inclined mousehole. In certain prior art systems, a spinner is movable vertically with respect to a torque wrench.

[0007] The prior art discloses a variety of tongs and spinners for use in wellbore operations, for example, but not limited to, as disclosed in and referred to in U.S. Patents 6,684,737; 6,971,283; 5,660,087; 5,161,438; 5,159,860; 5,842,390; 5,245,877; 5,259,275; 5,390,568; 4,446,761; 4,346,629; 4,221,269; 3,892,148; 4,023,449; 5,044,232; 5,081,888; 5,167,173; 5,207,128; 5,409,280; 5,868,045; 6,966,385; 6,138,529; 4,082,017; 6,082,224;

6,213,216; 6,330,911; 6,668,684; 6,752,044; 6,318,214; and 6,142,041 (all said patents incorporated fully herein for all purposes).

[0008] There is a need, recognized by the present inventors, for an efficient tubular spinning system which can effectively handle a range of tubulars with varying diameters.

[0009] In accordance with the present invention, there is provided a spinner apparatus for facilitating connection and disconnection of threaded tubulars, the spinner apparatus comprising a first roller on a first arm and a second roller on a second arm, the first and second arms movably linked to a body characterised in that, a first and second piston and cylinders are arranged between the first and second arms, wherein ends of the piston and cylinders meeting at a free-floating union, in use the piston and cylinders are activated to move the arms to move the first and second rollers into and out of engagement with a tubular to be spun. The free-floating union is preferably guided by a guide, which may be attached to the body. The body advantageously comprises a frame. Advantageously, the end comprises a hemispherical bearing each first end mounted on a first, and each second end mounted in a second hemispherical bearing so that each of the powered cylinder apparatus is substantially isolated from lateral loading.

[0010] The present invention also provides an apparatus for facilitating connection and disconnection of threaded tubulars, the apparatus comprising a spinner apparatus of the invention and a torque apparatus for torquing a connection between the threaded tubulars. Preferably, the spinner apparatus and the torque apparatus are fixed together on a upright beam.

[0011] The present invention also provides a method for facilitating connection and disconnection of threaded tubulars, the method comprising the steps of activating a spinner apparatus to move at least first and second rollers into contact with the tubular, the first roller comprising at least one projection and the second roller comprising at least one recess, the projection locating in at least part of the recess of the second roller and rotating at least one of the first and second rollers to spin at least one of the threaded tubulars.

[0012] The present invention, in certain embodiments, provides an apparatus for rotating a tubular, the apparatus including a plurality of adjacent driven rollers which can be interlaced to accommodate tubulars with a range of diameters. Such an apparatus may have a motor for each set of rollers. In certain aspects, this configuration of motors with interlacing rollers permits axes of adjacent motors to be relatively closer resulting in a more compact tool.

[0013] The interlacing facilitates maintenance of spacing apart of the rollers around a tubular and helps prevent the rollers from slipping on a tubular or from spitting a tubular out the front of the system. The spinner apparatus can be made more compact, whilst maintaining the ability to spin a range of diameters of tubulars.

[0014] The present application is divided from European Patent Publication No. 2 118 433, which relates to a spinner apparatus for facilitating connection and disconnection of threaded tubulars, the spinner apparatus comprising a first roller and a second roller characterised in that the first roller has a projection and the second roller has a recess, when in use, at least part of the projection is located within at least part of the recess. In use, the projection contacts the tubular, which may be provided with a contact material such as non-marking material which increases the surface energy between the roller and the tubular to reduce the chance of slippage therebetween. The first and second rollers may each be generally cylindrical having a circular cross-section, the projection projecting around the circumference thereof. The projection may be a continuous ring around the roller, preferably forming a ring of constant diameter and most preferably concentric with the roller. The projection may be formed by forming a recess in the roller. The recess may be formed by milling material from the roller. The projection may have an outer coating suitable for gripping a tubular to reduce slippage therebetween to reduce the possibility of marking the tubular and increase the speed of spinning. The outer most point of the projection preferably does not touch the base of the recess, leaving a small gap therebetween. Advantageously, the outer most point of the projection touches the base of the recess. Preferably, each roller has a surface area and the rollers are movable to contact the tubular with each roller having a similar amount of surface area in contact with the tubular. Advantageously, the spinning apparatus has a central axis and the rollers are positioned parallel to the central axis and are movable at a right angle to the central axis.

[0015] The second roller may comprise at least two projections, the recess formed therebetween. Preferably, the first roller comprises at least two recesses and the at least one projection formed between the at least two recesses. Advantageously, the at least two projections of the first roller interleave with the at least one projection of the second roller. Preferably, the diameter of the first roller (61,361) is equal to the diameter of the second roller.

[0016] Preferably, the first roller comprises a plurality of projections and the second roller comprises a plurality of projections, the plurality of projections of the first roller interleave with the plurality of projections of the second roller.

[0017] Advantageously, the first roller is arranged on a bogey. Preferably, the bogey is a passive bogey, in that it is free-floating, preferably, about a pin and most preferably free-floating about the pin for ten degrees of movement. Preferably, the bogey comprises a further roller. Advantageously, the further roller has at least one projection interleaving with the at least one projection of the first roller. Preferably, the bogey is pivotally arranged on an arm. Preferably, the arm is movable by activation of a piston and cylinder to move the bogey towards and

away from a tubular to be spun. Advantageously, the second roller is arranged on a bogey. Preferably, the bogey is an active bogey. The bogey is directionally controllable, preferably by a pin arranged in a slot. Advantageously, the slot controls the angle of the bogey. Preferably, the slot has a sharp kink. Advantageously, the bogey comprises a further roller (62,362). Preferably, the further roller has at least one projection interleaving with the at least one projection of the first roller. Advantageously, the bogey is pivotally arranged on an arm.

[0018] Preferably, the arm is movable on a piston and cylinder. Preferably, the spinner apparatus further comprises a further piston and cylinder, the further piston and cylinder linked to the piston and cylinder with a flexible union. Preferably, the flexible union comprises at least one of a ball and socket and the piston assembly comprises the other of the ball and socket. Advantageously, the arm is linked to a body, the free-floating union movable in relation to the body.

[0019] Advantageously, the first and second roller are driven by motors. Preferably, each rotor is driven be its own motor.

[0020] Preferably, the recess is a groove, may be a continuous groove about the perimeter of the roller.

[0021] For a better understanding of the present invention, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1A is a front perspective view of a spinner apparatus in accordance with the present invention;
Figure 1B is a rear perspective view of the spinner apparatus as shown in Figure 1A;
Figure 1C is a perspective view of a roller of the spinner apparatus shown in Figure 1A;
Figure 1D is a front view of the spinner apparatus as shown in Figure 1A;
Figure 1E is a side view of the spinner apparatus as shown in Figure 1A;
Figure 1F is a cross-section view along line 1E-1E of Figure 1C;
Figure 1G is a top view of part of the spinner apparatus shown in Figure 1A in a first step in a method of operation of the invention, with parts cutaway;
Figure 1H is a top view of part of the spinner apparatus shown in Figure 1A, in a seond step in a method of operation of the invention with parts cutaway;
Figure 2A is a perspective view of a main frame of the spinner apparatus as shown in Figure 1A;
Figure 2B is a perspective view of a left hand bogey of the spinner apparatus as shown in Figure 1A;
Figure 2C is a perspective view of a right hand bogey of the spinner apparatus as shown in Figure 1A;
Figure 2D is a perspective view of a torque reaction link of the spinner apparatus as shown in Figure 1A;
Figure 2E is a perspective view of a right hand arm of the spinner apparatus as shown in Figure 1A;
Figure 2F is a perspective view of a bogey limiter for use in the spinner apparatus as shown in Figure 1A;
Figure 3A is a perspective view of part of the spinner apparatus as shown in Figure 1A;
Figure 3B is a perspective view of part of the spinner apparatus as shown in Figure 1A;
Figure 3C is a perspective view of part of the spinner apparatus as shown in Figure 1A;
Figure 3D is a perspective view of part of the spinner apparatus as shown in Figure 1A;
Figure 3E is a perspective view of part of the spinner apparatus as shown in Figure 1A;
Figure 3F is a perspective view of part of the spinner apparatus as shown in Figure 1A;
Figure 4A is a perspective view of part of the spinner apparatus as shown in Figure 1A;
Figure 4B is a perspective view of part of the spinner apparatus as shown in Figure 1A;
Figure 5 is a side schematic view of an apparatus in accordance with the present invention;
Figure 6 is a side schematic view of an apparatus in accordance with the present invention;
Figure 7A is a front perspective view of a spinner apparatus in accordance with the present invention;
Figure 7B is a top view of the spinner apparatus as shown in Figure 7A;
Figure 7C is a rear perspective view of the spinner apparatus as shown in Figure 7A in a first step in a method of operation of the invention;
Figure 7D is a rear perspective view of the spinner apparatus as shown in Figure 7A in a second step in a method of operation of the invention;
Figure 7E is a front perspective view of the spinner apparatus as shown in Figure 7A in the second step in the method of operation of the invention;
Figure 7F is a bottom perspective view of the spinner apparatus as shown in Figure 7E;
Figure 7G is a top view of the spinner apparatus as shown in Figure 7E, with parts cut away;
Figure 7H is a top cross-section view of the spinner apparatus as shown in Figure 7E;
Figure 8A is a perspective view of part of a clamp apparatus of the spinner apparatus as shown in Figure 7A;
Figure 8B is a top view of the part shown in Figure 8A;
Figure 8C is a top view of part of the clamp apparatus shown in Figure 8A;
Figure 8D is a cross-section view along line 8D-8D of Figure 8B in a first step in a method of operation of the invention;
Figure 8E is a perspective view of part of the clamp apparatus shown in Figure 8A with hidden parts shown in dashed line, the clamp apparatus shown secured to a frame centre mount, shown in a second step in a method of operation of the invention;
Figure 8F is a side view of the clamp apparatus shown in Figure 8E, the clamp apparatus shown secured to a frame centre mount;
Figure 8G is a cross-section view of the clamp apparatus shown in Figure 8F, the clamp apparatus

shown secured to a frame centre mount;

Figure 8H is a top view of the clamp apparatus shown in Figure 8A with hidden parts shown in dashed line, the clamp apparatus shown secured to a frame centre mount;

Figure 8I is a cross-section view of the clamp apparatus as shown in Figure 8H; and

Figure 8J is a cross-section view of the clamp apparatus as shown in Figure 8I.

Figures 1A to 1H show a spinner apparatus 10 in accordance with the present invention which has a main frame 12 with a crossmember 13 connecting two spaced-apart upright beams 14 releasably connected by chains 16 to a hanging bracket 18. Clamping cylinder assemblies 20 disposed between frame members or plates 22, 24 move arms 26, 28 which, in turn, move bogeys 30, 32 to move rollers mounted thereon (described below) into contact with a tubular to be rotated. Tubulars can include pipe, drill pipe, tubing, liner and casing. Each arm 26, 28 includes a top plate (26a, 28a) and a bottom plate (26b, 28b). It is within the scope of the present invention for any part or piece or component that includes multiple items, for example (but not limited to) a component with multiple plates, to instead be made as a single integral component, for example a casting. Thus, for example, a part with multiple plates connected together, for example welded together, may be a single manufactured casting.

[0022] Chains or cables connected to torque reaction links 34, 36 releasably connect the spinner apparatus 10 to a support column or other structure (see also link 34, Figure 2D). Optional covers 41 - 44 shield motors 51 - 54 which rotate rollers 61 - 64. Referring to Figure 6, the arms 26, 28 are pivotably secured to trunnions 23, 25 of trunnion blocks 27, 29. An end 31, 33 of each cylinder assembly 20 is rotatably secured by a pin 35 to a cylinder mount 37. The pin 35 is arranged substantially vertical, such that each end 31, 33 of the cylinder assembly is rotatable in a substantially horizontal plane.

[0023] The plates 22, 24 have slots 21a, 21b (respectively - see Figures 1A, 2A) in which a pin 39 moves. The pin 39 extends through a hole 73 in an upper plate 30a (shown in Figure 2B), and a hole 74 in a lower plate 30b of the left hand bogey 30 to secure the left hand bogey 30 to the plates 22, 24. The slots 21a, 21b limit movement of the pin 39 thereby limiting movement of the left hand bogey 30. This also limits the movement of the rollers 63, 64 rotatably connected to the left hand bogey 30 (as described in detail below). Cover mount blocks 49 on the plate 30a provide structure to which the cover 43 is secured. The cover 44 is secured to the plates 26a, 26b. The left hand bogey 32 pivots about a pin 48. The pin 48 extends through holes 88 in the plates 26a, 26b.

[0024] The right hand bogey 32 is "free floating" in the sense that it is not slaved to anything and can pivot, for example up to 10 degrees with respect to the center line of the spinner apparatus 10. The right hand bogey 32 is movable freely about a pin 45. The right hand bogey 32 has a top plate 32a and a bottom plate 32b. The pin 45 passes through holes 71, 72 (see Figure 2C) to secure the right hand bogey 32 to the plates 22, 24. The cover 42 is secured to mount blocks 75. The cover 42 is secured to the arms 26, 28.

[0025] The motors 53, 54 are on top of the left hand bogey 32 and the motors 51, 52 are on top of the right hand bogey 30. As shown in dotted line in Figure 1D a flow divider 170 receives power fluid (for example hydraulic fluid under pressure from a rig source). Power fluid from the flow divider 170 is provided via connections 172 to the motors 51 - 54 and to the clamping cylinders 20. As shown the motors 51 - 54 are located above corresponding rollers; but it is within the scope of the present invention to locate the motors at any convenient location whether above the rollers or not.

[0026] The roller 62 is mounted with portions in the holes 76a, 76b (see Figure 2C); the roller 61 is mounted with portions in the holes 77a, 77b; the roller 64 is mounted with portions in the holes 78a, 78b (see Figure 2B); and the roller 63 is mounted with portions in the holes 79a, 79b.

[0027] The pin 47 extends through a hole 94 in the plate 26a, through a hole (not shown) in the plate 26b and through a hole 87 in the plate 22 and a hole 88 in the plate 24 to pivotably connect the arm 26 to the plates 22, 24. The pin 46 extends through a hole 89 in the arm 28, through holes 85, 86 in the plates 22, 24 and through a lower hole 101 in the plate 28b to pivotably pin the arm 28 to the plates 22, 24.

[0028] Figure 2E shows the arm 28 (the arm 26 is a mirror image of the arm 28).

[0029] Figure 2F shows a bogey limiter 110 (see also in Figure 1A) which prevents the bogey 32 from rotating more than a certain amount, for example within a 10 degree range of motion. In certain aspects, the bogey limiter is deleted.

[0030] Figures 3A to 3F show a roller 120 and associated parts. The roller 120 may be any of the rollers 61, 62, 63, 64 (or any roller herein). The roller 120 has a body 122 with a plurality of spaced-apart projections 124 - 127. Optionally, the projections have a series of spaced-apart grooves 128 or 129. It is believed that the projections with these grooves will function similarly to the treads of a tire on a wet surface and a surface film on the projections will be forced into the grooves thereby increasing friction between the rollers and a tubular to be rotated.

[0031] The roller body 122 has a recess 139 and a slot 131 which receives a corresponding member 132 (into slot 131) and a corresponding end (into recess 139) of a drive spindle 133. The drive spindle 133 passes through an upper bearing housing 134. The drive spindle 133 is connected to a drive shaft of a motor (for example a motor 51 - 54). The motor rotates the drive spindle 133 which in turn rotates the roller 120. The motor can be bolted to the upper bearing housing 134.

[0032] The roller 120 rotates on a lower spindle 135 which rotates in a lower bearing housing 136 whose bottom is covered with a cover 137. The upper bearing housing 134 and the lower bearing housing 136 are connected to a corresponding bogey (see any bogey in the spinner apparatus 10 shown in Figure 1A).

[0033] Between the projections 124 - 127 are a series of spaced-apart areas 141, 142, and 143 and an area 144 beneath the lowermost projection 127. Projections on an adjacent roller like the projections 124 - 127 can be received in and fit within the areas 141 - 144 as two rollers are moved toward each other. The areas 141 - 144 are recessed with respect to the outer surfaces of the projections 124 - 127. It is within the scope of the present invention for a first roller to have one projection (or at least one projection) and an adjacent roller to have one groove (or at least one groove), with the one projection projecting into and received within the one groove so that the two rollers are interlaced (or for the at least one projection to project into the at least one groove or for each of a series of spaced-apart projections on a first roller to project into and be received within a corresponding groove of a series of spaced apart grooves on a second adjacent roller. Also, a spinning wrench apparatus in accordance with the present invention can have two pairs of such rollers, the two pairs movable to contact each other so that a first roller of each pair interlaces with each other and a second roller of each pair interlaces with each other.

[0034] Figures 1F to 1H illustrate movement of the arms 26, 28; the bogeys 30, 32; and the rollers 61 - 64 with respect to the frame 12 and with respect to a tubular T (see Figure 1H).

[0035] In Figure 1F and 1G the pin 39 is at one end 21c of the slots 21a, 21b (end 21c of the slot 21a) which positions the rollers 63, 64 at an angle to a central axis A of the spinner apparatus 10 (for example in one particular aspect four degrees). The clamping cylinders 20 have not been actuated to move the arms 26, 28, the bogeys 30, 32 and the rollers 61 - 64 inwardly toward the tubular T.

[0036] As shown in Figure 1H, the clamping cylinders 20 have been actuated, pivoting the arms 26, 28 to move the bogeys 30, 32 and the rollers 61 - 64 moving the rollers 61, 62 toward the rollers 63, 64. The rollers 61, 63 are interlaced with each other with the projections on one roller received in the valleys of the other roller. The rollers 62, 64 are interlaced with each other with the projections on one roller received in the valleys of the other roller. As shown in Figure 1F, the rollers 61, 62 are mounted so that they are interlaced with each other with the projections of one roller received in the valleys of the other roller; as are the rollers 63, 64. All of the rollers contact the tubular T and, when rotated, the rollers rotate the tubular T. The interlacing facilitates maintenance of spacing apart of the rollers around a tubular and helps prevent the rollers from slipping on a tubular or from spitting a tubular out the front of the system.

[0037] As shown in Figure 1H, the pin 39 has moved to an opposite end 21d of the slots 21a, 21b guiding the orientation of the bogey 30 and rollers 63, 64 at a desired location. The available stroke of the cylinders stops movement of the bogey 30 at a "clamp off" position or "clamp on without pipe" position. As shown in Figure 1F, an axis B of the rollers 63, 64 is parallel to the axis A insuring the rollers are maintained horizontal to the central axis of the system at all times. In one aspect, the bogey pivot pins 45, 48 each will move through an arc while a theoretical pipe center remains in position relative to the system. This results in a small variable forward/rearward offset between the bogey pivot pins 45, 48 and the theoretical pipe center. This offset can be reduced or eliminated by allowing the bogies to angle slightly either side of perpendicular to centreline. This angle is governed by the shape of the guide slot (slots 21a,21b) acting with the pin 39 of the bogey 30. The slots 21a, 21b are shaped to "open up" the angle of the bogey 30 in a "clamp off" position (when the bogies are moved away from the theoretical pipe center). The use of the arms 26, 28 help maintain alignment of the rollers about the centre line, so that any diameter tubular within the range of diameters can be handled .

[0038] As shown in Figure 1H, each roller 61 - 64 has an equal amount of contact with the tubular T so that static clamp forces are applied equally by all four rollers, including those on the right hand bogey 32 (since the right hand bogey floats free, the left hand bogey allows all rollers to contact a tubular with equal force). During spinning, rollers diagonal to each other have equal clamp force, but the leading and trailing rollers on each bogey have different contact force onto a pipe.

[0039] Figures 4A and 4B are perspective views of the cover 41.

[0040] Figure 5 shows an apparatus 200 in accordance with the present invention for connecting and disconnecting tubulars TB and TL while a spinner apparatus 210 (shown schematically) in accordance with the present invention spins the tubular TB a wrench 202 (for example any suitable wrench or tong) holds the tubular TL. A hanger 204 permits connection of the spinner apparatus 210 to another member or structure. The wrench 202 is connected to the spinner apparatus 210 with a connection 206 and a spring 208. The spinner apparatus 210 may include any spinner apparatus in accordance with the present invention, including but not limited to, that of Figure 1A or of Figure 7A.

[0041] Figure 6 show an apparatus 10 in accordance with the present invention (like systems disclosed in co-owned U.S. Patents 7,185,547 and 7,062,991 incorporated fully herein for all purposes) which has a carriage 25 which is movably connected for up/down vertical movement to a column 14 and which can also translate horizontally on a rig floor RF for movement toward and away from a drill pipe D of a drill string DS in a well W. Support arms 22, 24 (two each) are pivotably connected at one end to a base 23 of the carriage 20. Optionally,

only one support arm is used or two arms in parallel are used. A connector 21 is removably emplaceable in a socket 29 to mount the system on the rig.

[0042] A torque wrench 11 (for example as disclosed in co-owned U.S. patents 7,185,547 and 7,062,991, or in any prior art cited therein) and a spinner apparatus 10 (any in accordance with the present invention) are connected to the carriage 20 and are movable by a power mechanism PM toward and away from the column 14 by moving the support arms 22, 24. Optionally, a known torque wrench may be used, for example instead of the torque wrench 100. The spinner is movable up and down on the spin wrench carriage 25 toward and away from the torque wrench. A control console CS for the spinner apparatus 10 is shown schematically in Figure 1B. Optionally, the console CS communicates by wire or wirelessly with the torque wrench 100 and/or the spinner apparatus 10 and/or the control console CS is located remotely from it.

[0043] Figures 7A to 7H show a spinner apparatus 300 in accordance with the present invention which has a frame 312 with a crossmember 313 connecting two spaced-apart beams 314 releasably connected by connectors 316 to a hanging bracket 318. Clamping cylinder assemblies 320 disposed between frame members 322, 324 are connected to and selectively move arms 326, 328 which, in turn, move bogeys 330, 332 to move rollers mounted thereon (described below) into contact with a tubular to be rotated. Cylinder yoke bushings 334 of the clamping cylinder assemblies 320 received and held in corresponding holes 326h, 328h in plates 326a, 326b, 328a, 328b of the arms 32b, 328, respectively, to pivotably connect the arms 326, 328 to the clamping cylinder assemblies 320. A center member 321 connected to both clamping cylinder assemblies 320 is secured to a frame center mount 335. It is within the scope of the present invention to use a single cylinder assembly instead of the two cylinder assemblies 320.

[0044] Each arm 326, 328 includes a top plate (326a, 328a) and a bottom plate 326b, 328b). These plates 326a, 326b, 328a, 328b are pivotably mounted to and between the frame members 322, 324 with pins 325.

[0045] Covers 341 - 344 shield motors 351 - 354 and rollers 361 - 364 which are rotated by the motors 351 - 354. The bogeys 330, 332 are pivotably connected to the arms.

[0046] The plates 322, 324 have slots 322a, 324a respectively in which a pin 339 moves. The pin 339 extends through a hole 373 in an upper plate 332a and a hole 374 in a lower plate 332b of the bogey 332. The slots 332a, 332b guide movement of the pin 339 thereby guiding movement of the bogey 332. This also guides the movement of the rollers 363, 364 rotatably connected to the bogey 332 (as described in detail below). Cover mount blocks 349 on the plate 332a provide structure to which the cover 343 is secured. The cover 344 is secured to the arm 328. The bogey 332 pivots about a pin 348. The pin 348 extends through holes 388 in the plates 328a, 328b.

[0047] The bogey 330 is "free floating"" in the sense that it is not slaved to anything and can pivot with respect to the arm 326 and can pivot, for example up to 10 degrees, with respect to the center line of the system. The bogey 330 freely pivots about a pin 345. The bogey 330 has a top plate 330a and a bottom plate 330b. The pin 345 passes through holes 371, 372 to secure the bogey 330 to the arm 326. The cover 341 is secured to mount blocks 375. The cover 342 is secured to the arm 326.

[0048] The motors 353, 354 are on top of the bogey 332; and the motors 351, 352 are mounted on top of the bogey 330. A flow divider 370 receives power fluid (for example hydraulic fluid under pressure from a rig source). Power fluid from the flow divider 370 is provided via connections 372 to the motors 351 - 354. Power fluid from the flow divider 370 is provided to the clamping cylinder assemblies 320 via connections 374. As shown the motors 351 - 354 are located above corresponding rollers; but it is within the scope of the present invention to locate the motors (or a single motor or two motors) at any convenient location whether above the rollers or not, below the rollers, or adjacent the rollers; or to use a single motor for driving multiple rollers, for example, but not limited to, a first motor for driving the rollers on one side, for example via appropriate gearing, and a second motor for driving the rollers on the other side. One motor can drive multiple rollers, for example via gearing, in synchronization.

[0049] The roller 362 is mounted with portions in the holes like holes 76a, 76b (see Figure 2C); the roller 361 is mounted with portions in the holes like 77a, 77b (see Figure 2C); the roller 364 is mounted with portions in the holes like holes 78a, 78b (see Figure 2B); and the roller 63 is mounted with portions in the holes 79a, 79b.

[0050] A pin 347 extends through holes in the plates 322, 324 and through holes in the plates 326a, 326b to pivotably connect the arm 326 to the plates 322, 324. A pin 346 extends through holes in the plates 328a, 328b and through holes in the plates 322, 324 to pivotably connect the arm 328 to the plates 322, 324.

[0051] The rollers 361 - 364 may be like any roller disclosed herein in accordance with the present invention (for example, but not limited to, the rollers shown in Figures 1A and 3C). For example, the roller 363 has a plurality of spaced-apart projections 377 and a plurality of spaced-apart recesses 379. Any of the rollers 361 - 364 may have grooves like the grooves 128 or 129 described above. The rollers 361 - 364 may have the associated parts as shown in Figures 3A - 3F.

[0052] As shown in Figures 7E to 7H, the clamping cylinder apparatuses have been activated to move the arms 326, 328, bogeys 330, 332, and rollers 361 - 364 inwardly to clamp a tubular T for spinning. The pin 339 has guided the rotation of the bogey 332 about the pivot pin 348. The pin 337 prevents the bogey from trying to rotate in the opposite direction to the rollers 363 and 364. The pin 339 slides along the slots 332a, 324a as the

clamp cylinders are operated, but it is the end stroke of the clamp cylinders and not the slots that limit the extremes of clamping movement. The bogey 332 can be considered as the "master" while the bogey 330 is the "slave". The bogey 332 aligns the spinner unit precisely with the tubular centerline irrespective of the tubular diameter. The bogey 330 then passively self aligns as clamp force is applied.

[0053] The rollers 361 - 364 are interlaced as shown in Figures 7E - 7H. The roller 361 interlaces with the roller 362 and with the roller 363. The roller 362 also interlaces with the roller 364. The roller 364 interlaces with the rollers 362 and 363.

[0054] In certain aspects, interlacing of rollers works like treads on a tire; i.e. contact area is reduced and local contact pressure is increased, while surface contamination tends to be pressed into the grooves.

[0055] Any suitable powered cylinder assemblies may be used for the clamping cylinder assemblies 320. In one particular aspect, as shown in Figures 7H and 8A to 8D, each clamping cylinder assembly 320 has a housing 320a within which a piston 320p is movably mounted. To accommodate the pivoting of an arm 326 or arm 328 to which the housing 320a is connected, a pivotable connector 320c connects the piston 320p to the center member 321.

[0056] The connector 320c has a first member 320d with a ball end 320e and a second member 320f with a ball end 320g. A pin 320h pins an end 320i of the second member 320f to the first member 320d. The ball end 320e of the first member is movable in a first spherical bearing 320j connected to the piston 320p. The ball end 320g is movable in a second spherical bearing 320k connected to the center member 321. The members 320d, 320f act like a rod connected to the piston 320p. Thus the housing 320a is pivotable with respect to the housing center member 321, allowing the cylinder to accommodate a certain amount of both angular and parallel misalignment without transferring significant loads to the cylinder slides and seals. Thus the fixed cylinders using the hemispherical bearings 320e, 320g are substantially or almost totally isolated from side loads (for example loads perpendicular to a longitudinal axis of the members 320d, 320f which could create a moment which would be resisted by sliding surfaces of the piston). In certain aspects such side or lateral loads can be the result of wear of moving parts; production or installation tolerances; mechanical deflection under loading; or incorrect operation.

[0057] A seal 320m (for example, but not limited to, a rubber bellows apparatus) seals the housing-320a-center-mount-321 interface and prevents moisture and contamination from reaching the connector system and ball joints. A retaining ring 321a screwed onto the center member 321 locks the ball end of the connector to the center member 321 to retain the spherical bearing 320k and resists cylinder retract loads when pressure is applied to the return side of the piston (pressure in the volume space 320x).

[0058] Pressurized oil from the flow divider 370 enters a cylinder retract port 320w to move the housing inwardly to unclamp the rollers from a tubular. The rollers are applied by supplying pressurized oil from the flow divider 370 to the rear of the piston via one of the two cylinder extend ports 320r. Channels 320s within the body of the cylinder lead this oil to the rear of the piston. Oil within the space 320x is pressed out of the cylinder retract port as the cylinder extends.

Claims

1. A spinner apparatus for facilitating connection and disconnection of threaded tubulars, the spinner apparatus comprising a first roller (361) on a first arm (326) and a second roller (363) on a second arm (328), said first and second arms (326,328) movably linked to a body (312) **characterised in that**, a first and second piston and cylinders (320) are arranged between said first and second arms, wherein ends (320f) of said piston and cylinders meeting at a free-floating union (321), in use said piston and cylinders are activated to move said arms to move said first and second rollers into and out of engagement with a tubular to be spun.

2. A spinner apparatus as claimed in Claim 1, wherein said free-floating union (321) is guided by a guide (335).

3. A spinner apparatus as claimed in Claim 2, wherein said guide (335) is attached to said body (312).

4. A spinner apparatus as claimed in any preceding claim 3, wherein said body (312) comprises a frame (322,324).

5. A spinner apparatus as claimed in any of Claims 1 to 4, wherein said free-floating union (321) comprises at least one of a ball (320g) and socket (320k) and said piston assembly comprises the other of the ball (320g) and socket (320k).

6. A spinner apparatus as claimed in any of Claims 1 to 4, wherein said ends (320f) of said piston comprise a hemispherical bearing (320e,320g,320k) said end of said first piston mounted on a first hemispherical bearing (320e,320g,320k), and said end of said second piston mounted in a second hemispherical bearing so that each of the powered cylinder apparatus is substantially isolated from lateral loading.

7. A spinner apparatus as claimed in any preceding claim, wherein said first and second rollers (361,363) are driven by at least one motor.

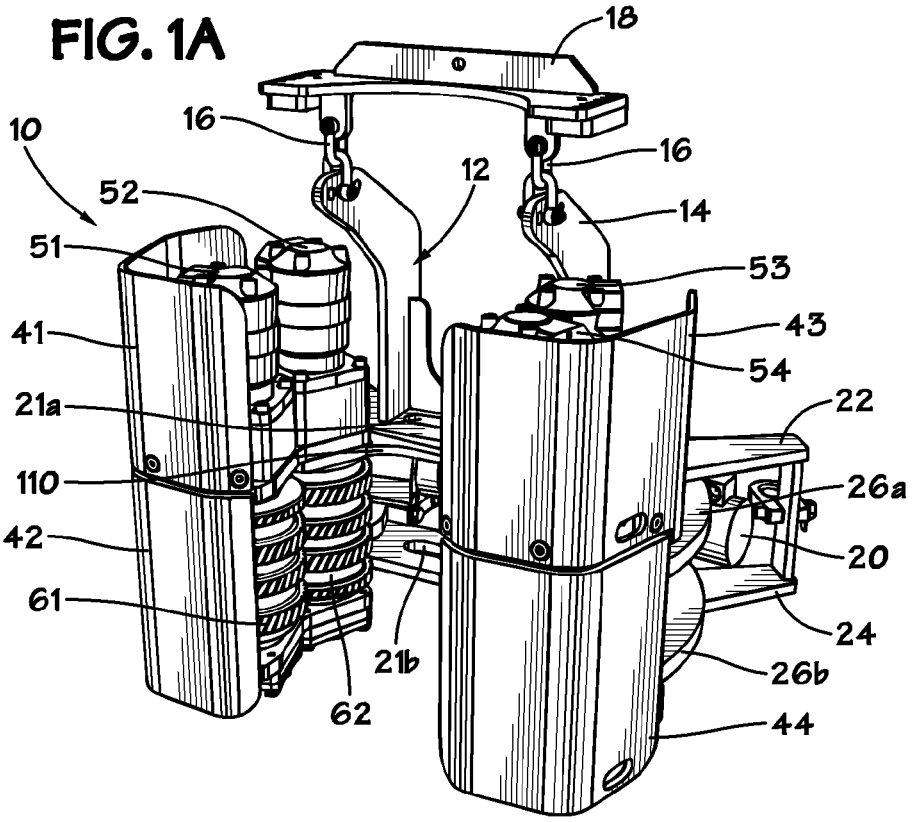
8. A spinner apparatus as claimed in any preceding

claim, wherein said first and second rollers (361,363) each have an adjacent driven roller (361,363) which interlaces to accommodate tubulars with a range of diameters.

9. An apparatus for facilitating connection and disconnection of threaded tubulars, the apparatus comprising a spinning apparatus as claimed in any preceding claim and a torque apparatus for torquing a connection between the threaded tubulars.

10. A method for facilitating connection and disconnection of threaded tubulars, the method comprising the steps of activating a spinner apparatus in accordance with any preceding claim, to move at least first and second rollers into contact with said tubular to spin at least one of said threaded tubulars.

FIG. 1A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43
54
21a
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110
26a
42
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61
24
21b
26b
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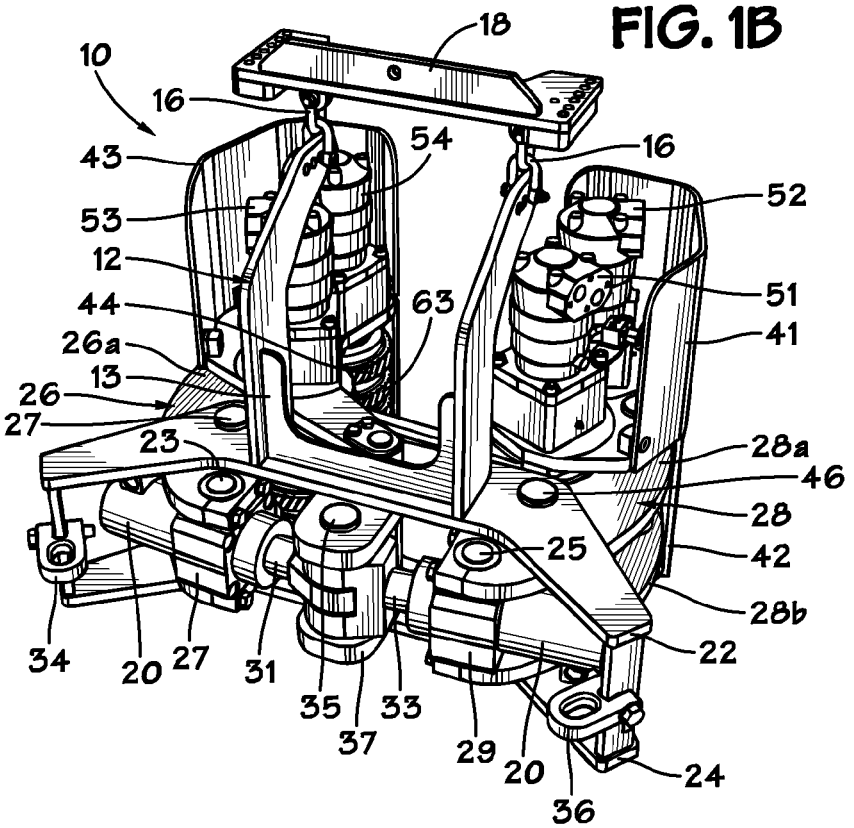
44

FIG. 1B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28a
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28b
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FIG. 1C

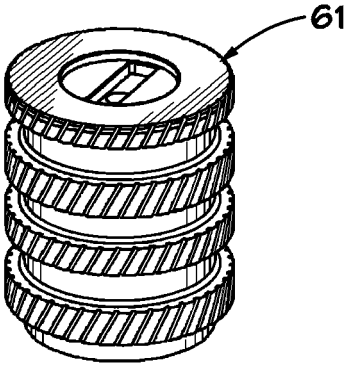
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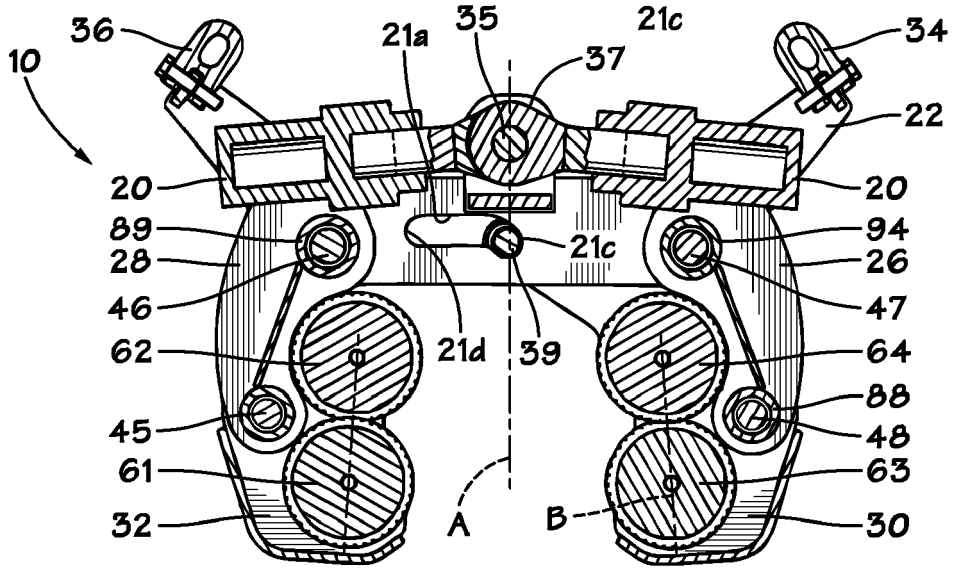
FIG. 1F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21a
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37
21c
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20
20
89
94
28
21c
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21d
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32
A
B
30

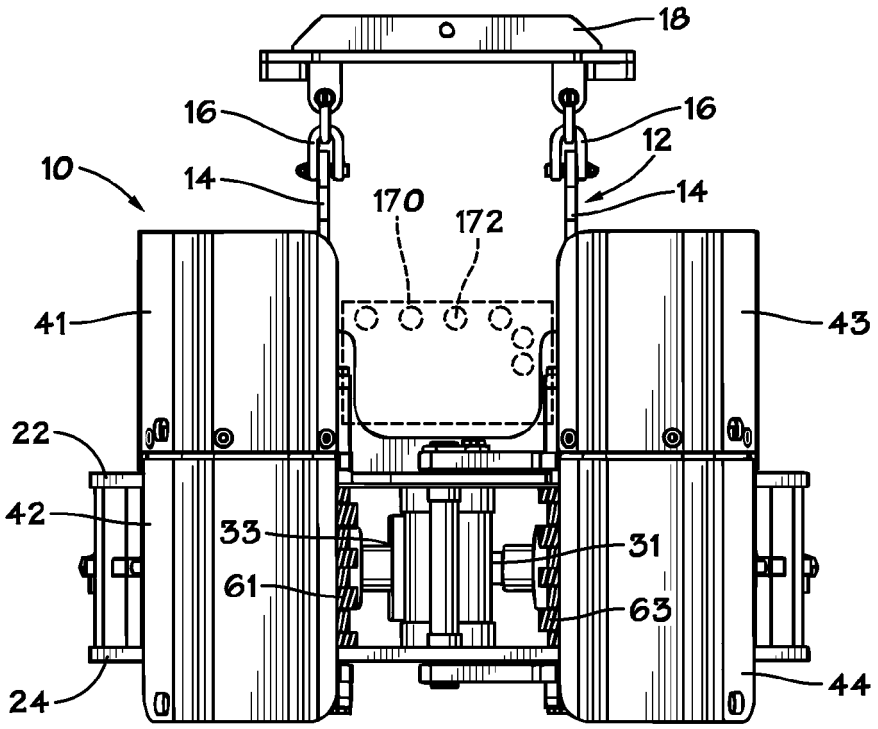
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FIG. 1D

FIG. 1E

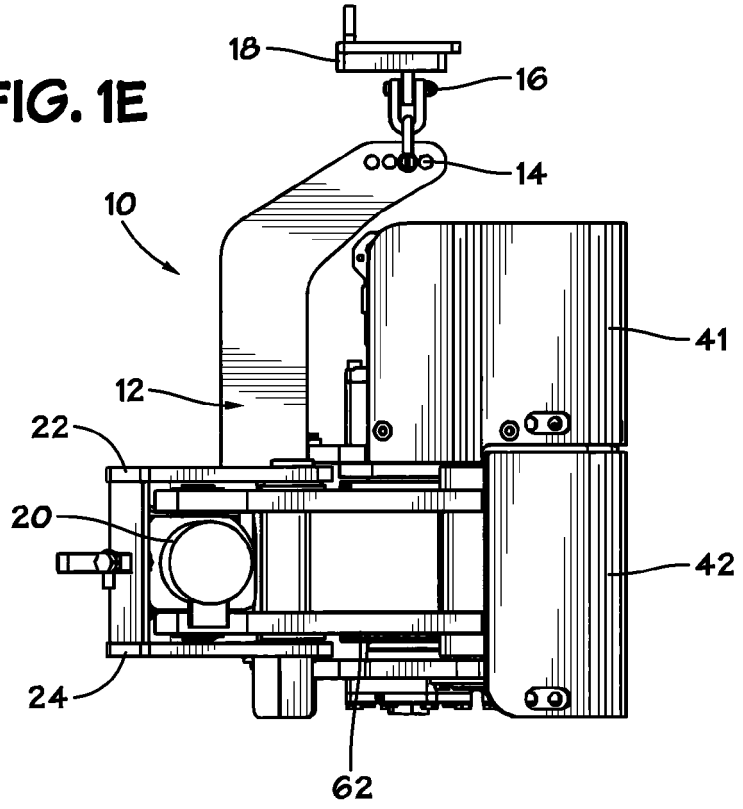
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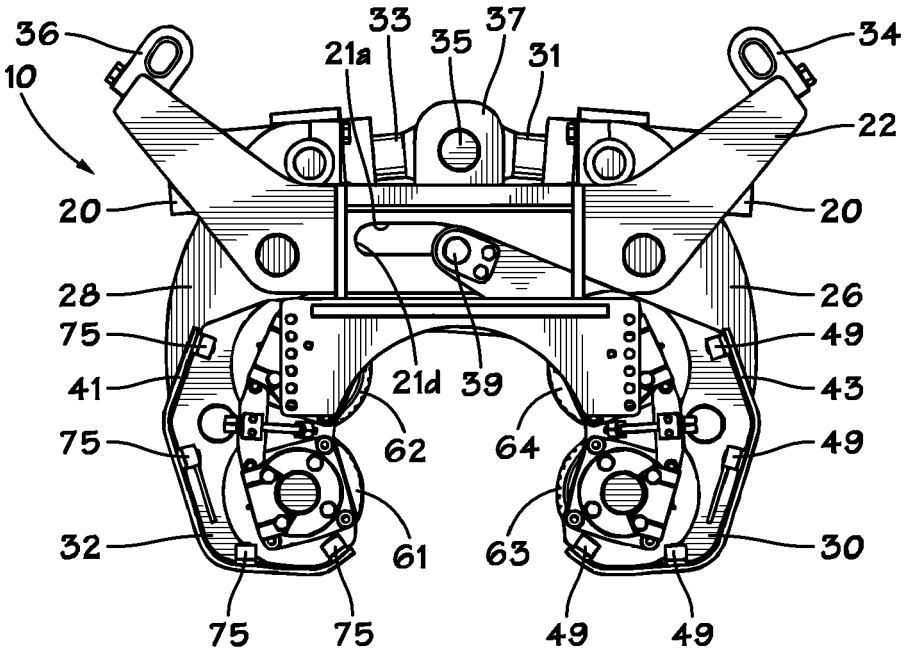
FIG. 1G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33
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21a
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75
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21d
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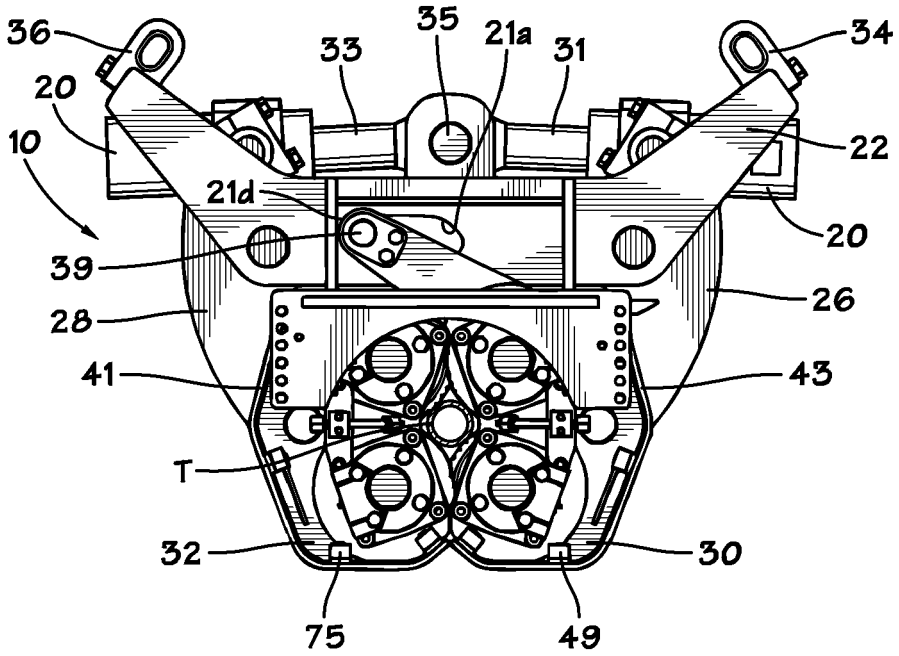
FIG. 1H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21a
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21d
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FIG. 2A

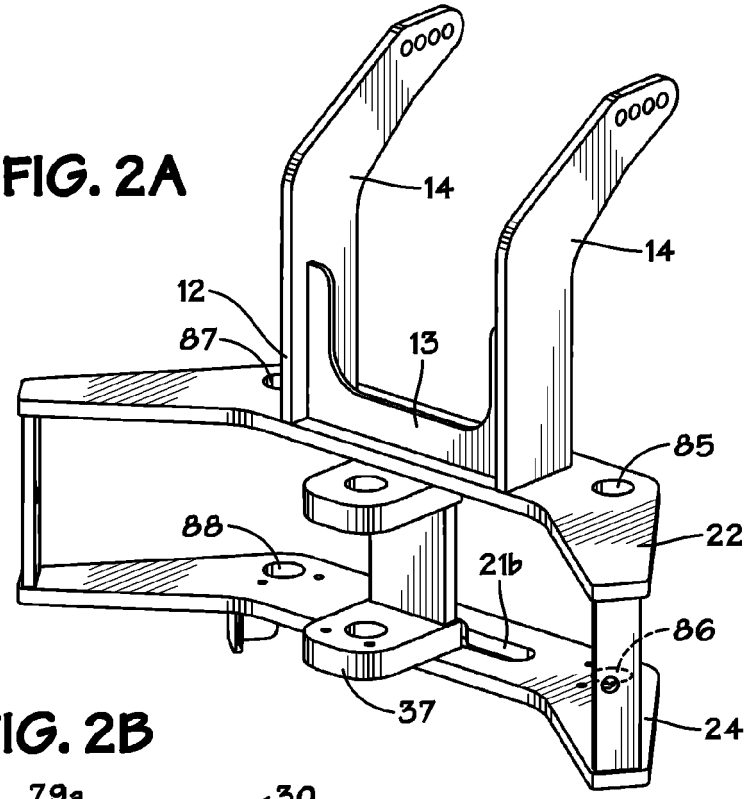


FIG. 2B

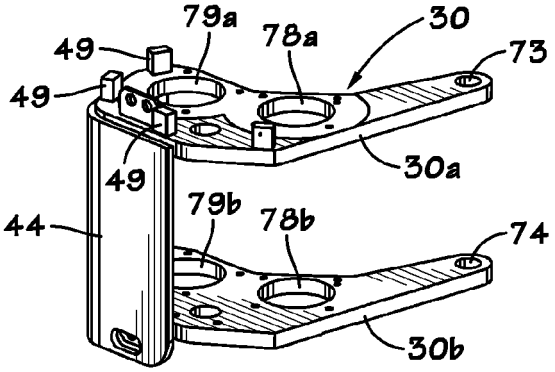
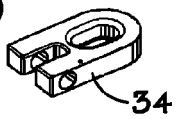


FIG. 2D



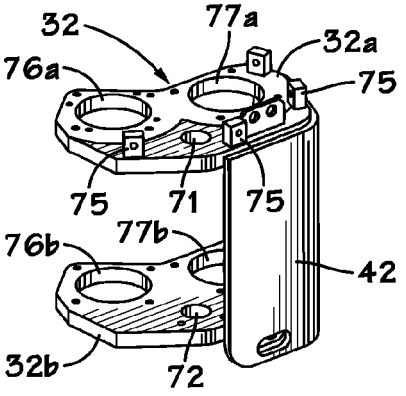


FIG. 2C

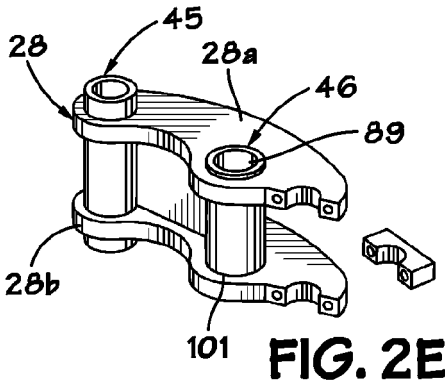


FIG. 2E

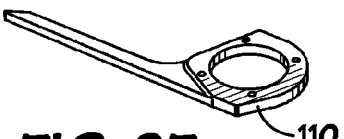
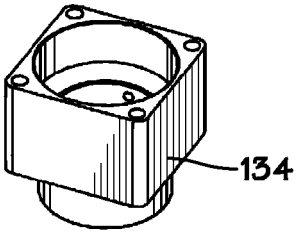


FIG. 2F

FIG. 3A



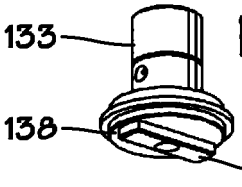


FIG. 3B

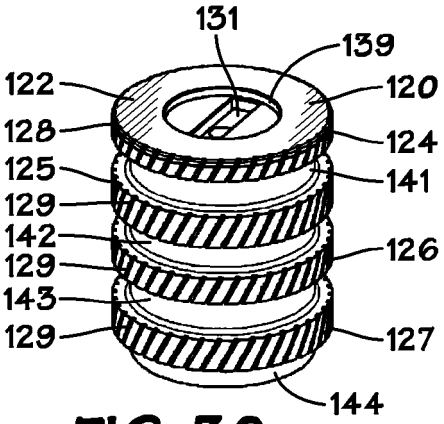


FIG. 3C

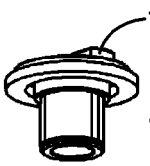


FIG. 3D

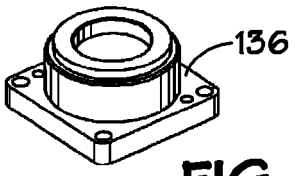


FIG. 3E

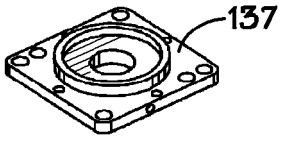


FIG. 3F

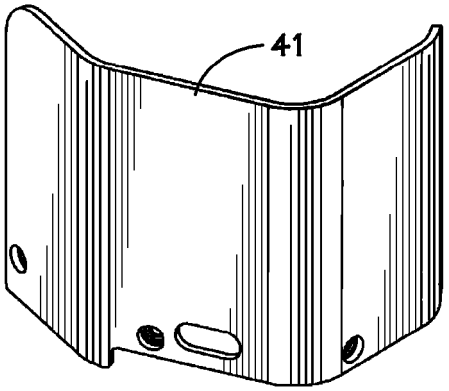


FIG. 4A

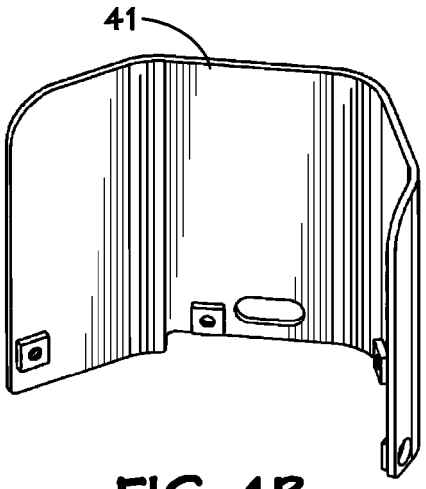


FIG. 4B

FIG. 5

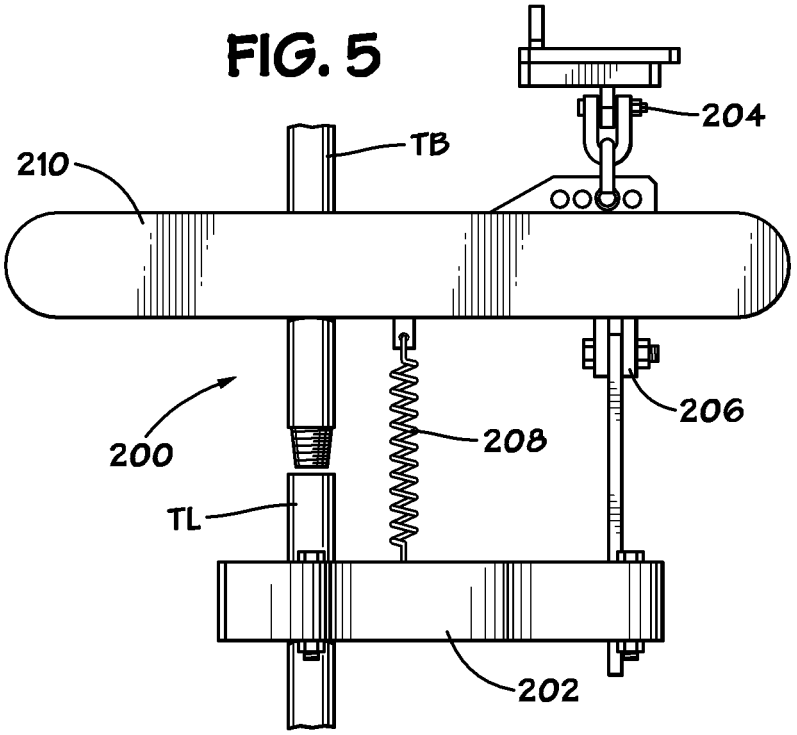

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FIG. 6

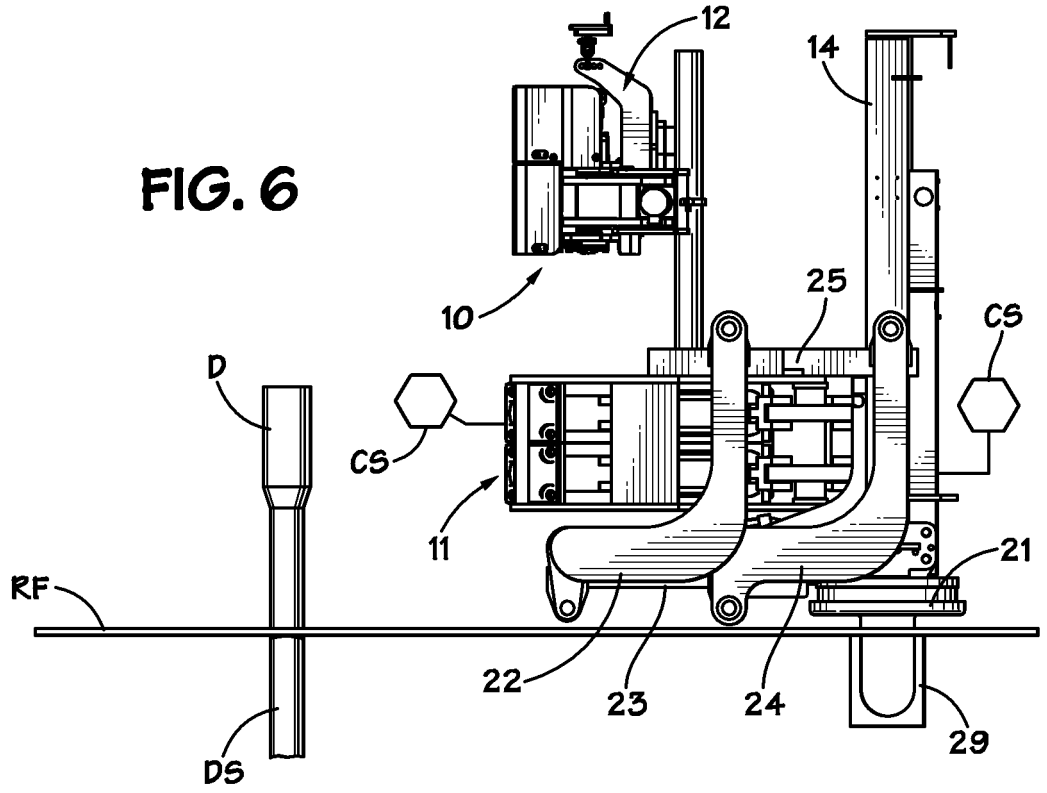
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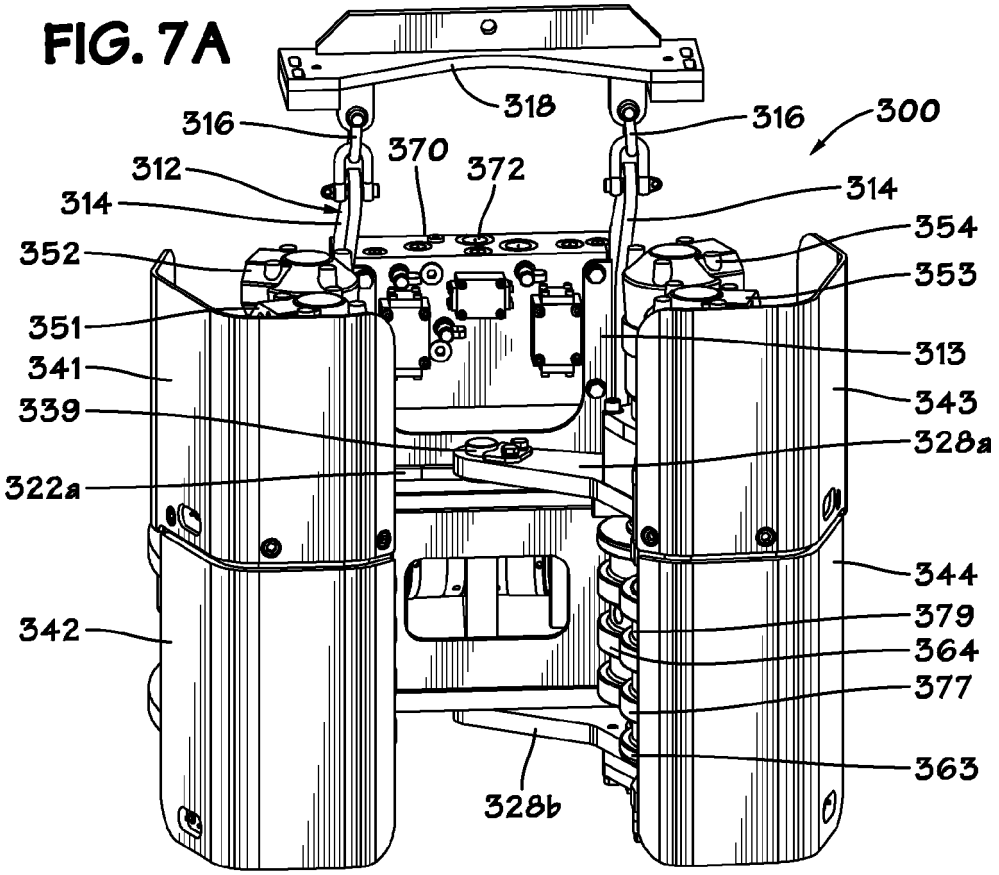
FIG. 7A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343
339
328a
322a
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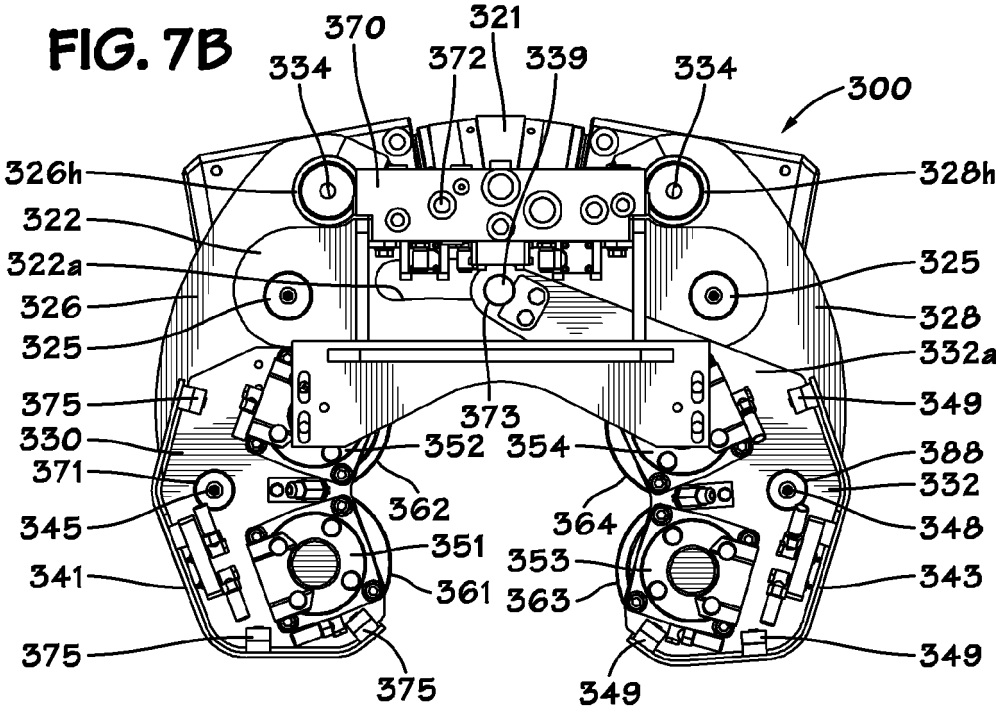
379
342
364
377
363
328b

FIG. 7B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322a
325
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332a
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330
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375
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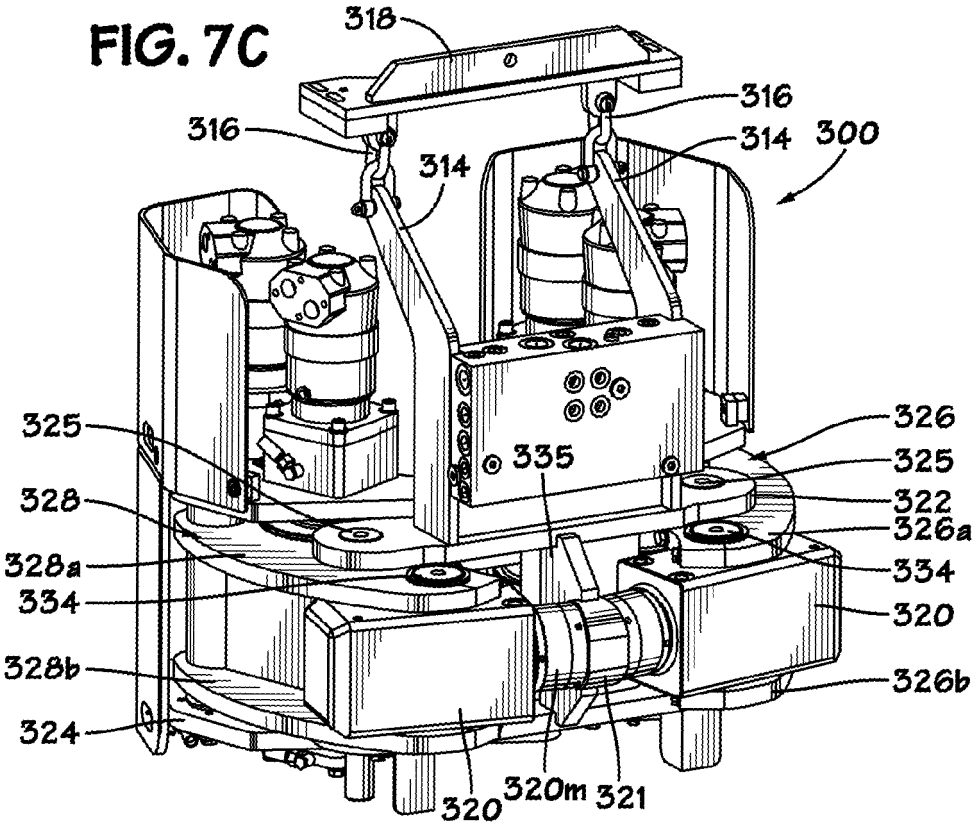
FIG. 7C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314
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325
326
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322
326a
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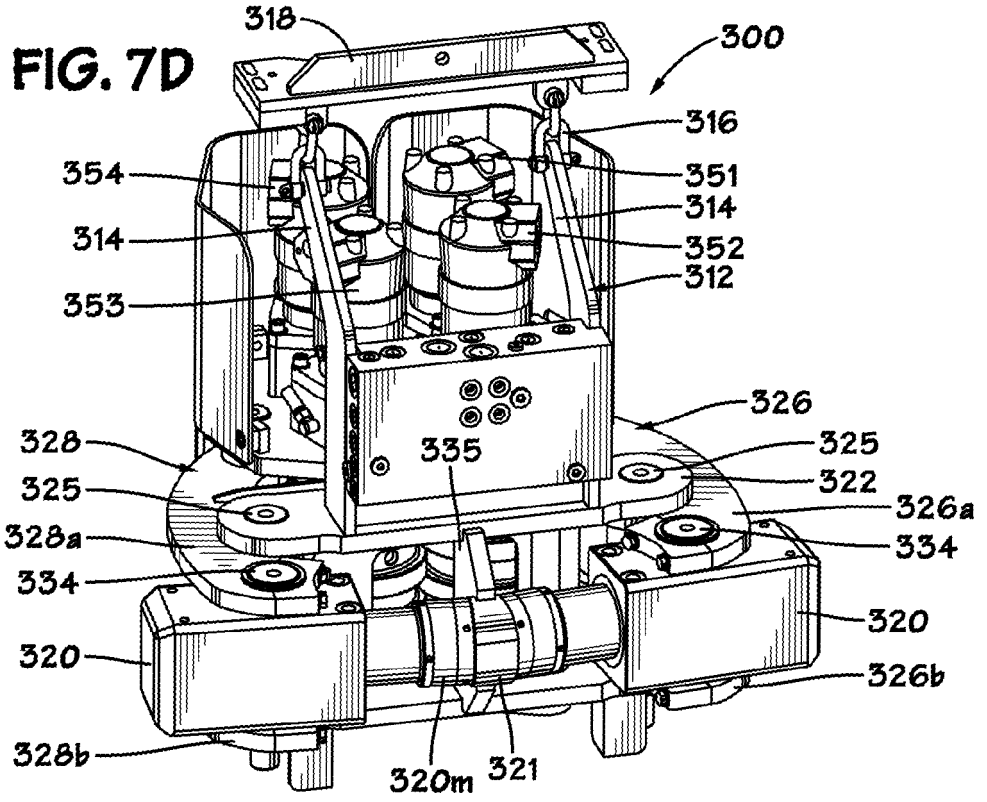
334
334
320
328b
326b
324
320
320m
321

FIG. 7D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326a
328a
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334
320
320
326b
328b
320m
321

FIG. 7E

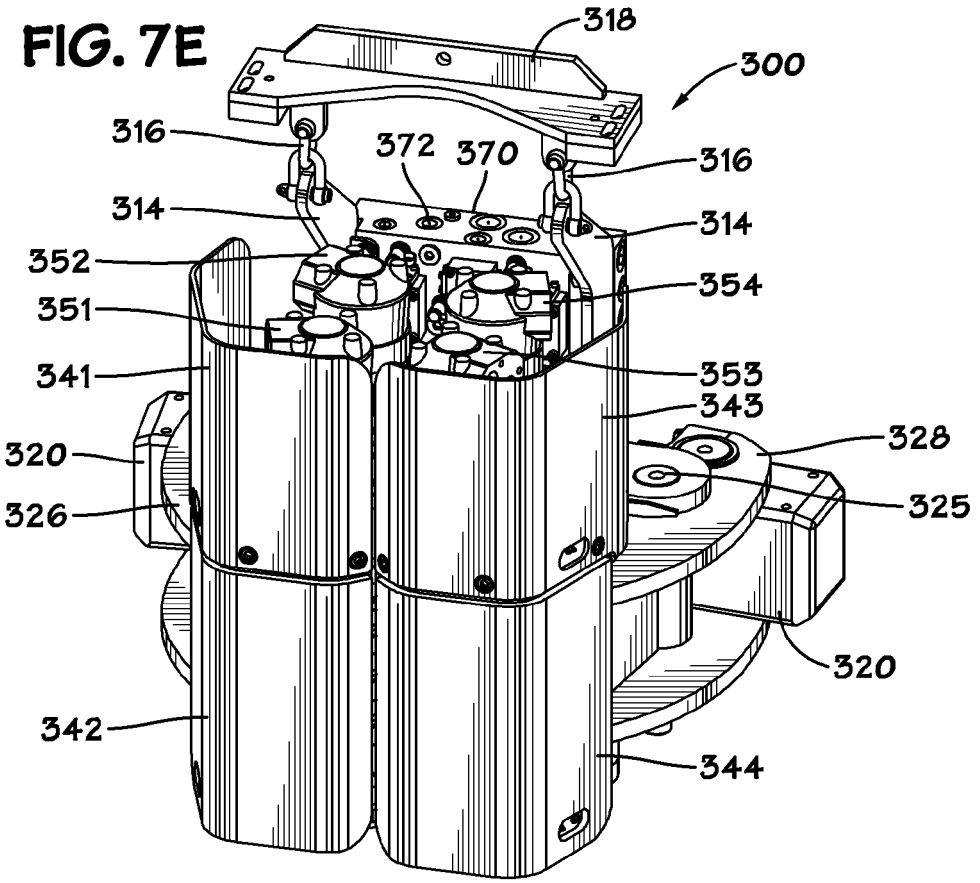
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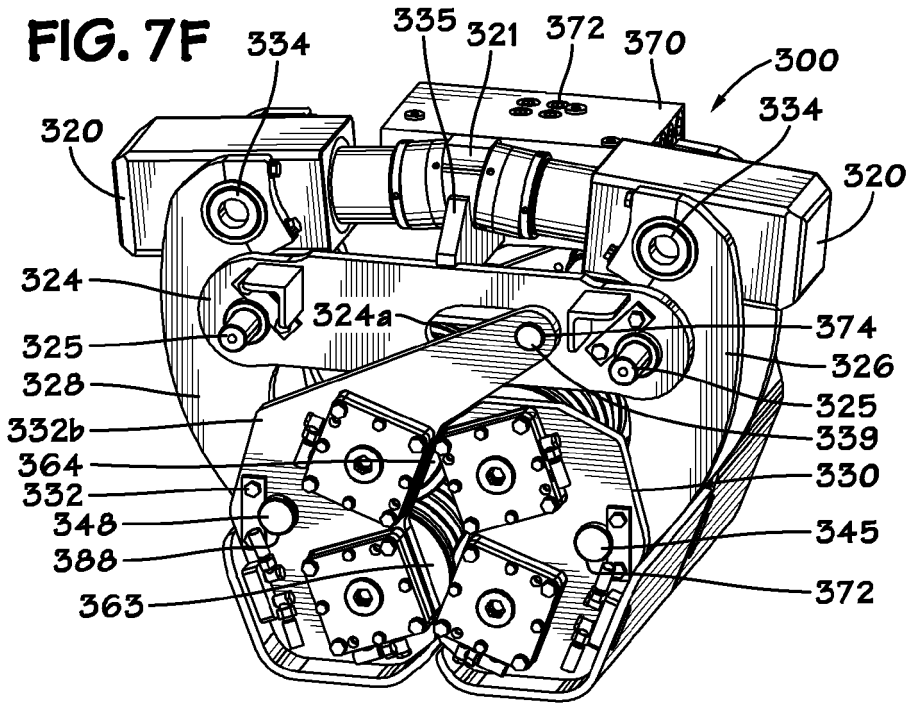
FIG. 7F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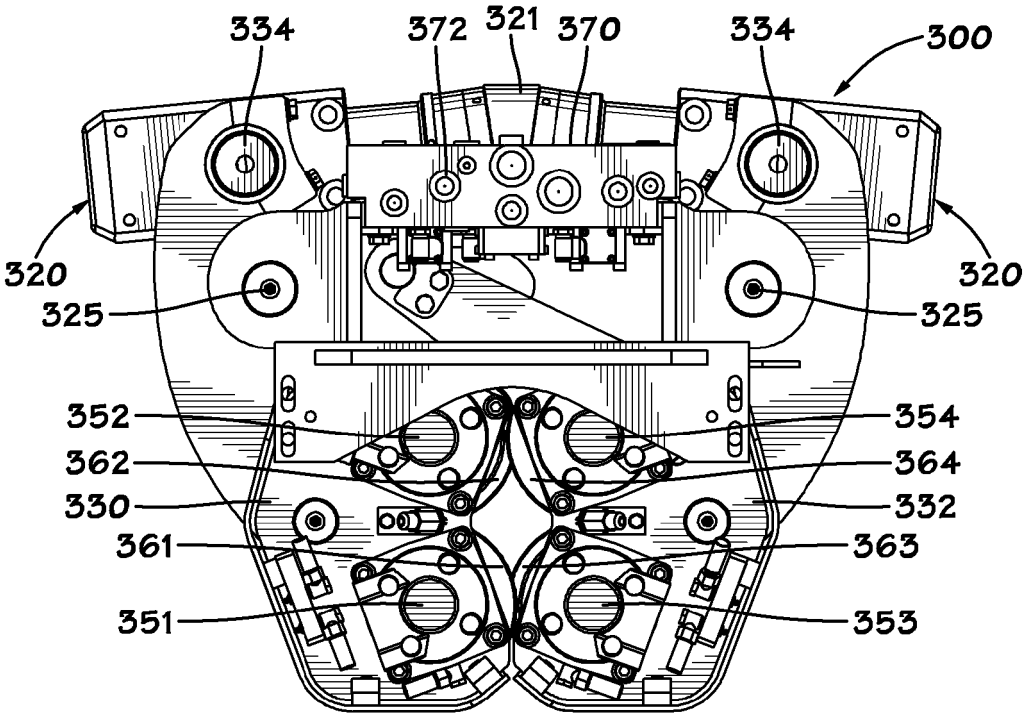
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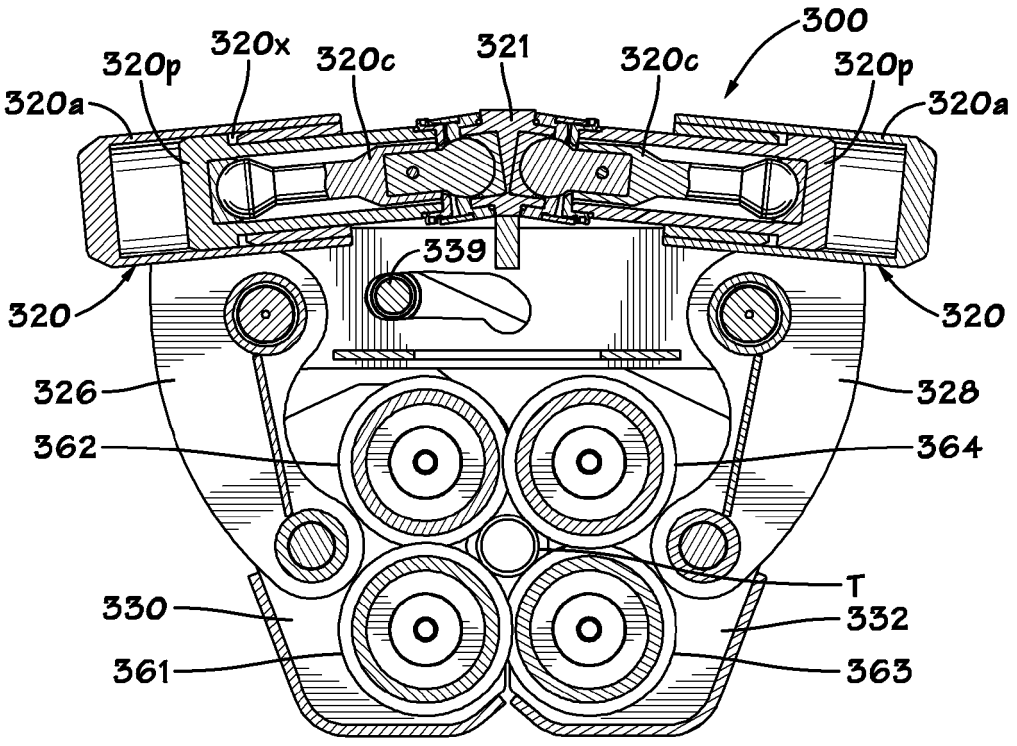
FIG. 7G


300
320p
320x
320c
321
320c
320p
320a
320a
339
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320
326
328
362
364
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332
361
363

FIG. 7H

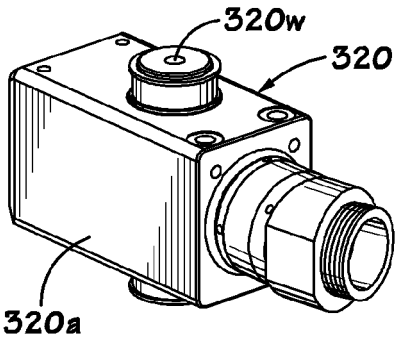


FIG. 8A

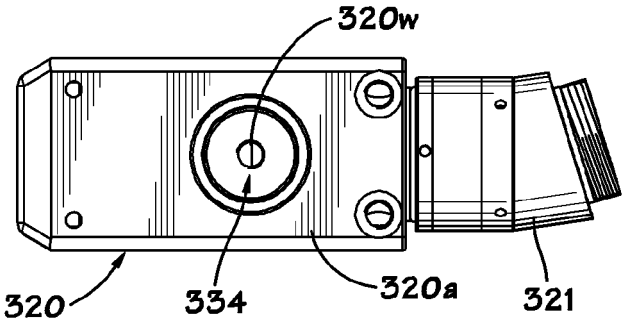


FIG. 8B

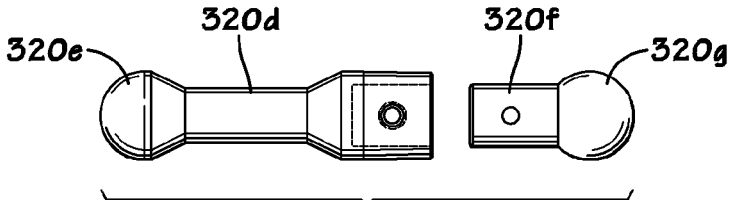


FIG. 8C

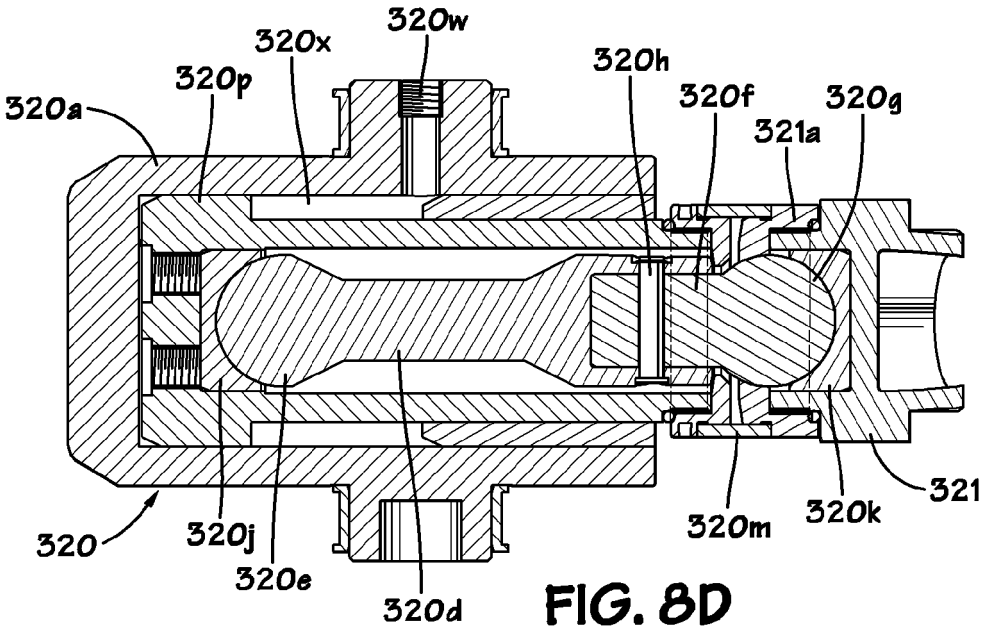
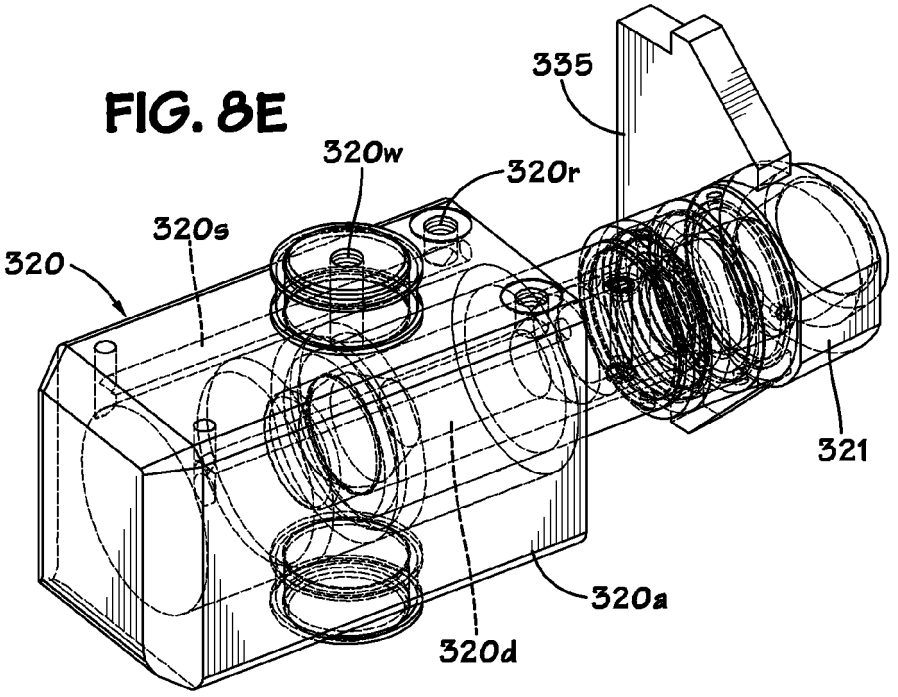


FIG. 8D

FIG. 8E



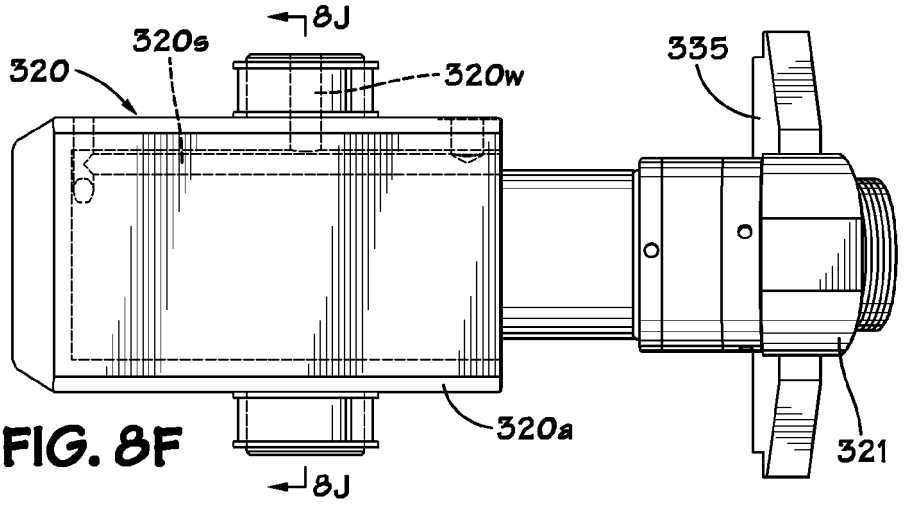


FIG. 8F

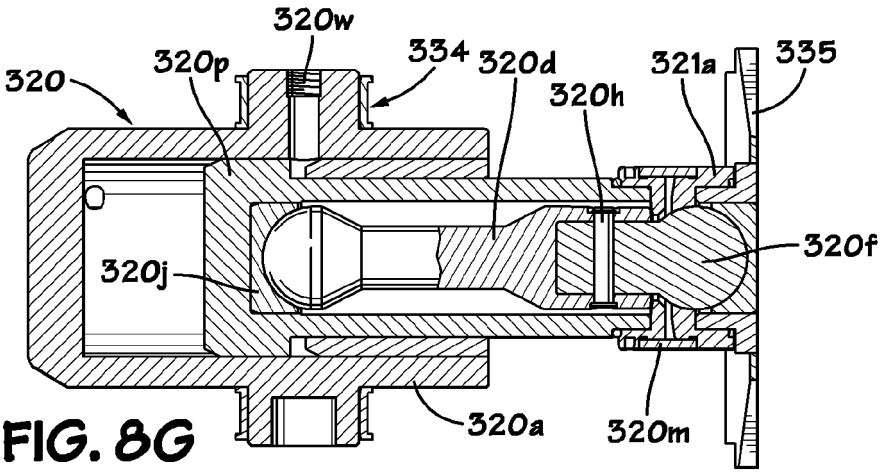


FIG. 8G

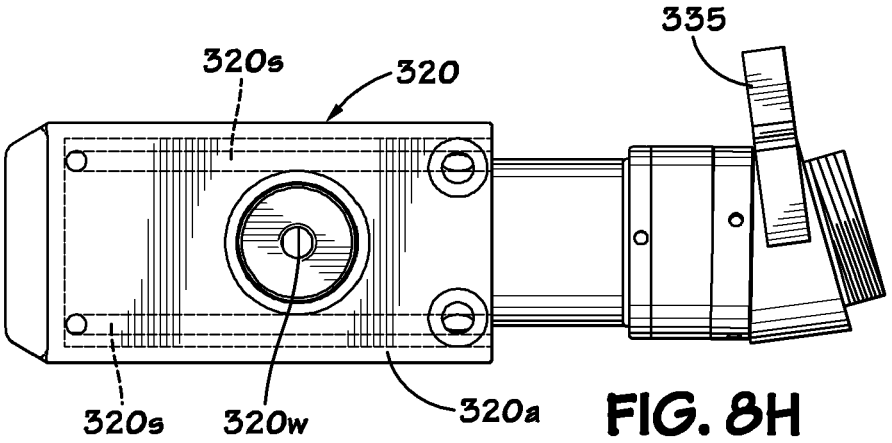


FIG. 8H

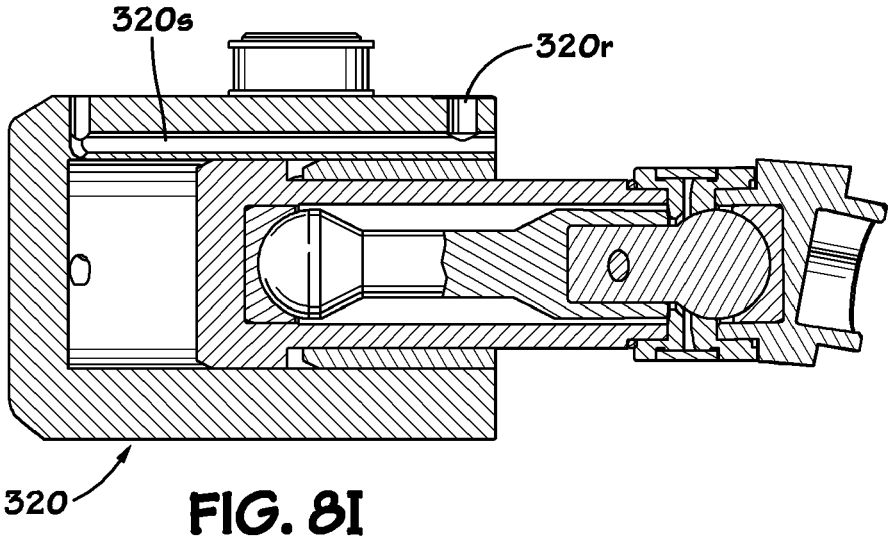


FIG. 8I

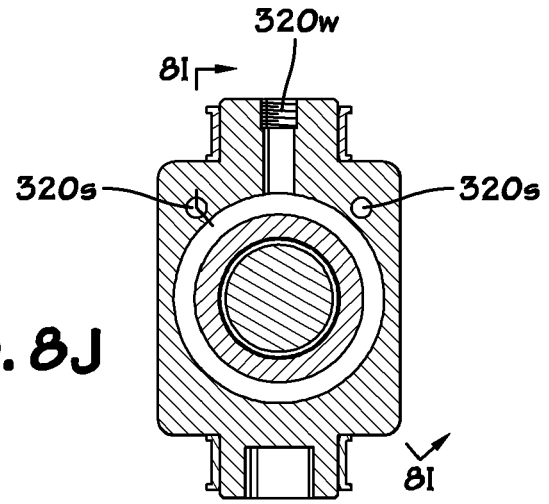


FIG. 8J

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EUROPEAN SEARCH REPORT

Application Number
EP 10 17 9907

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 December 2010	Manolache, Iustin

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