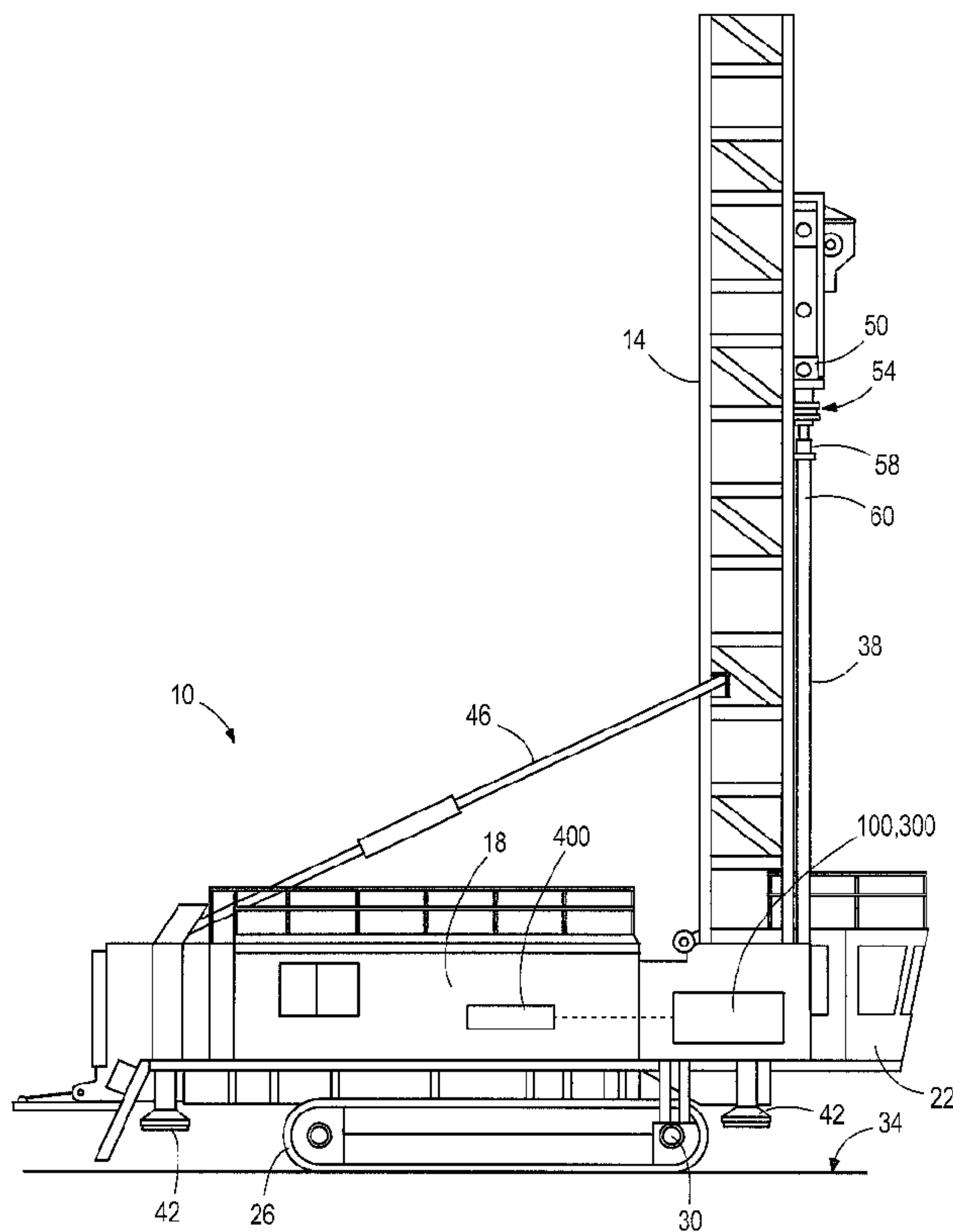




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(54) Titre : CLE DE DEVISSAGE AJUSTABLE DESTINEE A UNE MACHINE D'EXPLOITATION MINIERE  
(54) Title: ADJUSTABLE BREAKOUT WRENCH FOR A MINING MACHINE



(57) **Abrégé/Abstract:**

A breakout wrench assembly for a drill rig includes two support shafts. Each of the two support shafts is configured to extend in a direction relative to a drill pipe on a drill rig. The breakout wrench assembly also includes a carrier coupled to the two support shafts. The carrier is movable linearly along the two support shafts. The breakout wrench assembly also includes a breakout wrench pivotally coupled to the carrier or to one of the two support shafts. The breakout wrench includes a first end coupled to the carrier or to one of the two support shafts, and a second, opposite end configured to engage the drill pipe.

**ABSTRACT**

A breakout wrench assembly for a drill rig includes two support shafts. Each of the two support shafts is configured to extend in a direction relative to a drill pipe on a drill rig. The breakout wrench assembly also includes a carrier coupled to the two support shafts. The carrier is movable linearly along the two support shafts. The breakout wrench assembly also includes a breakout wrench pivotally coupled to the carrier or to one of the two support shafts. The breakout wrench includes a first end coupled to the carrier or to one of the two support shafts, and a second, opposite end configured to engage the drill pipe.

## ADJUSTABLE BREAKOUT WRENCH FOR A MINING MACHINE

### CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Application No. 62/294,732, filed February 12, 2016, the entire contents of which are incorporated herein by reference.

### BACKGROUND OF THE INVENTION

[0002] The present invention relates to drill rigs, and more particularly to breakout wrenches for blasthole drill rigs.

[0003] Blasthole drill rigs are commonly used in the mining industry to drill through hard rock. Blasthole drill rigs can be found, for example, in coal, copper, and diamond mines throughout the world. A blasthole drill rig typically includes a base, a drill tower extending vertically from the base, a sectioned drill string coupled to and supported by the drill tower and extending into a borehole, a drill bit coupled to (e.g., threaded) one end of the drill string within the borehole, and a drill head coupled to the other end of the drill string.

[0004] During operation, connections between sections of the drill string and the drill bit often become fixed together by flexing and binding – even welding – caused by normal operational loads of the drill rig. This creates sections that are fixed together so securely that even a rotary head of the drill cannot break apart fixed sections. In order to apply high torques to the drill string to break the fixed connections, conventional drill rigs include a breakout wrench pivotally coupled to the base or the drill tower such that a working end of the breakout wrench is pivotable to engage and disengage the drill string. Conventionally, the breakout wrench is pivotable at a fixed height relative to the drill string.

[0005] Depending on the geometry of the components in the drill string, it is favorable at times to adjust the vertical height of the breakout wrench along the drill string so that the breakout wrench engages proper locations along the string. In some specific drilling operations, such as down-the-hole (DTH) hammer drilling, vertical adjustment becomes even more important. In DTH hammer drilling assemblies, there is a very small range along the drill string near the drill bit (e.g., at a hammer, which is commonly used to couple a drill bit to a remainder of the drill string) that is strong enough to be gripped by the wrench without risking damage to

the hammer. This range may vary with different hammers. In addition, different sections and components disposed along the drill string may require wrench engagement at different heights. Accordingly, there is a need in this field for a durable, compact, strong, and vertically movable breakout wrench.

## **SUMMARY**

**[0006]** In accordance with one construction, a breakout wrench assembly for a drill rig includes two support shafts. Each of the two support shafts is configured to extend in a direction relative to a drill pipe on a drill rig. The breakout wrench assembly also includes a carrier coupled to the two support shafts. The carrier is movable linearly along the two support shafts. The breakout wrench assembly also includes a breakout wrench pivotally coupled to the carrier or to one of the two support shafts. The breakout wrench includes a first end coupled to the carrier or to one of the two support shafts, and a second, opposite end configured to engage the drill pipe.

**[0007]** In accordance with another construction, a breakout wrench assembly for a drill rig includes two support shafts, wherein each of the two support shafts is configured to extend in a direction relative to a drill pipe on a drill rig. The breakout wrench assembly also includes a carrier coupled to the two support shafts. The carrier is movable linearly along the two support shafts, and includes a top plate and a bottom plate. The breakout wrench assembly also includes a breakout wrench pivotally coupled to the carrier or to one of the two support shafts, the breakout wrench having a first end coupled to the carrier or to one of the two support shafts, and a second, opposite end configured to engage the drill pipe. The breakout wrench assembly also includes a first actuating mechanism to pivot the breakout wrench relative to the carrier. The first actuating mechanism is disposed between the top plate and the bottom plate. The breakout wrench assembly also includes a second actuating mechanism disposed between the two support shafts. The second actuating mechanism includes a body and a rod that moves relative to the body and slides within the body.

**[0008]** Other features and aspects of the invention will become apparent by consideration of the following detailed description and accompanying drawings.

**BRIEF DESCRIPTION OF THE DRAWINGS**

- [0009] FIG. 1 is a side view of a drill rig according to one construction.
- [0010] FIG. 2A is a perspective view of a breakout wrench assembly for use with the drill rig of FIG. 1, in a first vertical position.
- [0011] FIG. 2B is a perspective view of the breakout wrench assembly of FIG. 2A, in a second vertical position.
- [0012] FIG. 3 is a perspective view of a carrier of the breakout wrench assembly.
- [0013] FIG. 4 is an enlarged, partial perspective view of the breakout wrench assembly.
- [0014] FIG. 5 is another enlarged, partial perspective view of the breakout wrench assembly.
- [0015] FIG. 6 is a partial, perspective view of the breakout wrench assembly on the drill rig.
- [0016] FIG. 7A is a perspective view of another construction of a breakout wrench assembly for use with the drill rig of FIG. 1, in a first vertical position.
- [0017] FIG. 7B is a perspective view of the breakout wrench assembly of FIG. 7A, in a second vertical position.
- [0018] FIG. 8 is a perspective view of a carrier of the breakout wrench assembly of FIG. 7A.
- [0019] FIG. 9 is a cross section of a first portion of the carrier of FIG. 8.
- [0020] FIG. 10 is a cross section of a second portion of the carrier of FIG. 8.
- [0021] Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being

carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

## **DETAILED DESCRIPTION**

**[0022]** With reference to FIG. 1, a blasthole drill 10 is shown as having a drill tower or mast 14, a base 18 (e.g., a machinery house) beneath the drill tower 14 that supports the drill tower 14, an operator cab 22 coupled to the base 18, and crawlers 26 driven by a crawler drive 30 that drive the blasthole drill 10 along a ground surface 34. The blasthole drill 10 also includes a drill string 38 including a plurality of components such as, for example, drill pipes, a shock sub, a thread, a drill bit, and a bit stabilizer. The drill string 38 is configured to extend downward (e.g., vertically) through the ground surface 34 and into a borehole.

**[0023]** The blasthole drill 10 also includes leveling jacks 42 to support the blasthole drill 10 on the ground surface 34, a brace 46 that supports the drill tower 14 on the base 18, a drill head motor 50 coupled to the drill tower 14 that drives a drill head 54, and a coupling 58 that couples together the drill head 54 with an upper end 60 of the drill string 38. Other constructions of the blasthole drill 10 do not include, for example, the operator cab 22, the brace 46, or one or more other components as described above.

**[0024]** With reference to FIGS. 2A-6, the blasthole drill 10 also includes a breakout wrench assembly 100 for applying torque to the drill string 38 in order to uncouple components that become fixed together due to flexing, binding and welding caused by operational stresses on the drill string 38. In the illustrated construction, the breakout wrench assembly 100 is used as a retrofit or additional component for the blasthole drill 10. In other constructions, the breakout wrench assembly 100 is an integral component of the blasthole drill 10. In the illustrated construction, the breakout wrench assembly 100 is coupled to a lower plate 102 (FIG. 6) of the drill tower 14, so as to move with the rest of the drill tower 14. In some constructions, the breakout wrench assembly 100 is coupled to the base 18.

**[0025]** With reference to FIGS. 2A-2B, the breakout wrench assembly 100 includes a base plate 104, a mounting member 108, two support shafts 112, 116 extending (e.g., vertically) between the base plate 104 and the mounting member 108, and a carrier 120 that is displaceable along the support shafts 112, 116 using a first actuating mechanism 124 (e.g., a hydraulically or pneumatically actuated cylinder, linear actuator, etc.). In the illustrated

construction, the first actuating mechanism 124 includes a body 125 and a rod 126 that moves relative to the body 125 and slides within the body 125. A breakout wrench 128 (illustrated in movement) is pivotally coupled to the carrier 120 at a proximal end 130 of the breakout wrench 128. In some constructions, the breakout wrench 128 is actuated by a second actuating mechanism (e.g., a hydraulically or pneumatically actuated cylinder, linear actuator, etc.) to pivot the breakout wrench 128 about an axis A, and to move a distal or working end 136 of the breakout wrench 128 into and out of engagement with components of the drill string 38 (see, e.g., the second actuating mechanism 328 in FIGS. 7A, 7B). The breakout wrench 128 may be any type of breakout wrench, and is not limited by the specific structure illustrated. In some constructions, the axis A is both an axis of linear movement of the carrier 120 and the breakout wrench 128 (via the first actuating mechanism 124), as well as an axis of rotation of the breakout wrench 128. In some constructions, the axis A is parallel to the drill string 38.

**[0026]** With reference to FIGS. 3 and 4, the carrier 120 includes a top plate 140 spaced apart from a bottom plate 144 with two parallel tubes 148, 152 extending therebetween. Each tube 148, 152 defines an inner wall sized and shaped to receive one of the support shafts 112, 116. In the illustrated construction, each tube 148, 152 also includes one or more bearings 156, 160 disposed about the inner wall to facilitate sliding engagement with the support shaft 112, 116. In some constructions, a bearing surface is defined by the inner wall of the tubes 148, 152 such that no other bearing members are necessary. The carrier 120 also includes at least one mounting aperture 164 extending through at least a portion of the top plate 140 that is aligned with at least one corresponding mounting aperture 168 extending through at least a portion of the bottom plate 144. In the illustrated construction, the mounting apertures 164, 168 receive pins 172 (FIG. 4) extending between the top plate 140 and the bottom plate 144 that support the proximal end 130 of the breakout wrench 128. In the illustrated construction, the carrier 120 also includes at least one aperture 176 (FIG. 3) in each of the top and bottom plates 140, 144 that receives the first actuating mechanism 124, and at least one aperture 180 (e.g., threaded apertures, pin apertures, etc.) for mounting the first actuating mechanism 124 and/or the second actuating mechanism to the carrier 120, the apertures 176, 180 defining a mounting region 184.

**[0027]** With reference to FIG. 4, the support shafts 112, 116 are received within the tubes 148, 152, the pins 172 are received within the mounting apertures 164, 168, and the first actuating mechanism 124 is received within the apertures 176. The first actuating mechanism 124 is fixed to the carrier 120 via a mounting assembly 188 coupled to the apertures 180. In the

illustrated construction, the mounting assembly 188 includes two pillow blocks 192 coupled to the carrier 120 on opposing sides of the aperture 176 to support a trunnion mount 196 of the first actuating mechanism 124. However, other constructions include different mounting assemblies in place of or in addition to the mounting assembly 188 described above.

**[0028]** With reference to FIG. 5, the base plate 104 of the breakout wrench assembly 100 is coupled to the support shafts 112, 116 and includes drill mounting apertures 200 (e.g., to couple the base plate 104 to the base 18) and an actuating mechanism mounting assembly 204. In the illustrated construction, the actuating mechanism mounting assembly 204 includes a split mounting block 208 having a pin 212 extending across the mounting block 208 and coupled to an end of the first actuating mechanism 124. In some constructions, the pin 212 extends perpendicular to the trunnion mount 196 of the mounting assembly 188 such that a universal joint is created to isolate the first actuating mechanism 124 from undesirable forces that may affect useful life.

**[0029]** With reference to FIG. 6, the breakout wrench assembly 100 (notably without the first actuating mechanism 124 illustrated) is attached to the base 18 and drill tower 14 of the blasthole drill 10. In the illustrated construction, the base plate 104 is coupled to the blasthole drill 10 via fasteners 216 extending through the drill mounting apertures 200, with the mounting member 108 coupled to the drill tower 14 in a similar fashion, at a position offset from the drill string 38. The breakout wrench 128 may be pivoted into engagement (illustrated) and out of engagement (not shown) with the drill string 38. Other constructions include other mounting features (e.g., welding, etc.) to mount the breakout wrench assembly 100 to the blasthole drill 10.

**[0030]** In operation, the breakout wrench assembly 100 pivots the breakout wrench 128 about the vertical axis A while also vertically displacing the breakout wrench 128 along the support shafts 112, 116. This vertical movement allows a user to align the working end 136 of the breakout wrench 128 along an optimal section of the drill string 38. Note that while the term "vertical axis" is used herein, during some operations the tower 14 could be tilted at an angle relative to ground during drilling (i.e., angle drilling), which would cause the axis A to also tilt and thus no longer be vertical. Either before or after an optimal height of the breakout wrench 128 is attained, a user pivots the breakout wrench 128 into engagement with the drill string 38. Once engaged, the breakout wrench 128 is operated to apply high levels of torque to disconnect drill string components that were previously fixed in place, or alternatively to attach new components

to a drill string 38. Once this operation is complete and the breakout wrench 128 is no longer required, the breakout wrench 128 is then pivoted away from the drill string 38 such that other drill operations are not inhibited.

**[0031]** The first actuating mechanism 124 and/or the second actuating mechanism are operated manually, or may be automated. For example, and with reference to FIG. 1, in some constructions, the first actuating mechanism 124 and/or second actuating mechanism is operatively coupled to a controller 400 (FIG. 1) including switches/buttons to allow an operator to control the movement of each actuating mechanism. In some constructions, the controller 400 includes a user interface to control operation. In some constructions, the controller 400 operates the first actuating mechanism 124 and/or the second actuating mechanism (e.g., automatically) according to predetermined operational parameters. In some constructions, the controller 400 includes a single button to actuate the operation of the breakout wrench assembly 100. In some constructions, the controller 400 gathers feedback from both the drill string 38 and the breakout wrench assembly 100 so as to partially or fully automate and properly operate the breakout wrench assembly 100. In some constructions, the first actuating mechanism 124 and the second actuating mechanism are each actuated individually and manually by the operator.

**[0032]** FIGS. 7A-10 illustrate a second construction of a breakout wrench assembly 300, which is similar to the constructions of the breakout wrench assembly 100 shown in FIGS. 1-6. The breakout wrench assembly 300 is an original feature incorporated onto a new blasthole drill 10, as opposed to being a retrofit. Accordingly, this description will focus on the aspects of the construction shown that are different from the constructions shown in FIGS. 1-6. It should be noted, however, that any features and alternatives presented in this construction may be incorporated or substituted into the embodiment of FIGS. 1-6, or vice versa.

**[0033]** With reference to FIGS. 7A and 7B, the breakout wrench assembly 300 includes a first base plate 304, a second base plate 308, and a first mounting plate 310 that are each coupled to the blasthole drill 10 (e.g., by fasteners, etc.). The breakout wrench assembly 300 similarly includes two or more support shafts 312, 316 extending vertically with a carrier 320 that is displaceable along the support shafts 312, 316 using a first actuating mechanism 324 (e.g., a hydraulically or pneumatically actuated cylinder, linear actuator, etc.). In the illustrated construction, the first actuating mechanism 324 includes a body 325 and a rod 326 that moves relative to the body 325 and slides within the body 325. In the illustrated construction, the support shaft 316 is shared with a pipe carousel 327 (e.g., for holding drill pipes) to minimize

deck space occupied by the breakout wrench assembly 300. In some constructions, the body 325 is fixed to the pipe carousel 327. As illustrated in FIGS. 7A and 7B, the breakout wrench assembly 300 also includes a second actuating mechanism 328 (e.g., a hydraulically or pneumatically actuated cylinder, linear actuator, etc.) for pivoting a breakout wrench 332. In the illustrated construction, the second actuating mechanism 328 is disposed within the carrier 320, and is coupled to one of the support shafts 312 at one end and to the breakout wrench 332 at an opposite end.

**[0034]** With reference to FIG. 8, the carrier 320 includes a top plate 336 and a bottom plate 341. At one end of the carrier 320, a tube 344 extends between and connects the top and bottom plates 336, 341, and is configured to receive one of the support shafts 312, 316. On an opposite end, a pair of apertures 348, 352 are formed in the top and bottom plates 336, 341 such that the apertures 348, 352 are aligned to receive the other of the support shafts 312, 316 (e.g., a shared support shaft 316 that is also used to pivotally support a pipe carousel). Additionally, a support member 356 (e.g., rib) extends between the top and bottom plates 336, 341 between the tube 344 and the apertures 348, 352 to enhance the rigidity of the carrier 320.

**[0035]** With continued reference to FIG. 8, the top plate 336 includes a first mounting member 360 that is coupled to and provides support for the first actuating mechanism 324. The carrier 320 also includes a second mounting member 364 including a pin aperture 368 supported on the tube 344, which is used to mount the second actuating mechanism 328. As illustrated in FIGS. 7A and 7B, the breakout wrench 332 is mounted to the support shaft 316 such that the breakout wrench 332 moves vertically with the carrier 320 and also pivots about the support shaft 316.

**[0036]** With reference to FIGS. 9 and 10, the breakout wrench assembly 300 also includes bearings (e.g., self-lubricated plastic bushings, ball bearings, etc.) engaging the support shafts 312, 316. For example, as illustrated in FIG. 9, the tube 344 includes a bearing 372 disposed on an interior wall to facilitate sliding engagement of the carrier 320 with the support shaft 312. As illustrated in FIG. 10, the breakout wrench 332 includes a bearing 376 for engagement with the support shaft 316 between the top and bottom plates 336, 341 of the carrier 320 (FIG. 10), such that the breakout wrench 332 in this construction is coupled separately to the support shaft 316 itself between the plates 336, 341 (as opposed to being directly coupled to the carrier 320 itself).

**[0037]** In operation, the breakout wrench assembly 300 functions in generally the same way as the breakout wrench assembly 100 set forth above, in that the breakout wrench 332 is movable vertically (or at an inclined angle for example during angle drilling) via the carrier 320 on the shafts 312, 316 and the first actuating mechanism 324, and is movable pivotally about the shaft 316 via the second actuating mechanism 328. As illustrated in FIGS. 1-6, however, the rod 126 remains stationary, and the body 125 moves with the carrier 120, whereas in FIGS. 7A-10 the body 325 remains stationary and the rod 326 moves with the carrier 320. Other constructions include different arrangements than that illustrated.

**[0038]** The vertical adjustability of the breakout wrench assemblies 100, 300 is favorable in certain circumstances in order to engage proper locations along the drill string 38. In some specific drilling operations, such as down-the-hole (DTH) hammer drilling, this feature becomes even more important. As noted above, in DTH hammer drilling assemblies, there is a very small range along the drill string 38 near the drill bit (e.g., at the hammer) that is strong enough to be gripped by the working end (e.g., working end 136) of the wrench without risking damage to the drill hammer. This range may vary with different drill hammers. Accordingly, vertical displacement of the wrench helps improve performance of the breakout wrench assembly 100, 300.

**[0039]** The breakout wrench assemblies 100, 300 also are compact, durable, and stable structures that have a large range of motion using a relatively low number of simple components. One feature enhancing durability of the above described breakout wrench assemblies 100, 300 is the inclusion of more than one vertical support shaft because the shafts 112, 116, 312, 316 resist moment forces created by operation of the breakout wrench 128, 332 to enhance durability. This reduces the need for additional structural and support components, thereby reducing cost, easing manufacturability, and minimizing the required deck space. In addition, the actuating mechanisms are better shielded from operational stressors, and the vertical displacement makes the drill more accommodating to additional components. That is, components that may otherwise impede a traditional, pivoting breakout wrench may now be included in the blasthole drill 10 because the breakout wrench assemblies 100, 300 are capable of being maneuvered vertically to access the drill string.

**[0040]** Although the invention has been described in detail with reference to certain preferred embodiments, variations and modifications exist within the scope and spirit of one or more independent aspects of the invention as described.

**CLAIMS**

1. A breakout wrench assembly for a drill rig, the breakout wrench assembly comprising:  
two support shafts, wherein each of the two support shafts is configured to extend in a direction relative to a drill pipe on a drill rig;  
a carrier coupled to the two support shafts, wherein the carrier is movable linearly along the two support shafts; and  
a breakout wrench pivotally coupled to the carrier or to one of the two support shafts, the breakout wrench having a first end coupled to the carrier or to one of the two support shafts, and a second, opposite end configured to engage the drill pipe.
2. The breakout wrench assembly of claim 1, further comprising an actuating mechanism to pivot the breakout wrench relative to the carrier.
3. The breakout wrench assembly of claim 2, wherein the carrier includes a top plate and a bottom plate, and wherein the actuating mechanism is disposed between the top plate and the bottom plate.
4. The breakout wrench assembly of claim 1, further comprising an actuating mechanism to move the carrier linearly along the two support shafts.
5. The breakout wrench assembly of claim 4, wherein the actuating mechanism is disposed between the two support shafts, and includes a body and a rod that moves relative to the body and slides within the body.
6. The breakout wrench assembly of claim 4, wherein the actuating mechanism is a first actuating mechanism, and wherein the breakout wrench assembly further includes a second actuating mechanism to pivot the breakout wrench relative to the carrier.
7. The breakout wrench assembly of claim 6, wherein the first actuating mechanism is hydraulically or pneumatically operated, and wherein the second actuating mechanism is hydraulically or pneumatically operated.

8. The breakout wrench assembly of claim 1, wherein the carrier includes a top plate and a bottom plate spaced apart from the top plate.
9. The breakout wrench assembly of claim 8, wherein the carrier includes two parallel tubes extending between the top plate and the bottom plate, wherein each of the two parallel tubes is sized and shaped to receive one of the two support shafts.
10. The breakout wrench assembly of claim 9, wherein the carrier further includes a first bearing disposed within one of the two tubes, and a second bearing disposed within the other of the two tubes.
11. The breakout wrench assembly of claim 8, wherein the carrier includes a first mounting aperture extending through at least a portion of the top plate, and a second mounting aperture extending through at least a portion of the bottom plate.
12. The breakout wrench assembly of claim 11, wherein the carrier includes a pin that extends into both the first mounting aperture and the second mounting aperture, wherein the pin supports the first end of the breakout wrench.
13. The breakout wrench assembly of claim 8, further comprising an actuating mechanism to move the carrier linearly along the two support shafts, wherein the carrier includes a first aperture extending through the top plate, and a second aperture extending through the bottom plate, and wherein the actuating mechanism extends through both the first aperture and the second aperture.
14. The breakout wrench assembly of claim 13, further comprising a mounting assembly coupled to the top plate, wherein the mounting assembly includes two pillow blocks coupled to the top plate, and wherein the actuating mechanism includes a trunnion mount that is supported by the two pillow blocks.
15. The breakout wrench assembly of claim 14, further comprising a base plate coupled to the two support shafts, the base plate including an actuating mechanism mounting assembly

having a split mounting block and a pin extending across the split mounting block and coupled to an end of the actuating mechanism.

16. The breakout wrench assembly of claim 15, wherein the pin extends perpendicular to the trunnion mount.

17. A drill rig comprising:  
a base;  
a drill tower extending from the base;  
a drill pipe coupled to and extending from the drill tower; and  
the breakout wrench assembly of claim 1.

18. A breakout wrench assembly for a drill rig, the breakout wrench assembly comprising:  
two support shafts, wherein each of the two support shafts is configured to extend in a direction relative to a drill pipe on a drill rig;

a carrier coupled to the two support shafts, wherein the carrier is movable linearly along the two support shafts, wherein the carrier includes a top plate and a bottom plate;

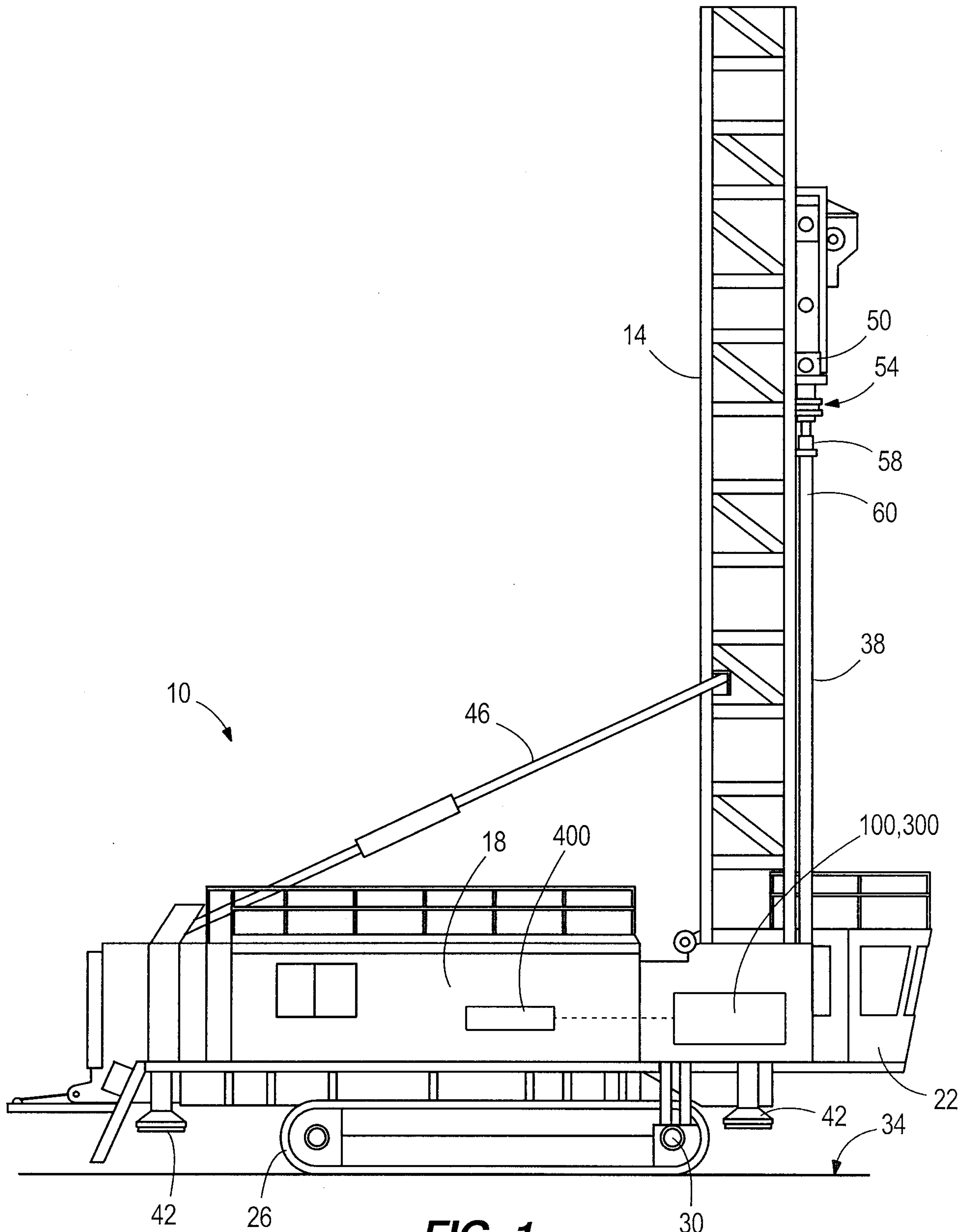
a breakout wrench pivotally coupled to the carrier or to one of the two support shafts, the breakout wrench having a first end coupled to the carrier or to one of the two support shafts, and a second, opposite end configured to engage the drill pipe;

a first actuating mechanism to pivot the breakout wrench relative to the carrier, wherein the first actuating mechanism is disposed between the top plate and the bottom plate; and

a second actuating mechanism disposed between the two support shafts, wherein the second actuating mechanism includes a body and a rod that moves relative to the body and slides within the body.

19. The breakout wrench assembly of claim 18, wherein the carrier includes two parallel tubes extending between the top plate and the bottom plate, wherein each of the two parallel tubes is sized and shaped to receive one of the two support shafts.

20. The breakout wrench assembly of claim 18, further comprising a base plate coupled to the two support shafts, the base plate including an actuating mechanism mounting assembly having a split mounting block and a pin extending across the split mounting block and coupled to an end of the second actuating mechanism.



**FIG. 1**

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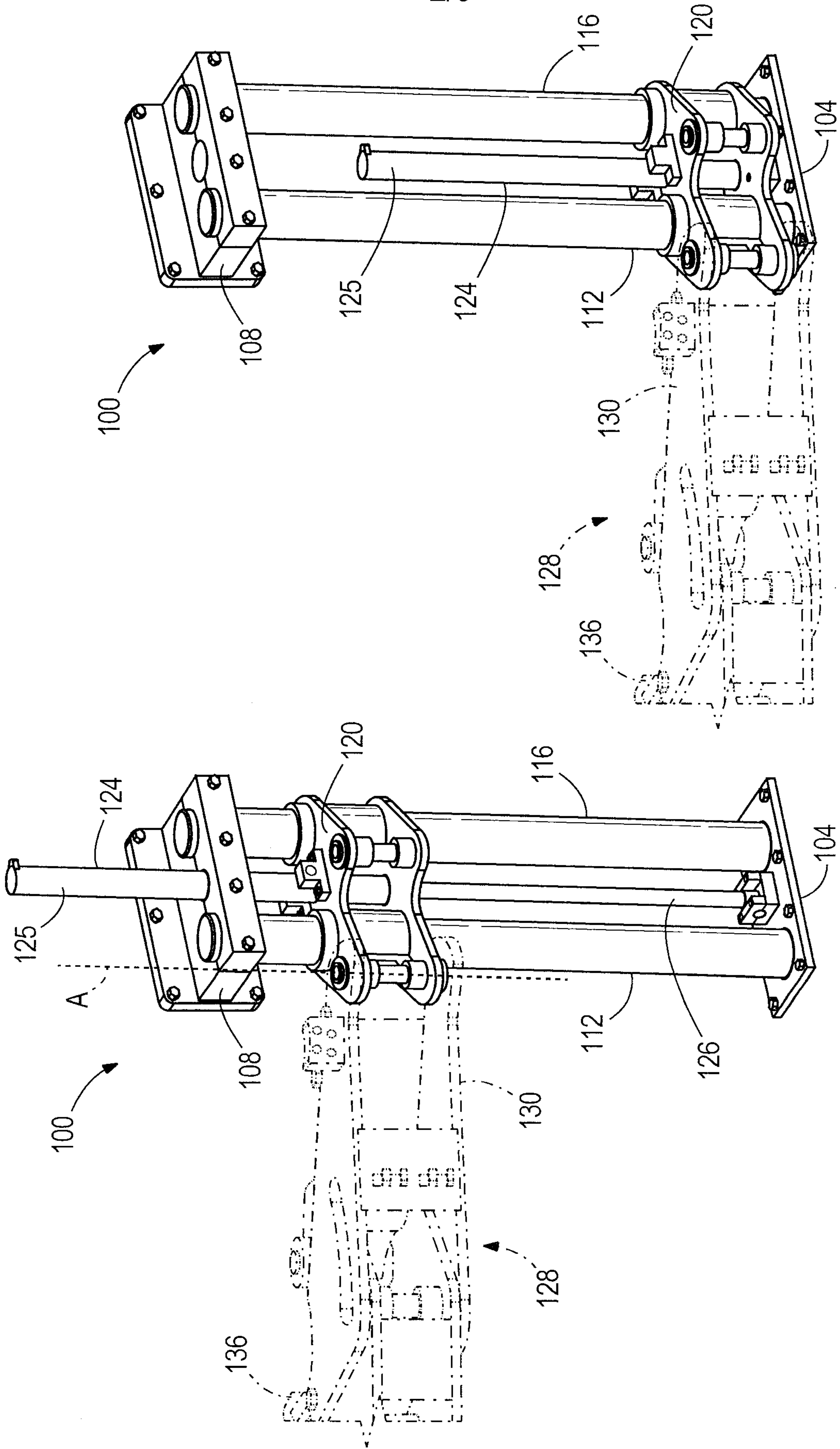
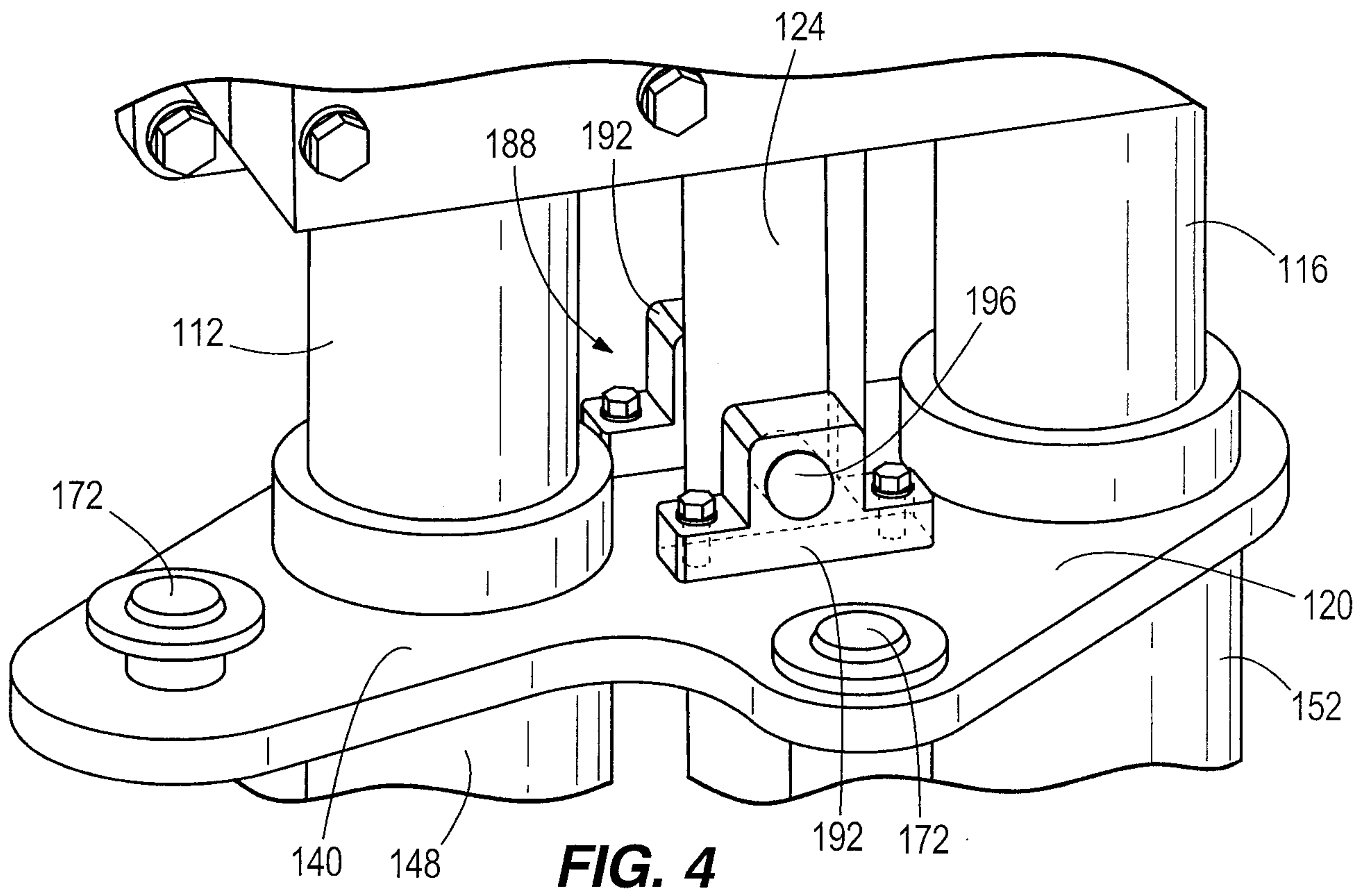
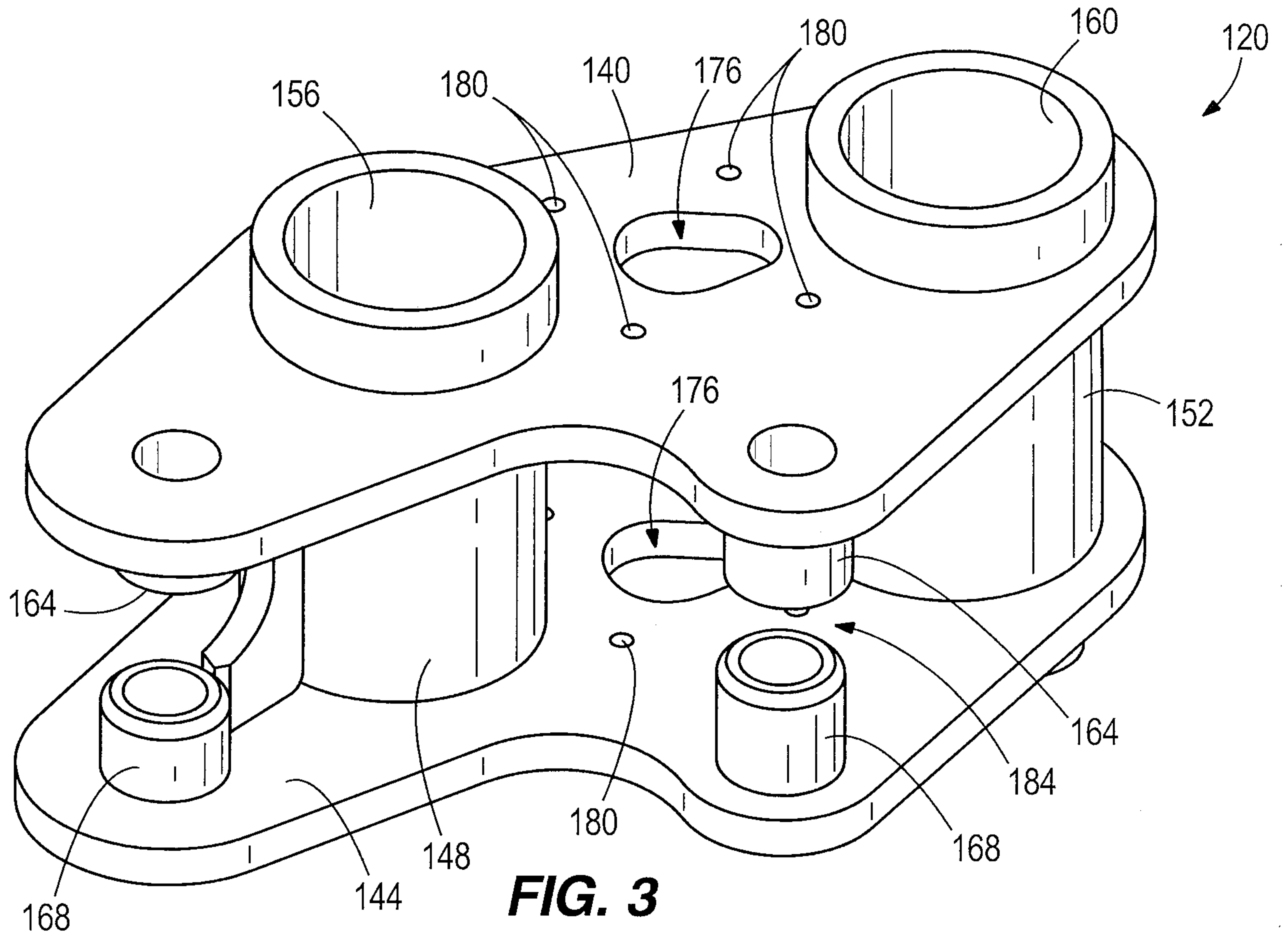
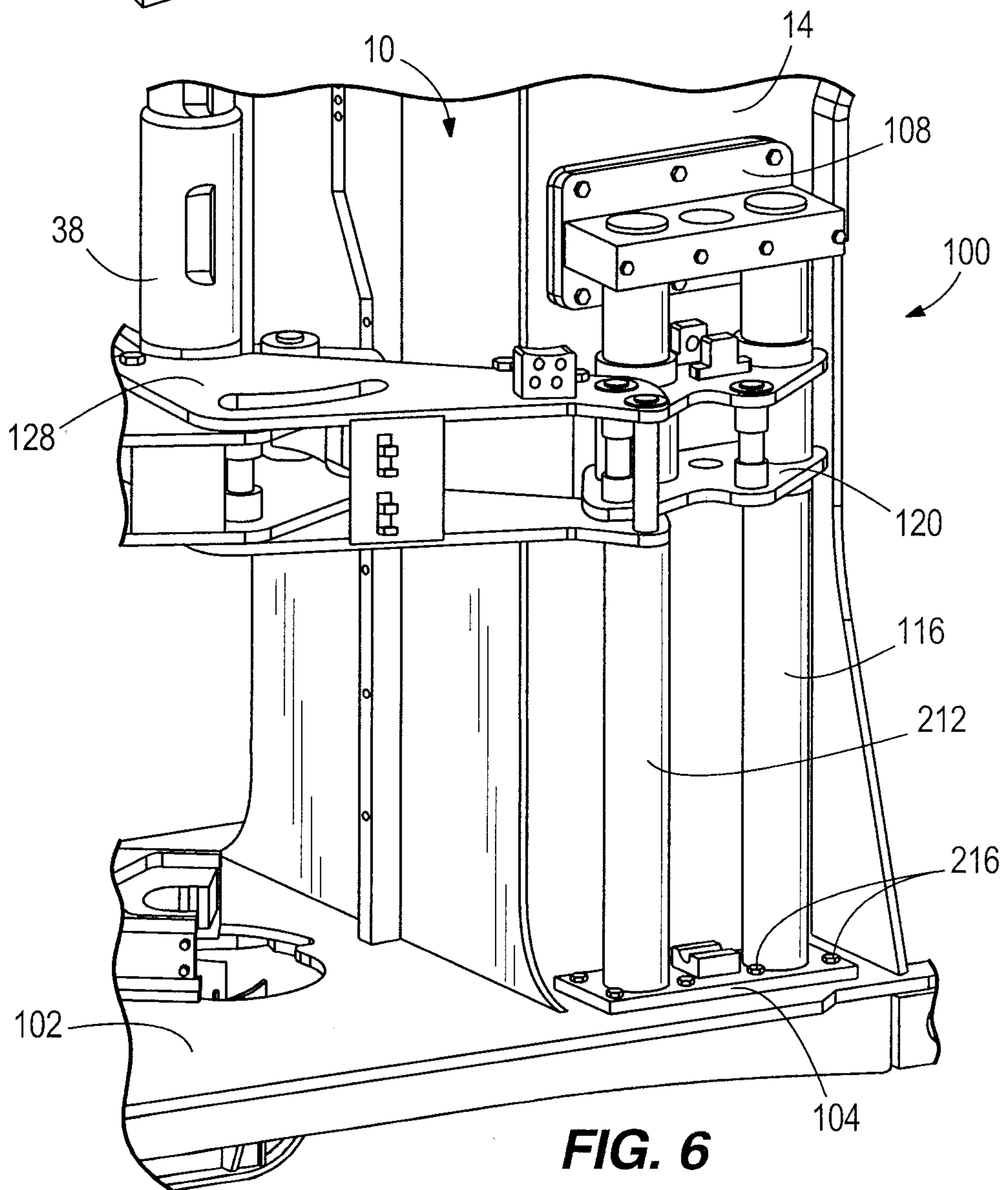
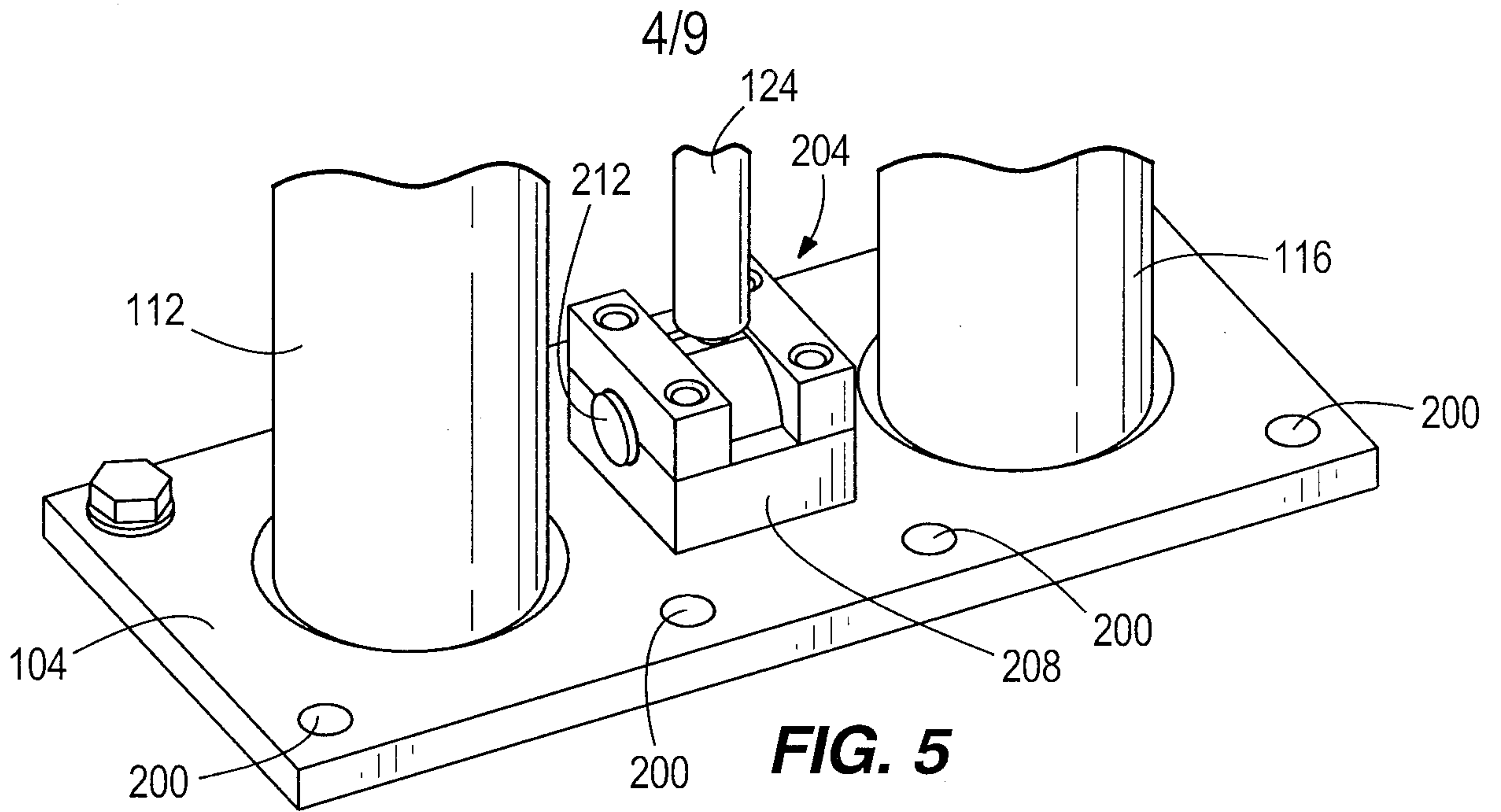


FIG. 2A

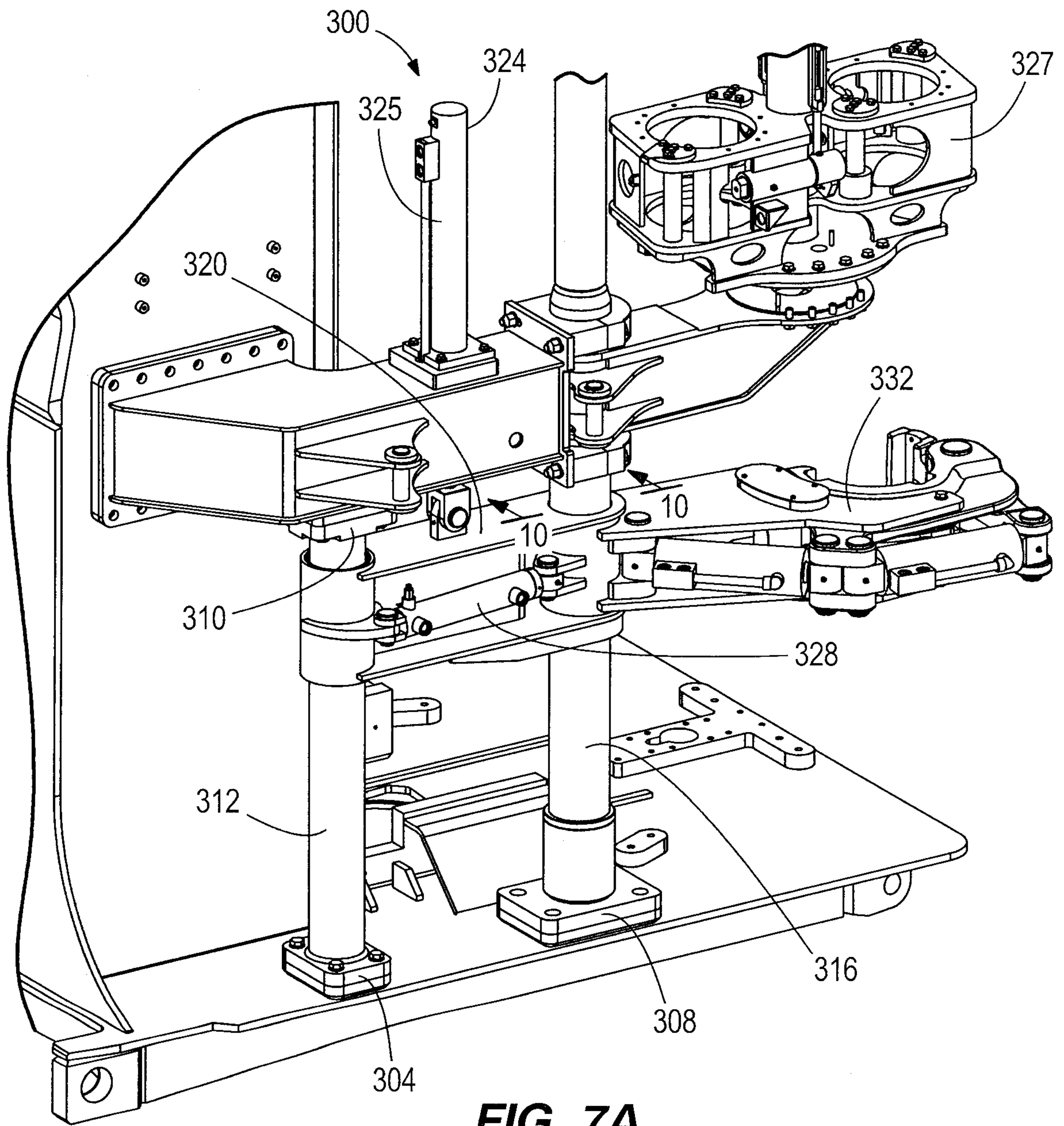
FIG. 2B

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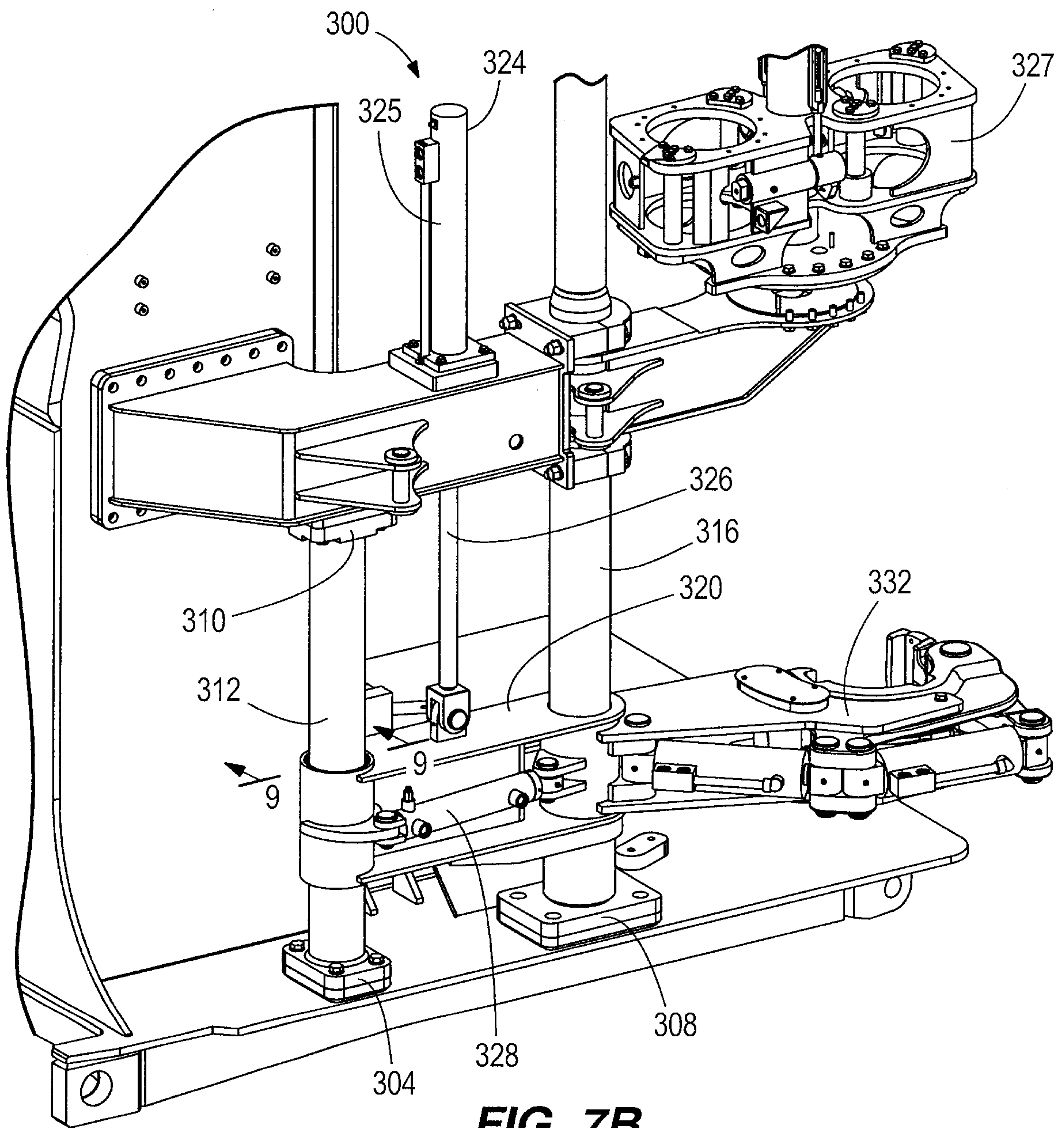


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**FIG. 7A**

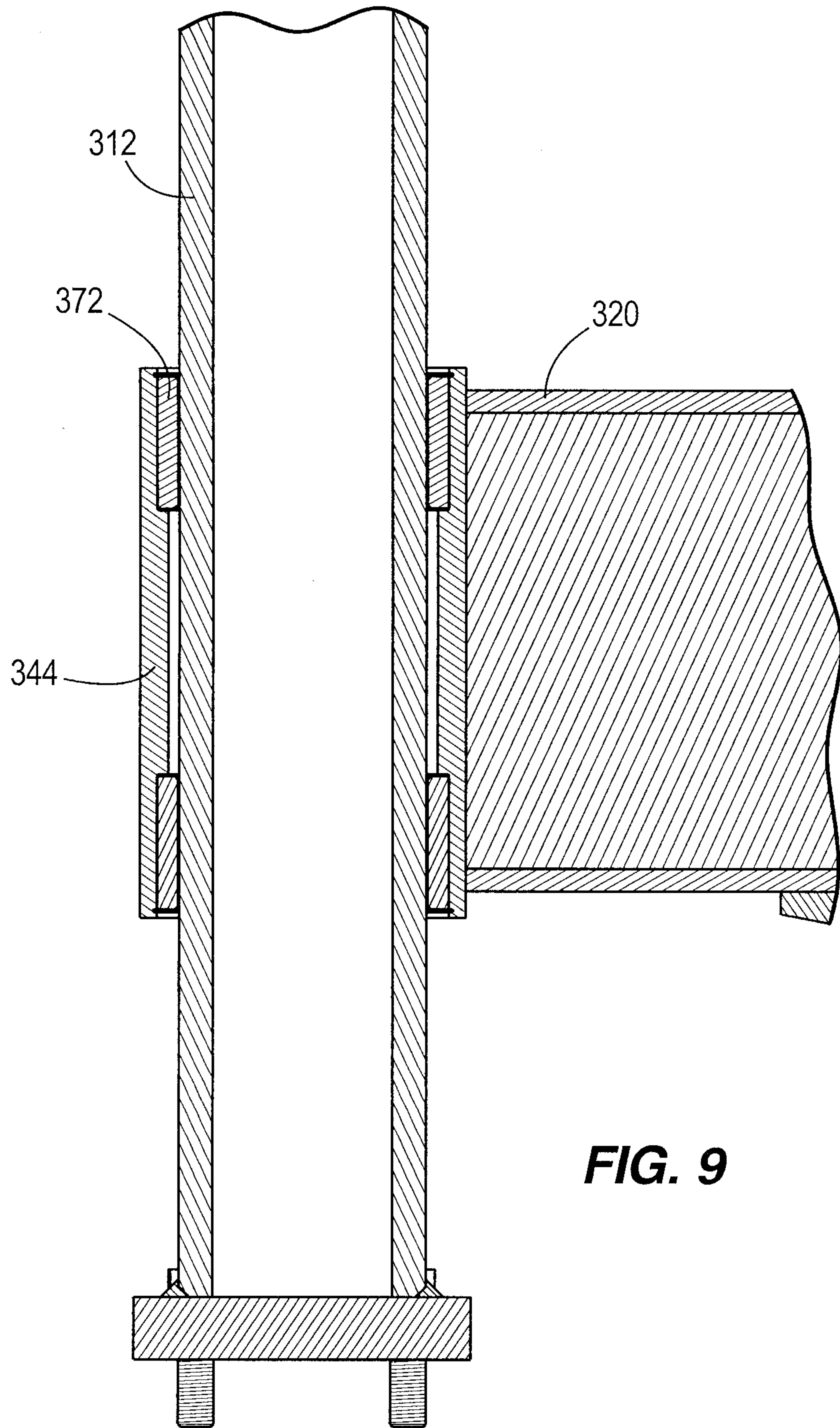
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**FIG. 7B**

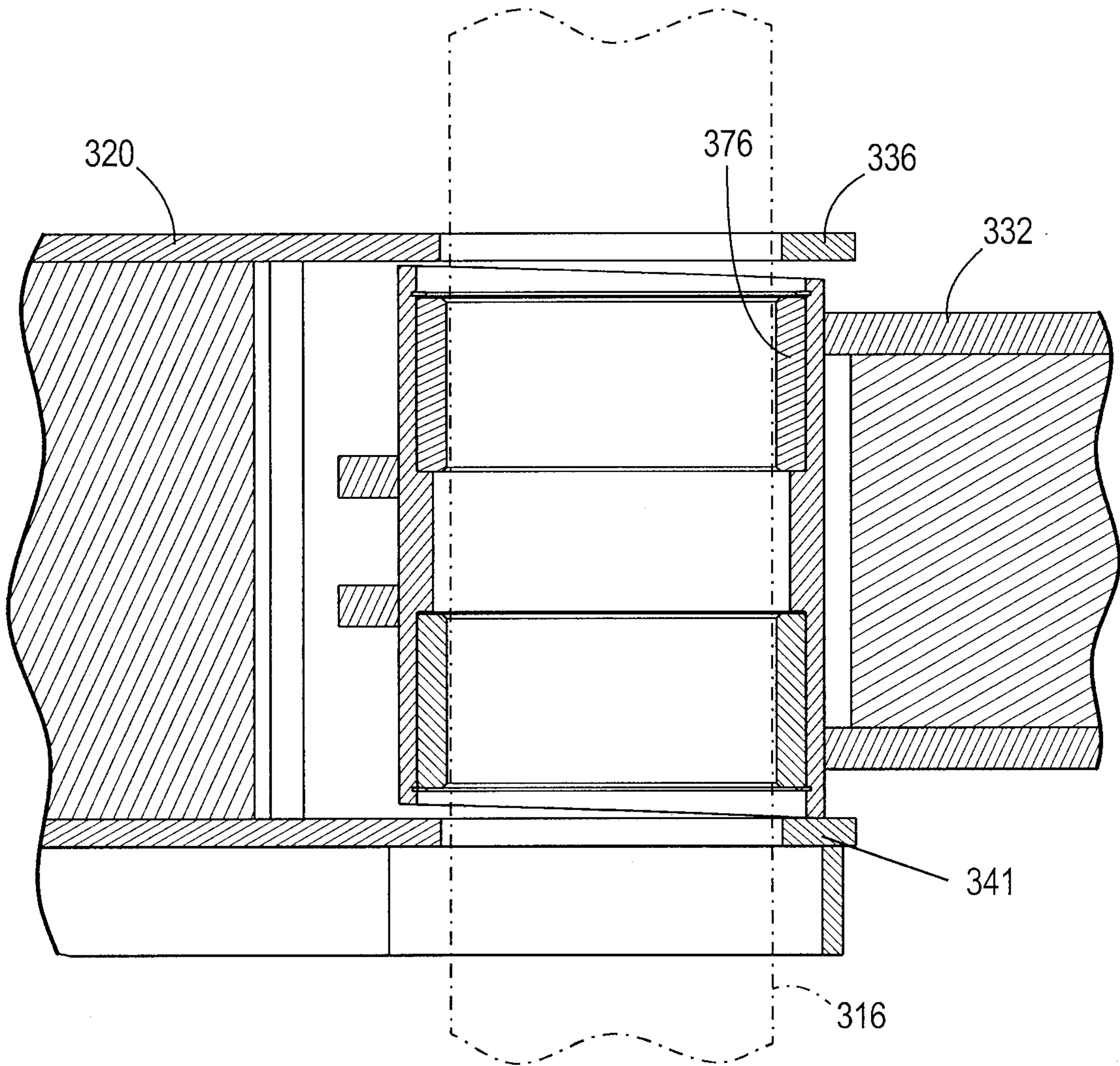


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**FIG. 9**

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**FIG. 10**

