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(71) Applicant: **Sandvik SRP AB**
233 81 Svedala (SE)

(72) Inventors:
- **LARSSON, Mikael**
  23381 Svedala (SE)
- **BENGTSSON, Andreas**
  23381 Svedala (SE)
- **ANNERFELDT, Per-Olof**
  23381 Svedala (SE)

(74) Representative: **Sandvik**
Sandvik Intellectual Property AB
811 81 Sandviken (SE)

(54) **A CONE CRUSHER PINION SHAFT ASSEMBLY RING**

(57) A cone crusher pinion shaft assembly ring (210,220, 225) for temporarily supporting a pinion shaft (130) having a pinion shaft inner end (140) and a pinion shaft outer end (150) in a pinion shaft housing (160) of a pinion shaft housing assembly (200), the pinion shaft assembly ring (210,220, 225) comprising an annular body (300) having an upper surface (310) and an opposite lower surface (320), and an opening (330) in the annular body (300) for receiving the pinion shaft first end (140) wherein the annular body (300) and the opening (330) are configured to positionally fix the pinion shaft inner end (140) or the pinion shaft outer end (150) in position within the pinion shaft housing (160) during assembly of the pinion shaft housing assembly (200). The invention also relates to the use of the assembly ring (210,220,225) and to a method of forming a sealed cone crusher pinion shaft assembly (100).

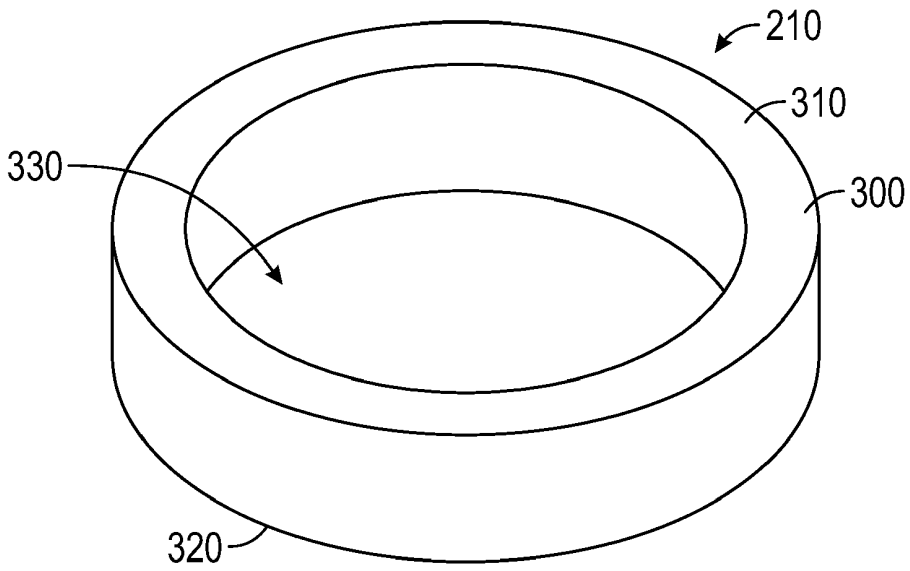

FIG. 5

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Description

Field of the Invention

[0001] This invention relates to a cone crusher pinion shaft assembly ring and to the use of the pinion shaft assembly ring to fix a pinion shaft in position in a pinion shaft housing during assembly of a pinion shaft housing assembly. The invention also relates to a method of forming a sealed cone crusher pinion shaft assembly.

Background to the Invention

[0002] Cone or gyratory crushers, hereinafter referred to collectively as cone crushers, are used for crushing and size reducing hard materials such as ore, mineral and rock. The crusher generally includes a top shell, a central crusher shaft for operation of the top shell, a bottom shell and a frame. The top shell comprises a crushing head mounted to an upper end of the central crusher shaft, an inner crushing shell (referred to as an inner shell or mantle) mounted to the crushing head, and a second crushing shell (referred to as an outer shell or concave) mounted to a frame so that a crushing chamber is defined between the inner shell and outer shell.

[0003] A driven pinion shaft housing assembly is operatively connected to the central crusher shaft to effect rotation of the inner shell within the outer shell about an eccentric (gyratory) axis to crush material passed into the crushing chamber. The pinion shaft housing assembly is generally made up of a pinion shaft rotatably mounted between end bearings in a sealed bearing assembly housing.

[0004] However, it has been found that pinion shaft housing assemblies can be prone to leakage due to damaged seal rings and/or bearings with the damage typically having been caused during assembly of the pinion shaft housing assembly. More particularly, during the assembly process, the pinion shaft is not secured in position within the housing with the result that axial and/or radial movement of the pinion shaft can occur during manipulation of the pinion shaft assembly causing the pinion shaft to impact and damage the seals and/or bearings resulting in leakages. Similarly, where the seal rings are used to secure the pinion shaft during the assembly process damage can also occur. Moreover, the damage to the seals and/or bearings may remain undetected and the resulting leakages may only manifest after delivery of a cone crusher to a customer and when the cone crusher is put to use.

[0005] It is an object of the invention to overcome at least one of the above-referenced problems.

Summary of the Invention

[0006] According to the invention there is provided a cone crusher pinion shaft assembly ring for temporarily supporting a pinion shaft having a pinion shaft first end and a pinion shaft second end in a pinion shaft housing of a pinion shaft housing assembly, the pinion shaft assembly ring comprising:

an annular body having an upper surface and an opposite lower surface, and

an opening in the annular body for receiving the pinion shaft first end or the pinion shaft second end wherein the annular body and the opening are configured to positionally fix the pinion shaft first end or the pinion shaft second end in position within the pinion shaft housing during assembly of the pinion shaft housing assembly. The assembly ring therefore supports the pinion shaft to prevent the pinion shaft from moving during assembly of the pinion shaft housing assembly thereby avoiding damage to seals and bearings so that leaks are prevented.

[0007] In any embodiment, the opening is sized and shaped to securely receive the pinion shaft first end or second end in an inner interference fit. The inner interference fit ensures that the pinion shaft is gripped by the opening.

[0008] In any embodiment, the annular body is sized and shaped to extend between the pinion shaft first end or the pinion shaft second end and a housing assembly and axially support the pinion shaft first end or the pinion shaft second end in the housing assembly. The axial support serves to prevent axial movement of the pinion shaft to prevent damage to the housing assembly.

[0009] In any embodiment, the annular body is sized and shaped to extend between the pinion shaft first end or the pinion shaft second end a housing assembly and radially support the pinion shaft first end or the pinion shaft second end in the housing assembly. The radial support serves to prevent radial movement of the pinion shaft to prevent damage to the housing assembly.

[0010] In one embodiment, the annular body is sized and shaped to extend between the pinion shaft first end or the pinion shaft second end and a housing assembly in an outer interference fit. The outer interference fit ensures that the assembly ring is gripped by the housing assembly.

[0011] In any embodiment, one of the upper and lower surfaces of the assembly ring is contoured to be complementarily engageable with a crusher pinion shaft housing seal ring. The assembly ring can therefore serve a dual function by temporarily supporting a pinion shaft during assembly of the pinion shaft housing assembly and being adapted for use as a tool to press a seal into place in the housing assembly. Suitably, the upper or lower surface is contoured to define a recess complementary with the pinion shaft housing seal ring. The recess can therefore receive a seal ring in a mating relationship.

[0012] In another embodiment, the invention also extends to the use of a pinion shaft assembly ring as hereinbefore defined to temporarily fix in position a pinion shaft in a pinion shaft housing of a pinion shaft housing

assembly during assembly of the pinion shaft housing assembly. Use of the assembly ring serves to prevent undetectable damage to seals and bearings during the pinion shaft housing assembly manufacturing process.

[0013] In one embodiment, a first pinion shaft assembly ring fixes the pinion shaft first end in position in the housing and a second assembly ring fixes the pinion shaft second end in position in the housing. The use of an assembly ring at each end of the pinion shaft securely prevents movement of the pinion shaft.

[0014] In another embodiment, the invention also extends to a method of forming a sealed cone crusher pinion shaft assembly comprising a pinion shaft having a pinion shaft first end and a pinion shaft second end, and an outer housing having a housing first end opening and a housing second end opening, the method comprising:

mounting a first bearing on the pinion shaft first end;
orienting the housing in an upright position to receive the pinion shaft;
inserting the pinion shaft second end through the housing second end opening to form an unsealed pinion shaft assembly;
mounting a first pinion shaft assembly ring at the pinion shaft first end between the pinion shaft and the housing to support the pinion shaft first end in the housing towards its first end;
mounting a second pinion shaft assembly ring at the pinion shaft second end between the pinon shaft and the housing to support the pinion shaft in the housing towards its second end;
inverting the unsealed pinion shaft assembly;
removing the second pinion shaft assembly ring;
mounting a second bearing on the pinion shaft second end;
sealing the housing second end opening;
removing the first pinion shaft assembly ring, and
sealing the housing first end opening to form the sealed cone crusher pinion shaft housing assembly.
The assembly rings support and fix the pinion shaft in position during manipulation of the housing assembly so that damage to the seals and bearings is avoided to prevent leakages.

[0015] In one embodiment, the method further comprises the step of reinverting the unsealed pinion shaft assembly before removing the first assembly ring. By reinverting the unsealed pinion shaft assembly, ease of access to the first assembly ring and housing first end is facilitated

[0016] In one embodiment, the method further comprises the steps of temporarily attaching a first bearing cover over the housing first end opening after mounting the first assembly ring at the pinion shaft first end and removing the first bearing cover to remove the first pinion shaft assembly ring, and temporarily attaching a second bearing cover to the housing second end opening after mounting the second pinion shaft assembly ring at the pinion shaft second end and removing the second bearing cover to remove the second pinion shaft assembly ring. The bearing covers assist in containing the assembly rings within the housing.

[0017] In one embodiment, the method further comprises the steps of attaching the second bearing cover over the housing second end opening when sealing the housing second end opening and attaching the first bearing cover to the housing first end opening when sealing the housing first end opening. The bearing covers together with the seals ensure that the pinion shaft housing assembly is effectively sealed.

[0018] Optionally, in one embodiment, the housing second end opening is sealed with at least one second end seal ring and the second assembly ring is contoured to complementarily engage the at least one second end seal ring and the method further comprises the step of pressing the second end seal ring into position with the second assembly ring. Accordingly, the contoured second assembly ring can also be used as a seal pressing tool.

[0019] In one embodiment of the method, the second assembly ring comprises at least one recess to complementarily engage the at least one second end seal ring so that the second assembly ring can receive the second end seal ring.

[0020] The assembly rings of the invention the invention axially and/or radially secure pinion shafts in position during manufacture of pinion shaft housing assemblies. Accordingly, the seals and bearings are also not required to support the pinion shaft during assembly. The assembly rings therefore ensure that seals and bearings remain intact and undamaged during manipulation of the pinion shaft housing assembly so that leakages resulting from damage to the seals and/or bearings caused by the pinion shaft are eliminated.

Brief Description of the Drawings

[0021] The invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a cross-section view through a cone crusher having a sealed pinion shaft housing assembly assembled in accordance with the method of the invention;

Figure 2 is an enlarged perspective view from above and the inner end of the sealed pinion shaft housing assembly of Figure 1;

Figure 3 is an enlarged perspective view from above and the outer end of the sealed pinion shaft housing assembly of Figure 1;

Figure 4 is a cross-section view through the assembled and sealed pinion shaft housing assembly of

Figures 2 and 3;

Figure 5 is an enlarged perspective view from above and one side of a first embodiment of an assembly ring of the invention for use in temporarily supporting a pinion shaft in a pinion shaft housing of a pinion shaft housing assembly during the assembly of the pinion shaft housing assembly of Figures 2 to 4;

Figure 6 is a cross-sectional view through the pinion shaft assembly ring of Figure 5;

Figure 7 is a top plan view of the pinion shaft assembly ring of Figure 6;

Figure 8 is an enlarged perspective view from above and one side of a second embodiment of an assembly ring of the invention in which the assembly ring is configured to temporarily support a pinion shaft second or outboard end in a pinion shaft housing during assembly of the pinion shaft housing assembly;

Figure 9 is a cross-sectional view through the pinion shaft assembly ring of Figure 8;

Figure 10 is a top plan view of the pinion shaft assembly ring of Figure 8;

Figure 11 is an enlarged perspective view from above and one side of a third embodiment of an assembly ring of the invention for use in temporarily supporting a pinion shaft in a pinion shaft housing in which the upper surface of the assembly ring is contoured to be complementarily engageable with a crusher pinion shaft housing seal ring;

Figure 12 is a cross-sectional view through the pinion shaft assembly ring of Figure 11;

Figure 13 is a top plan view of the pinion shaft assembly ring of Figure 11;

Figure 14 is a partially exploded perspective view from above and one side of a pinion shaft housing assembly being assembled with the housing assembly vertically mounted on a support with inner/inboard end disposed upwards and the (inner) assembly ring of Figures 5 to 7 being mounted on the inboard end of the pinion shaft between the pinion shaft and the housing;

Figure 15 is a perspective view from above and one side of the pinion shaft housing assembly of Figure 14 with the inner bearing cover secured to the housing;

Figure 16 is a partially exploded perspective view from above and one side of the pinion shaft housing assembly of Figure 15 (with the support omitted for clarity) with the housing assembly mounted on a support and the (outer) assembly ring of Figures 8 to 10 being mounted on the outer/outboard end of the pinion shaft between the pinion shaft and the housing;

Figure 17 is a perspective view from above and one side of the pinion shaft housing assembly of Figure 16 with the outer bearing cover secured to the housing;

Figure 18 is a cross-sectional view through the housing assembly with the assembly rings mounted between the pinion shaft and the housing at each end of the pinion shaft to form an unsealed pinion shaft assembly;

Figure 19 is a perspective view from above and one side of the housing assembly of Figure 17 in a horizontal position with the lifting eye bolt being removed from the inboard end of the housing assembly;

Figure 20 is a perspective view from above and one side of the housing assembly of Figure 19 with the lifting eye bolt being inserted in the outboard end of the housing assembly to invert the housing assembly on the support;

Figure 21 is a partially exploded perspective view of the housing assembly of Figure 20 vertically mounted on the support with the outboard end disposed upwards and the outer assembly ring being removed from the housing;

Figure 22 is a partially exploded perspective view from above and one side of the housing assembly vertically mounted on the support with the inboard end disposed upwards with the inner assembly ring being removed from the housing assembly;

Figure 23 is a cross-sectional view through the outboard end of a sealed pinion shaft housing with the uncontoured surface of the assembly ring of Figures 11 to 13 being urged against a first seal of the housing assembly to press the seal into position at the bearing cover, and

Figure 24 is a cross-sectional view through the outboard end of a sealed pinion shaft housing with the contoured surface of the assembly ring of Figures 11 to 13 being urged against a second seal of the housing assembly to press the seal into position at the bearing cover.

Detailed Description of the Invention

[0022] Referring to Figure 1, a crusher 1 is generally

made up of a frame 10 having an upper frame 20, a lower frame 30 and a crushing head 40 mounted on a rotatable elongate main shaft 50. A first inner crushing shell 60 is fixedly mounted on the crushing head 40, a second outer crushing shell 70 is fixedly mounted at the upper frame 20 to define a crushing zone 80 between the opposed inner and outer shells 60,70. A discharge zone 90 defined in part by the lower frame 30 is positioned below the crushing zone 80.

[0023] A drive (not shown) is coupled to the main shaft 50 via a pinion shaft housing assembly 100 and suitable gearing 110 to effect eccentric rotation of the main shaft 50 about its longitudinal axis 120 to cause the crushing head 40 to perform a gyratory pendulum movement and crush material introduced into the crushing zone 80. If desired, the pinion shaft housing assembly 100 can be directly driven.

[0024] As shown in Figures 2 to 4, the pinion shaft housing assembly 100 is made up of an elongate pinion shaft 130 having a first inboard end 140 for receiving a pinion (not shown) and a second outboard end 150 connectable with the drive (not shown). The pinion shaft 130 is mounted in a cylindrical housing 160 having an open first inboard end opening 170 and an open second outboard end opening 180 at respective first inboard and second outboard bearings 190,230 with the pinion shaft inboard and outboard ends 140,150 projecting from the housing 160. The housing assembly 100 is closed at its inboard and outboard end openings 170,180 by first inner and second outer bearing covers 250,260 respectively. The housing assembly 100 is sealed at the first inner bearing cover 250 by at least one inboard end seal ring 270 and at the second outer bearing cover 260 by at least one, and typically first and second as shown, outboard end seal rings 290.

[0025] Figures 5 to 7 show a first embodiment of an assembly ring 210 of the invention for use in temporarily supporting the pinion shaft 130 in the pinion shaft housing 160 during the assembly of the pinion shaft housing assembly 100 of Figures 2 to 4. The assembly ring 210 is made up of an annular body 300 having an upper surface 310 and an opposite lower surface 320. The annular body 300 defines a central opening 330 for receiving the pinion shaft first or inboard end 140 to securely hold the inboard end 140 in the assembly ring 210. i.e. the opening 330 is sized and shaped to securely receive the pinion shaft inboard end 140 typically in a releasable interference fit. Similarly, the annular body 300 is sized and shaped to extend between the pinion shaft first end 140 and the housing 160, typically in an interference fit, to axially and/or radially support the pinion shaft first end 140 the housing assembly 100. Accordingly, as shall be explained more fully below, the assembly ring 210 is an inner or inboard assembly ring 210 configured to positionally fix the pinion shaft inboard end 140 in position within the pinion shaft housing 160 during assembly of the pinion shaft housing assembly 100.

[0026] Figures 8 to 10 show a second embodiment of the assembly ring of the invention in which the assembly ring is a second or outboard assembly ring 220 configured to temporarily support the pinion shaft 130 second or outboard end 150 in the pinion shaft housing 160 during assembly of the pinion shaft housing assembly 100. The outboard assembly ring 220 is similar to the inboard assembly ring 210 of Figures 5 to 7 and like numerals indicate like parts. More particularly, the outboard assembly ring 220 is made up of the annular body 300 with an upper surface 310 and an opposite lower surface 320 and an opening 330 in the annular body 300 for receiving the pinion shaft first end 150. In the present embodiment, the annular body 300 and the opening 330 are sized differently to the annular body 300 to be complementary with and conform to the pinion shaft outboard end 150 which differs in size and shape to the pinion shaft inboard end 140. Accordingly, the outboard assembly ring 220 is also sized and shaped to securely receive the pinion shaft outboard end 150 and axially and/or radially fix the pinion shaft outboard end 150 in position in the housing 160 using interference fits.

[0027] Figures 11 to 13 show a third embodiment of an assembly ring of the invention in which the assembly ring 225 is similar to the assembly rings 220 of Figures 8 to 10 and like numerals indicate like parts. However, in the present embodiment, the upper surface 310 of the assembly ring 225 is contoured to be complementarily engageable with a crusher pinion shaft housing seal ring 290 so that the seal ring 270 can be received by the assembly ring 225 pressed into place in the housing following removal of the assembly ring 225 from the housing 160 during the assembly process. More particularly, the upper surface 310 is contoured to define a circular recess or groove 280 configured to be complementary in size and shape with the pinion shaft housing seal ring 290 so that the recess 280 can receive the seal ring 290. Accordingly, the assembly ring 225 of the present embodiment is a dual function assembly ring 225 in that it can be used, firstly, as an assembly ring 225 to temporarily fix in position a pinion shaft 130 in a pinion shaft housing 160 during assembly of a pinion shaft housing assembly 200 and, secondly, as a tool for pressing a seal 290 into place following its removal from the housing 160.

[0028] The assembly ring 210,220,225 of the invention can be formed from any suitable materials such as metals, alloys, rubbers, plastics, alumina etc. and the like.

[0029] Figures 14 to 22 describe the use of the assembly rings 210,220 of Figures 5 to 10 in the assembly of the pinion shaft housing assembly 100 shown in Figures 1 to 4. As shown in Figure 14, the pinion shaft housing 160 is first supported in a vertically upright position on a support 360 with the housing inboard end opening 170 disposed upwards and the housing outboard end 180 opening disposed downwards. The pinion shaft 130 fitted with the inboard bearing 190 (not visible in Figures 14 and 15) is then lowered into the housing 160 via a lifting eye bolt 380 fitted at the pinion shaft inboard end 140 so that the pinion shaft inboard end 140 is located at the

housing inboard end opening 170 and the pinion shaft outboard end 150 is located at the housing outboard end 180 opening. The inner assembly ring 210 of Figures 5 to 7 is then installed over the pinion shaft 130 at the pinion shaft inboard end 140 by placing the opening 330 over the pinion shaft 130. The pinion shaft inboard end 140 is therefore secured by the opening 130 in an inner interference fit 340 (see also Figure 18) while the annular body 300 extends between the pinion shaft inboard end 140 and the housing 160 to radially and/or axially fix and support the pinion shaft inboard end 140 in the housing 160 via an outer interference fit 350 (see also Figure 18).

[0030] The inner bearing cover 250 is then temporarily attached to the housing 160 at the housing inboard end opening 170 with screws and washers 370 as shown in Figure 14.

[0031] As shown in Figure 16, the outer assembly ring 220 of Figures 8 to 10 is then installed over the pinion shaft 130 at the pinion shaft outboard end 150 by placing the opening 330 over the pinion shaft 130. The pinion shaft outboard end 150 is therefore secured by the opening 330 in an inner interference fit 340 (see also Figure 18) while the annular body 300 extends between the pinion shaft outboard end 150 and the housing 160 to radially and/or axially fix and support the pinion shaft outboard end 150 in the housing 160 via an outer interference fit 350 (see also Figure 18).

[0032] The outer bearing cover 260 is then attached to the housing 160 at the housing outboard end opening 180 with screws and washers 370 as shown in Figure 16.

[0033] Figure 18 shows a cross-sectional view through the housing assembly with the inner and outer assembly rings 210,220 mounted between the pinion shaft 130 and the housing 160 at each end 140,150 of the pinion shaft 130 to form an unsealed pinion shaft assembly 200. As shown in the drawing, each assembly ring 210,220 defines an inner interference fit 340 between the assembly rings 210,220 and the pinion shaft 130 and an outer interference fit 350 between the assembly rings 210,220 and the housing 160 at each end 140,150 of the pinion shaft 130 to prevent axial and/or radial movement of the pinion shaft 130 in the unsealed pinion shaft assembly 200.

[0034] As shown in Figures 19 and 20, the lifting eye bolt 380 is then removed from the pinion shaft inboard end 140 and inserted in the pinion shaft outboard end 150

[0035] The unsealed pinion shaft housing assembly 200 is then lifted via the lifting eye bolt 380, inverted and vertically supported in the support 360 so that the pinion shaft inboard end 140 is disposed downwards and the pinion shaft outboard end is disposed upwards as shown in Figure 21. The lifting eye bolt 380 is then removed together with the screws and washers 370 and outboard bearing cover 260 from the housing 160. The outer assembly ring 220 is then removed so that the outboard bearing 230 (see Figure 4) can be installed together with the outboard end seal rings 290, spacers, retaining rings and the like.

[0036] The outer bearing cover 260 is then re-attached with the screws and washers 370 and the lifting eyebolt 380 attached to the pinion shaft inboard end 140 to re-invert the unsealed pinion shaft assembly so that the pinion shaft outboard end 150 is disposed downwards and the pinion shaft inboard end 140 is disposed upwards in the support 360 as shown in Figure 22. The screws and washers 370 together with the inboard bearing cover 250 are then removed along with the inner assembly ring 210 and the inboard end seal ring 270 together with spacers, retaining rings and the like are installed to form the sealed pinion shaft housing assembly 100 shown in Figures 2 to 4.

[0037] The sealed pinion shaft housing assembly 100 has seals 270,290 and bearings 190,230 which remain undamaged as the assembly rings 210,22 prevented axial and/or radial movement of the pinion shaft 130 during the assembly process. More particularly, during manipulation (e.g. inversion) of the pinion shaft housing assembly during the assembly process, the pinion shaft 130 remains positionally fixed both radially and axially by the inner and outer assembly rings 210,220 so that damage to the seals 270, 290 and bearings 190,230 previously resulting from pinion shaft 130 movement is prevented.

[0038] Figures 23 and 24 show the use of the assembly ring 225 of Figures 11 to 13 as a tool for pressing seals 270,290 into place in the housing assembly 100. More particularly, the assembly ring 225 can be used as an outer assembly ring 225 in the same way as the assembly ring 220 described above. However, following its removal from the housing 160 as described in relation to Figure 21 above, the uncontoured lower 320 surface of the assembly ring 225 can be urged against a first seal 270 of the housing assembly 100 to press the seal 270 into position at the outer bearing cover 260 (see Figure 23). Similarly, as shown in Figure 24, the outer assembly ring 225 can be reversed so that the contoured surface 310 of the assembly ring 225 can receive a second seal ring 290 disposed over the first seal ring 270 in its recess 280 in a complementary manner to press the second seal ring 290 into position against the first seal ring 270 at the outer bearing cover 260. The assembly ring 225 can therefore serve a dual function as an assembly ring and a seal pressing tool.

Claims

1. A cone crusher pinion shaft assembly ring (210,220, 225) for temporarily supporting a pinion shaft (130) having a pinion shaft first end (140) and a pinion shaft second end (150) in a pinion shaft housing (160) of a pinion shaft housing assembly (200), the pinion shaft assembly ring (210,220, 225) comprising: an annular body (300) having an upper surface (310) and an opposite lower surface (320), and
an opening (330) in the annular body (300) for receiving the pinion shaft first end (140) or the pinion

shaft second end (150) wherein the annular body (300) and the opening (330) are configured to positionally fix the pinion shaft first end (140) or the pinion shaft second end (150) in position within the pinion shaft housing (160) during assembly of the pinion shaft housing assembly (200).

2. A cone crusher pinion shaft assembly ring (210,220, 225) as claimed in Claim 1 wherein the opening (330) is sized and shaped to securely receive the pinion shaft first end (140) or second end (150) in an inner interference fit (340).

3. A cone crusher pinion shaft assembly ring (210,220,225) as claimed in Claim 1 or Claim 2 wherein the annular body (300) is sized and shaped to extend between the pinion shaft first end (140) or the pinion shaft second end (150) and a housing assembly (200) and axially support the pinion shaft first end (140) or the pinion shaft second end (150) in the housing assembly (200).

4. A cone crusher pinion shaft assembly ring (210.220,225) as claimed in Claim 3 wherein the annular body (300) is sized and shaped to extend between the pinion shaft first end (140) or the pinion shaft second end (150) and a housing assembly (200) and radially support the pinion shaft first end (140) or the pinion shaft second end (150) in the housing assembly (200).

5. A cone crusher pinion shaft assembly ring (210.220,225) as claimed in Claim 4 wherein the annular body (300) is sized and shaped to extend between the pinion shaft first end (140) or the pinion shaft second end (150) and a housing assembly (200) in an outer interference fit (350).

6. A cone crusher pinion shaft assembly ring (210,220,225) as claimed in any of Claims 1 to 5 wherein one of the upper and lower surfaces (310,320) is contoured to be complementarily engageable with a crusher pinion shaft housing seal ring (290).

7. Use of a pinion shaft assembly ring (210,220,225) as claimed in any of Claims 1 to 6 to temporarily fix in position a pinion shaft (130) in a pinion shaft housing (160) of a pinion shaft housing assembly (200) during assembly of the pinion shaft housing assembly (200).

8. Use as claimed in Claim 7 wherein a first pinion shaft assembly ring (210) fixes the pinion shaft first end (140) in position in the housing (160) and a second assembly ring (220) fixes the pinion shaft second end (150) in position in the housing (160).

9. A method of forming a sealed cone crusher pinion shaft assembly (100) comprising a pinion shaft (130) having a pinion shaft first end (140) and a pinion shaft second end (150), and an outer housing (160) having a housing first end opening (170) and a housing second end opening (180), the method comprising:

mounting a first bearing (190) on the pinion shaft first end (140);
orienting the housing (160) in an upright position to receive the pinion shaft (130);
inserting the pinion shaft second end (150) through the housing second end opening (180) to form an unsealed pinion shaft assembly (200);
mounting a first pinion shaft assembly ring (210) at the pinion shaft first end (140) between the pinion shaft (130) and the housing (160) to support the pinion shaft first end (140) in the housing (160) towards its first end (140);
mounting a second pinion shaft assembly ring (220,225) at the pinion shaft second end (150) between the pinon shaft (130) and the housing (160) to support the pinion shaft (130) in the housing (160) towards its second end (150);
inverting the unsealed pinion shaft assembly (200);
removing the second pinion shaft assembly ring (220,225);
mounting a second bearing (230) on the pinion shaft second end (150);
sealing the housing second end opening (180);
removing the first pinion shaft assembly ring (210), and
sealing the housing first end opening (170) to form the sealed cone crusher pinion shaft housing assembly (240).

10. A method as claimed in Claim 9 further comprising the step of reinverting the unsealed pinion shaft assembly (200) before removing the first assembly ring (210).

11. A method as claimed in Claim 9 or Claim 10 further comprising the steps of temporarily attaching a first bearing cover (250) over the housing first end opening (170) after mounting the first assembly ring (210) at the pinion shaft first end (130) and removing the first bearing cover (250) to remove the first pinion shaft assembly ring (210), and temporarily attaching a second bearing cover (260) to the housing second end opening (180) after mounting the second pinion shaft assembly ring (220) at the pinion shaft second end (150) and removing the second bearing cover (260) to remove the second pinion shaft assembly ring (220,225).

12. A method as claimed in Claim 11 further comprising

the steps of attaching the second bearing cover (260) over the housing second end opening (180) when sealing the housing second end opening (180) and attaching the first bearing cover (250) to the housing first end opening (170) when sealing the housing first end opening (170).

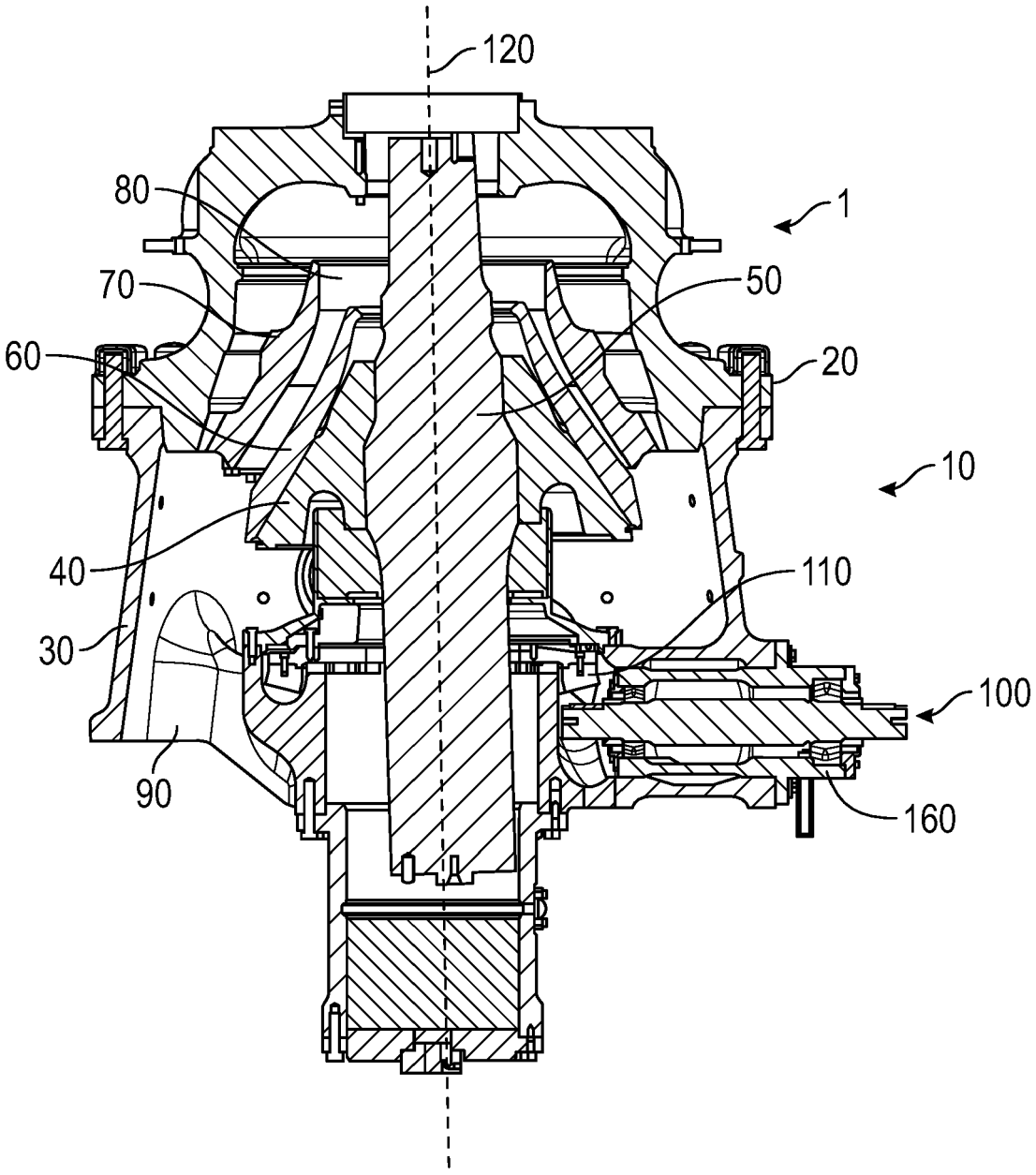


FIG. 1

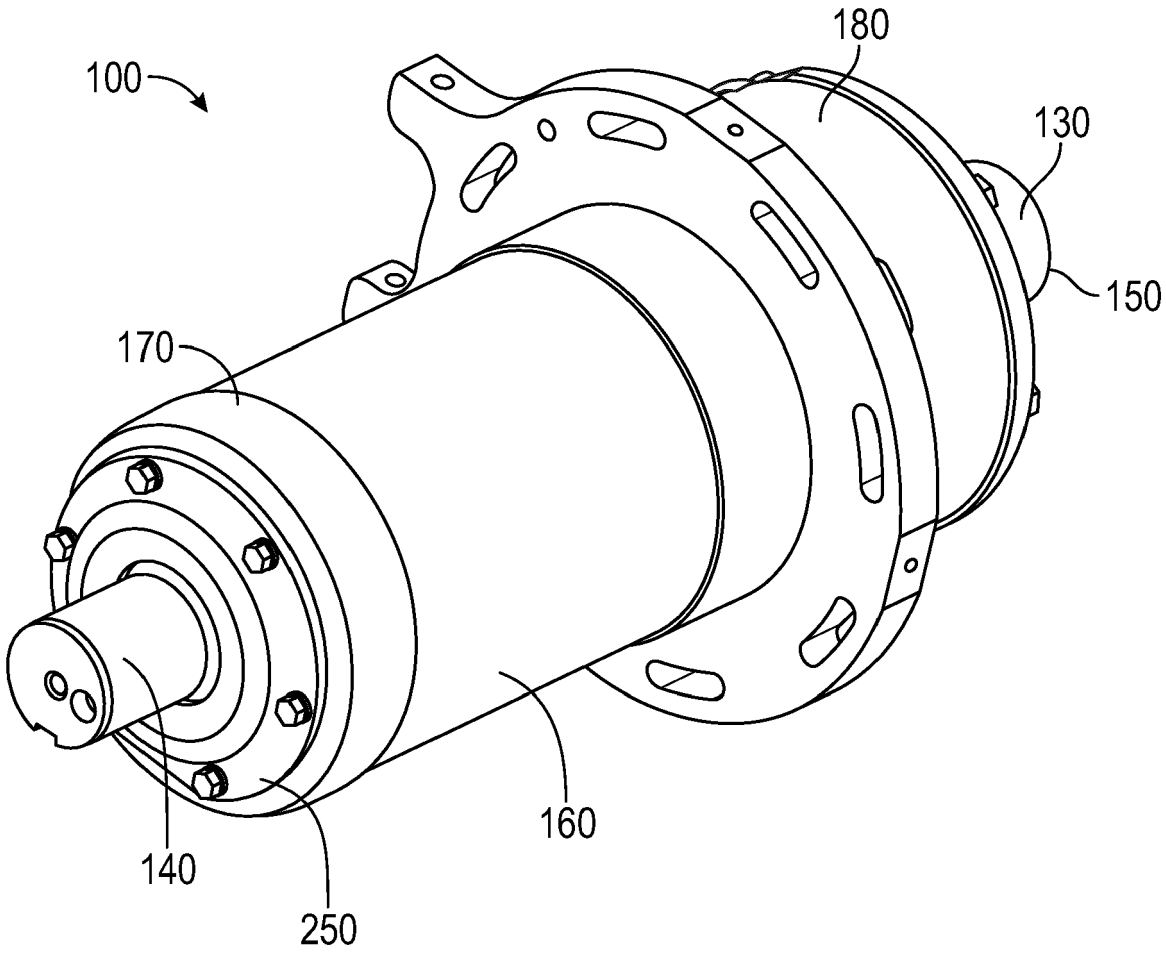


FIG. 2

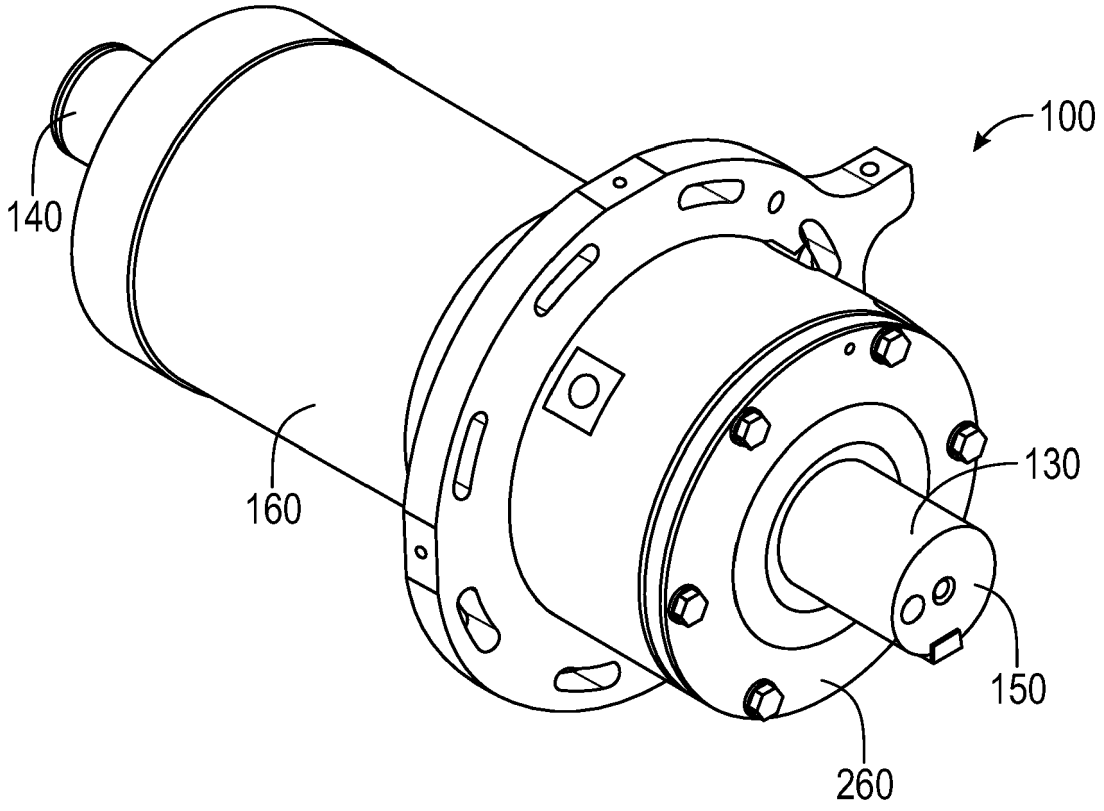


FIG. 3

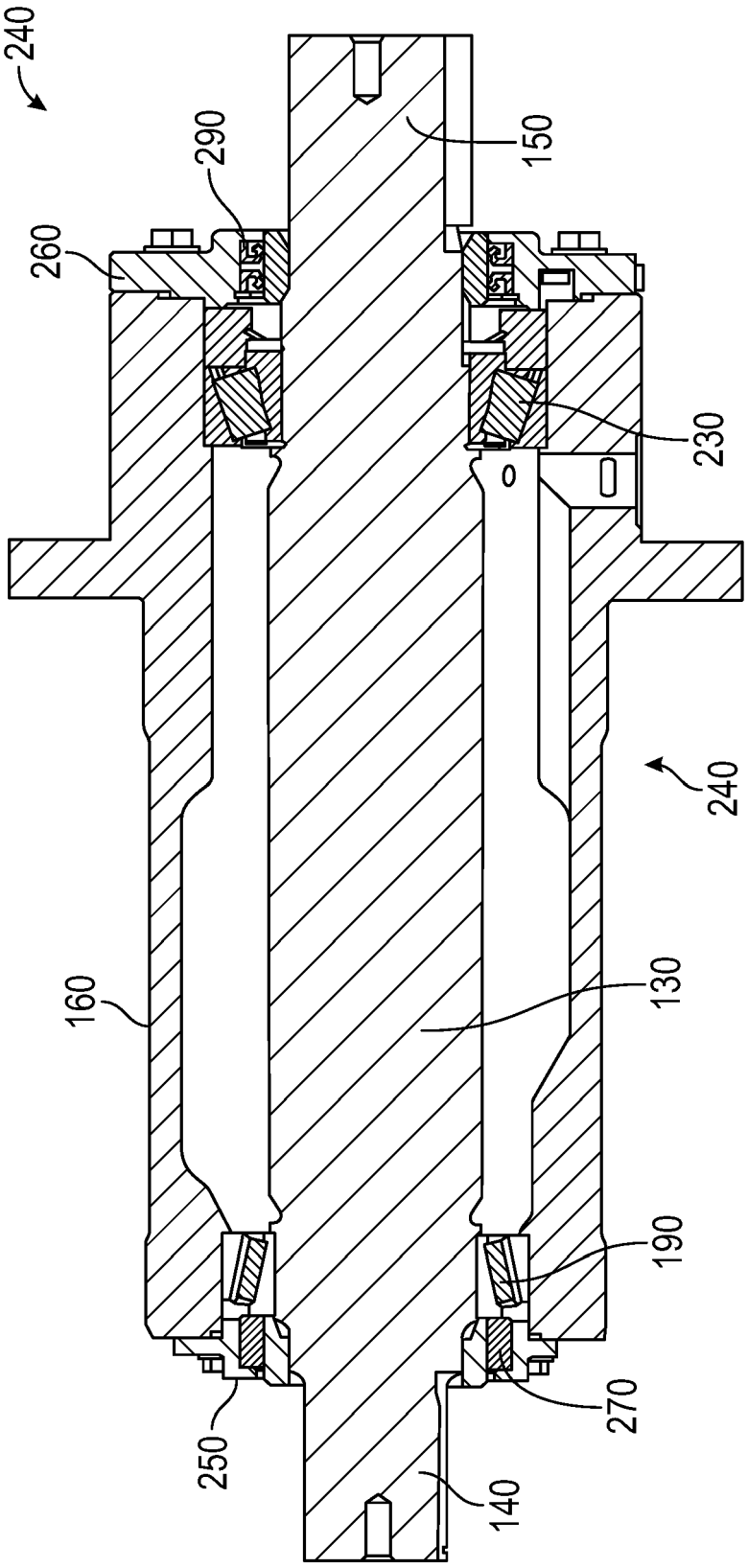
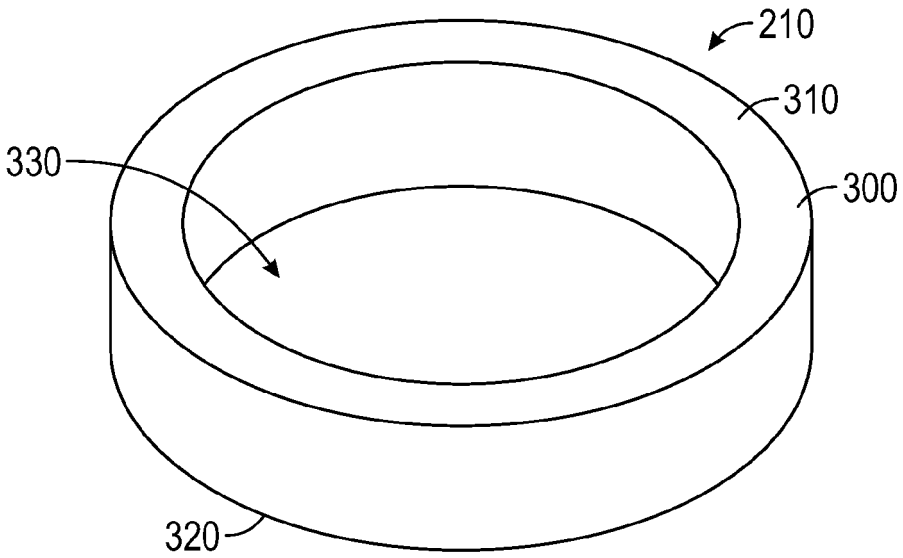


FIG. 4



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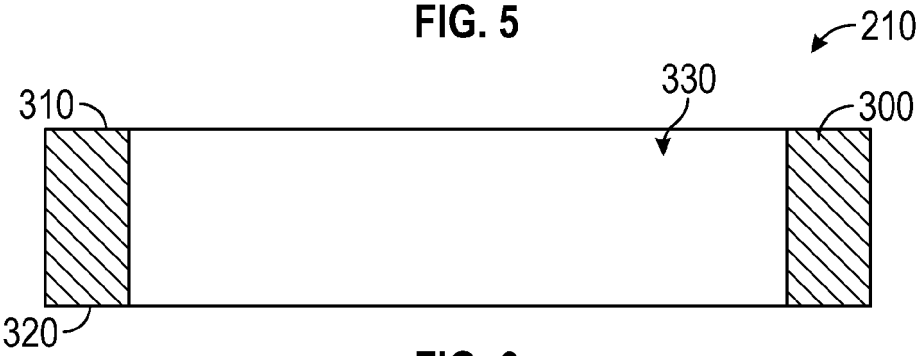

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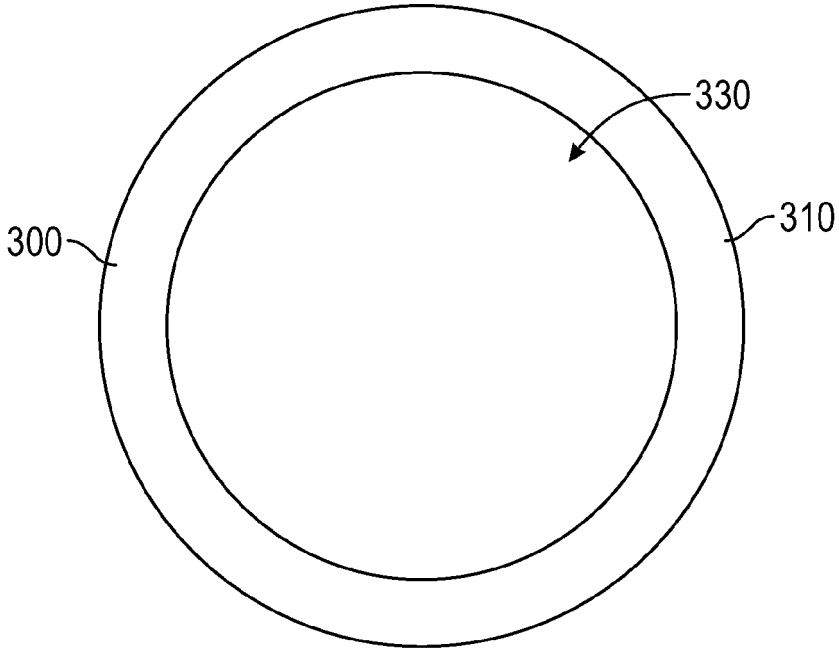

FIG. 7

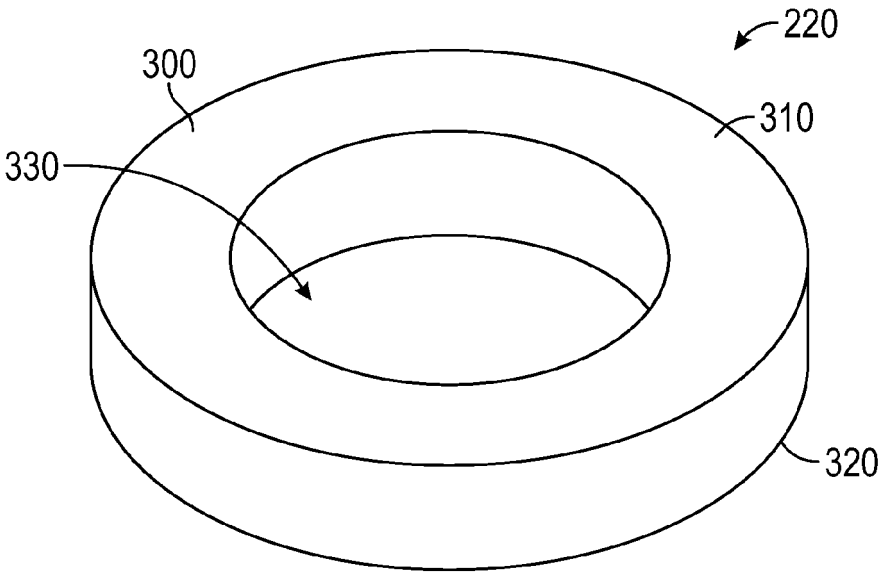

FIG. 8

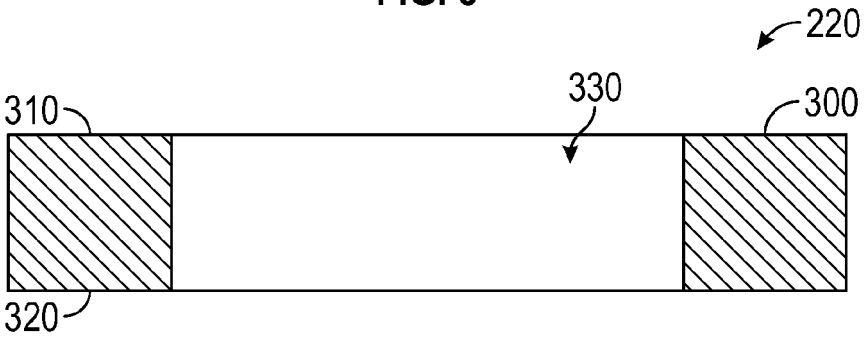

FIG. 9

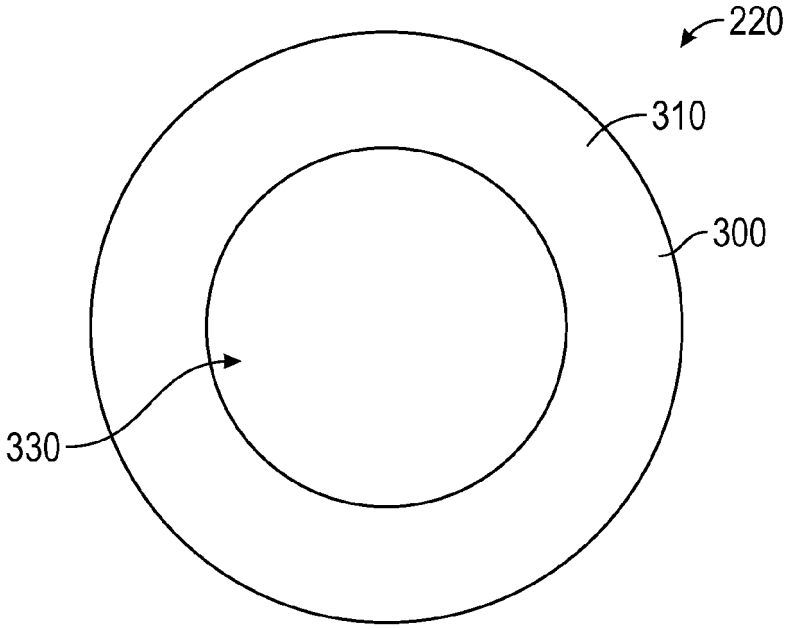

FIG. 10

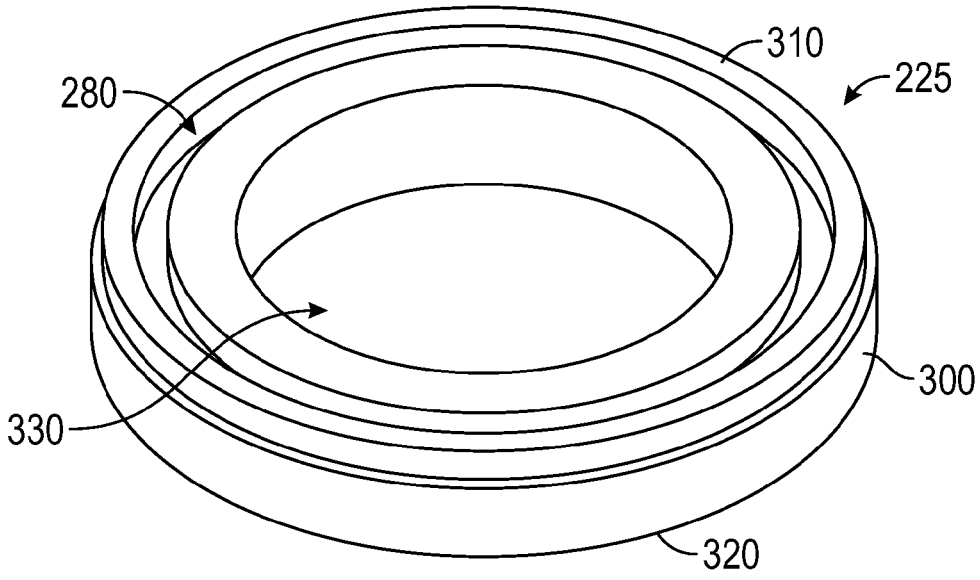

FIG. 11

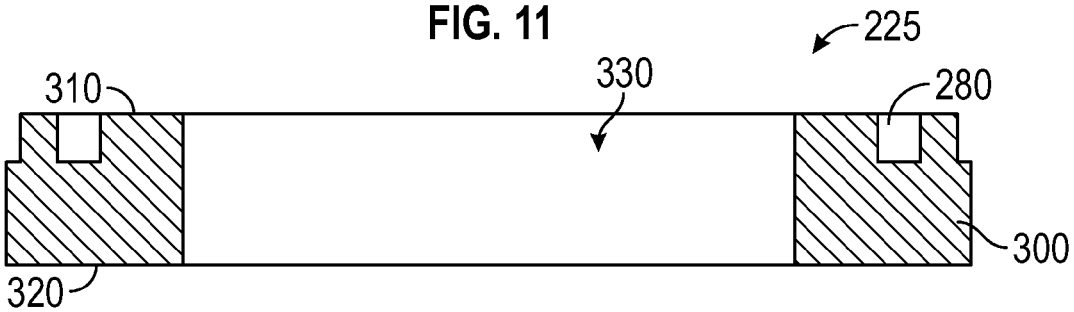

FIG. 12

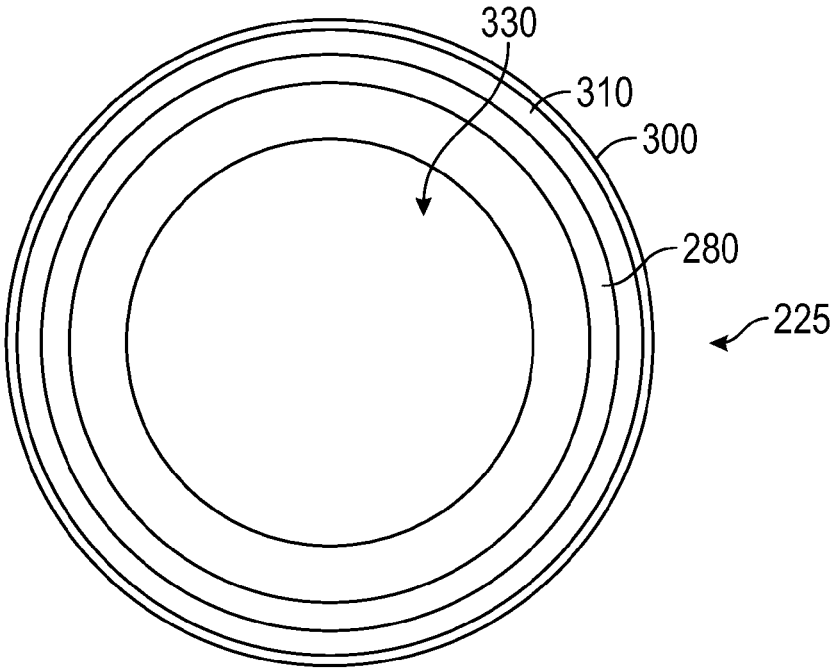

FIG. 13

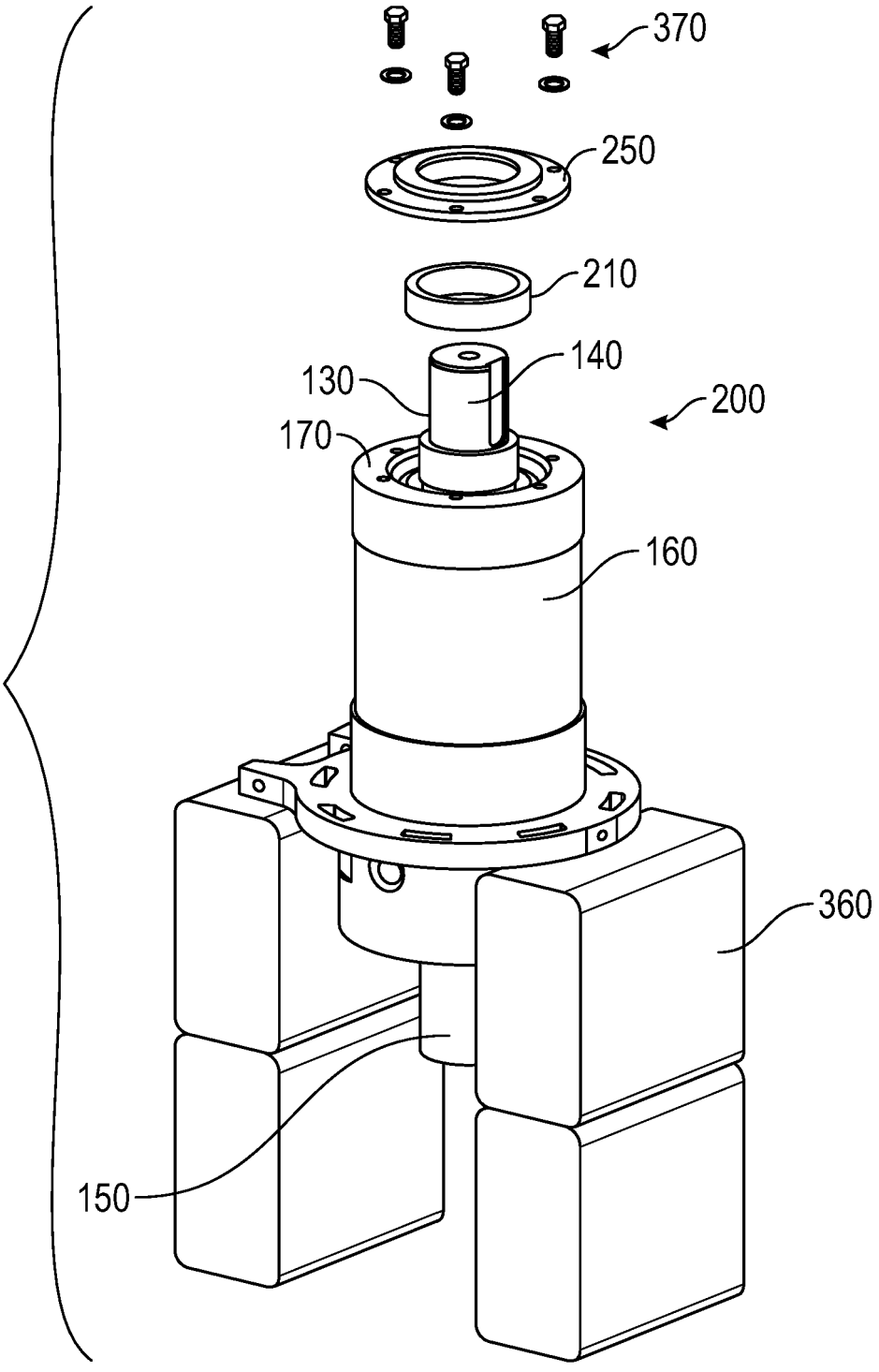

FIG. 14

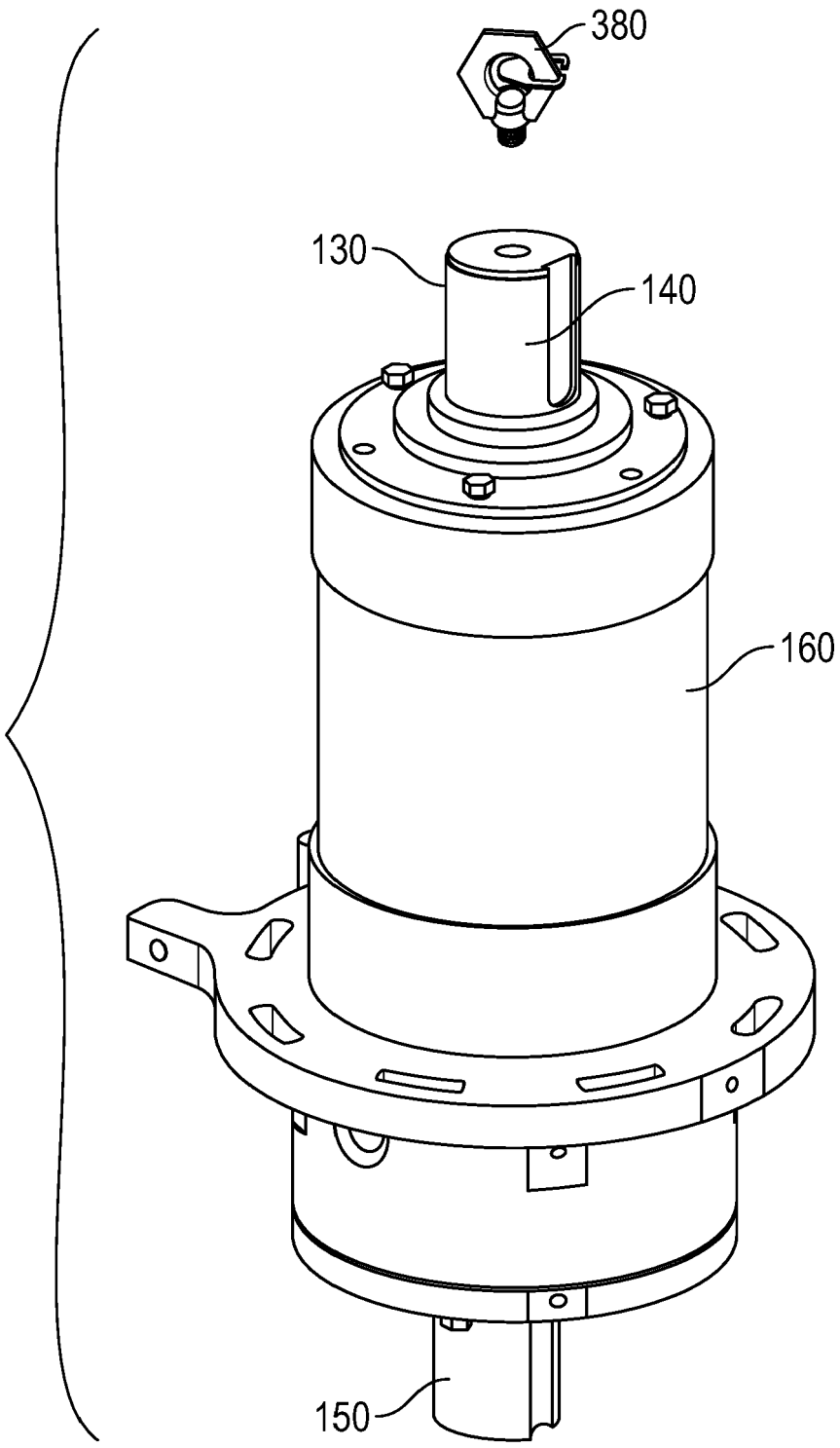

FIG. 15

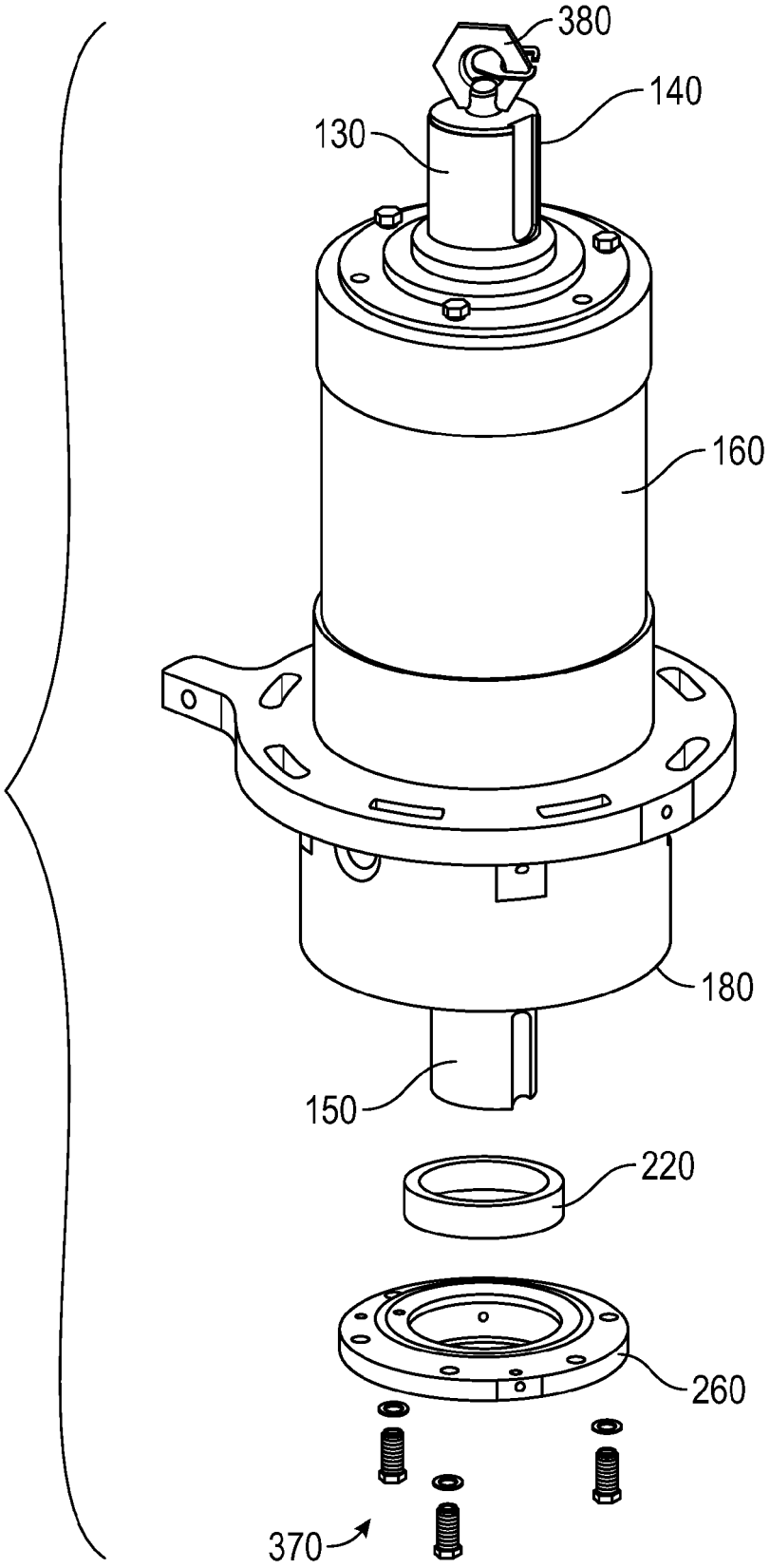

FIG. 16

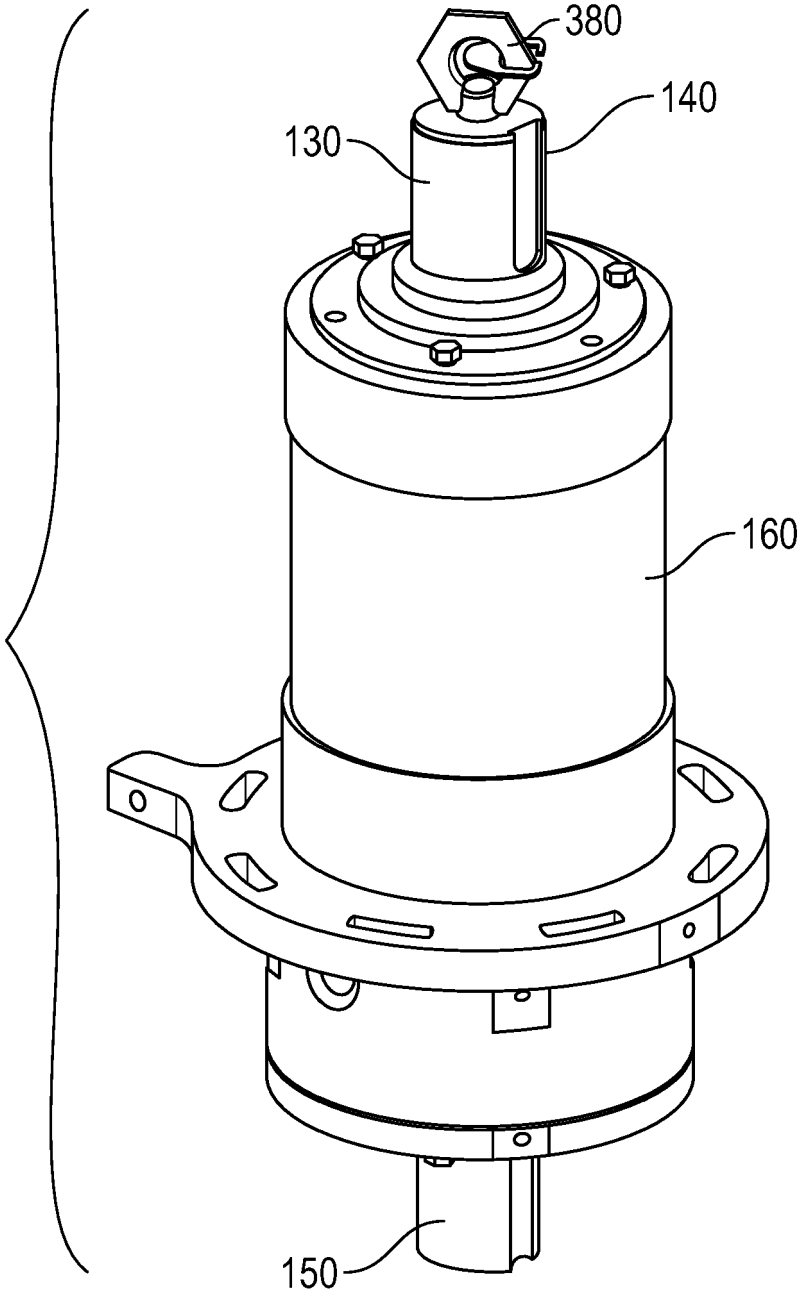

FIG. 17

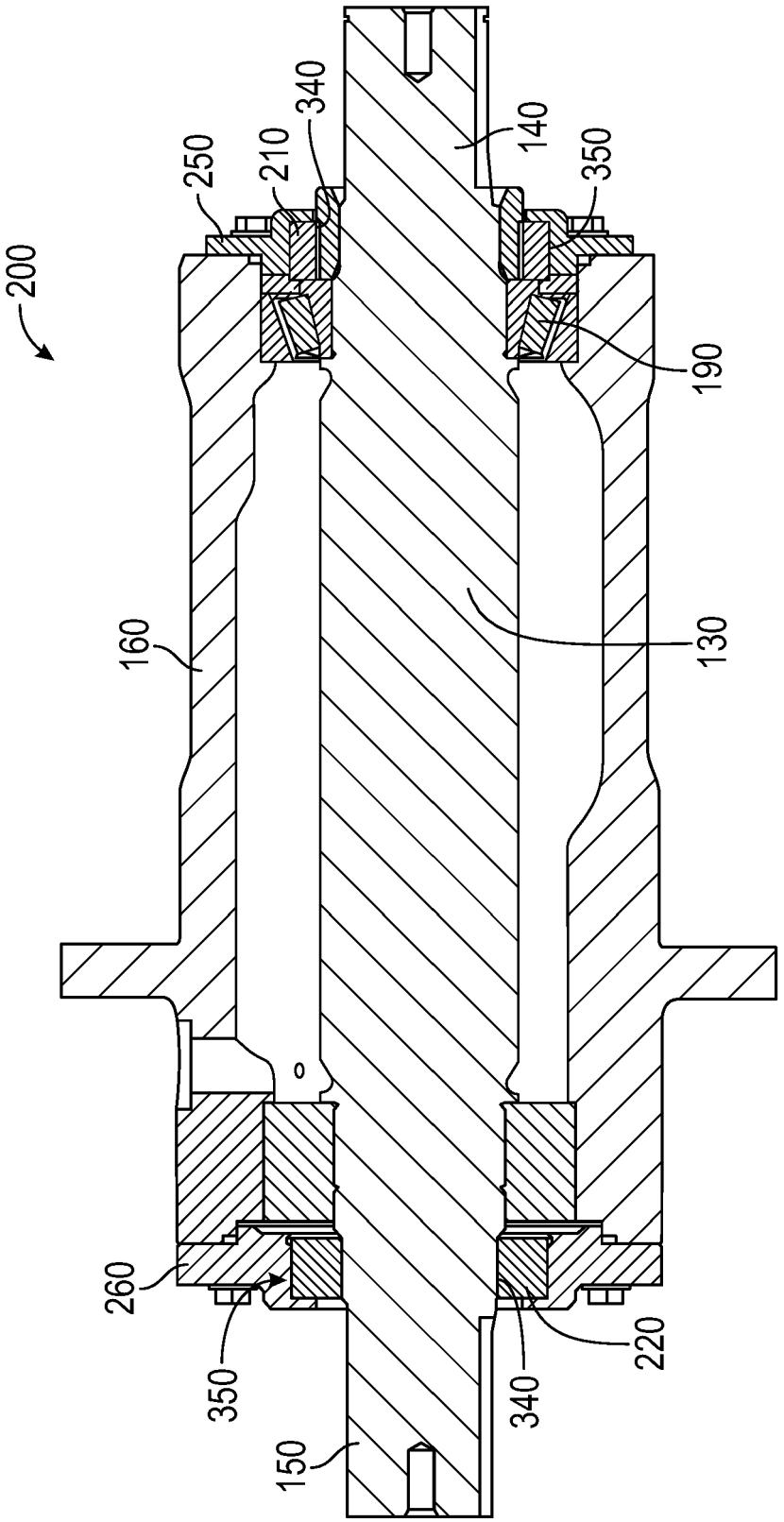

FIG. 18

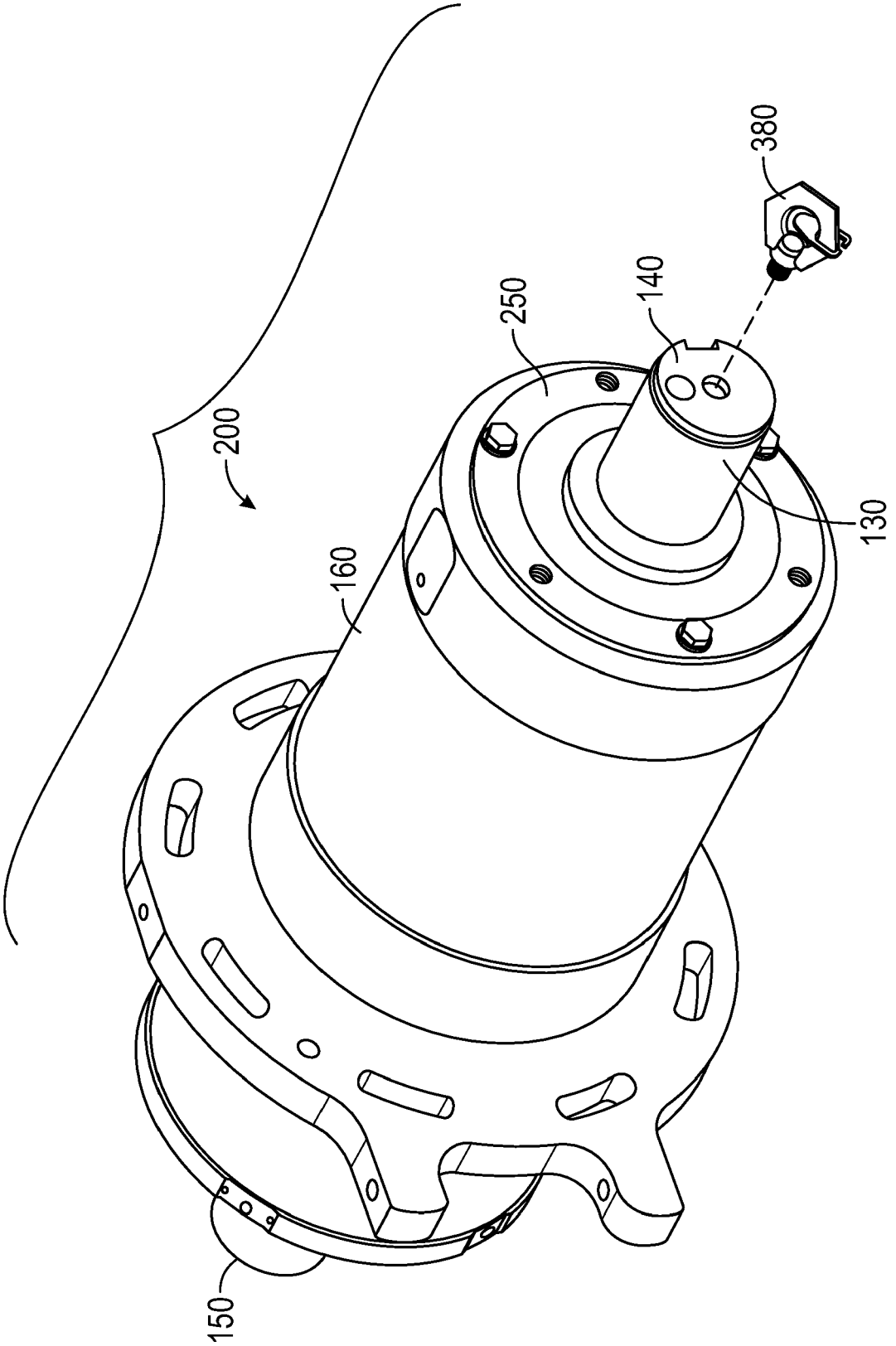

FIG. 19

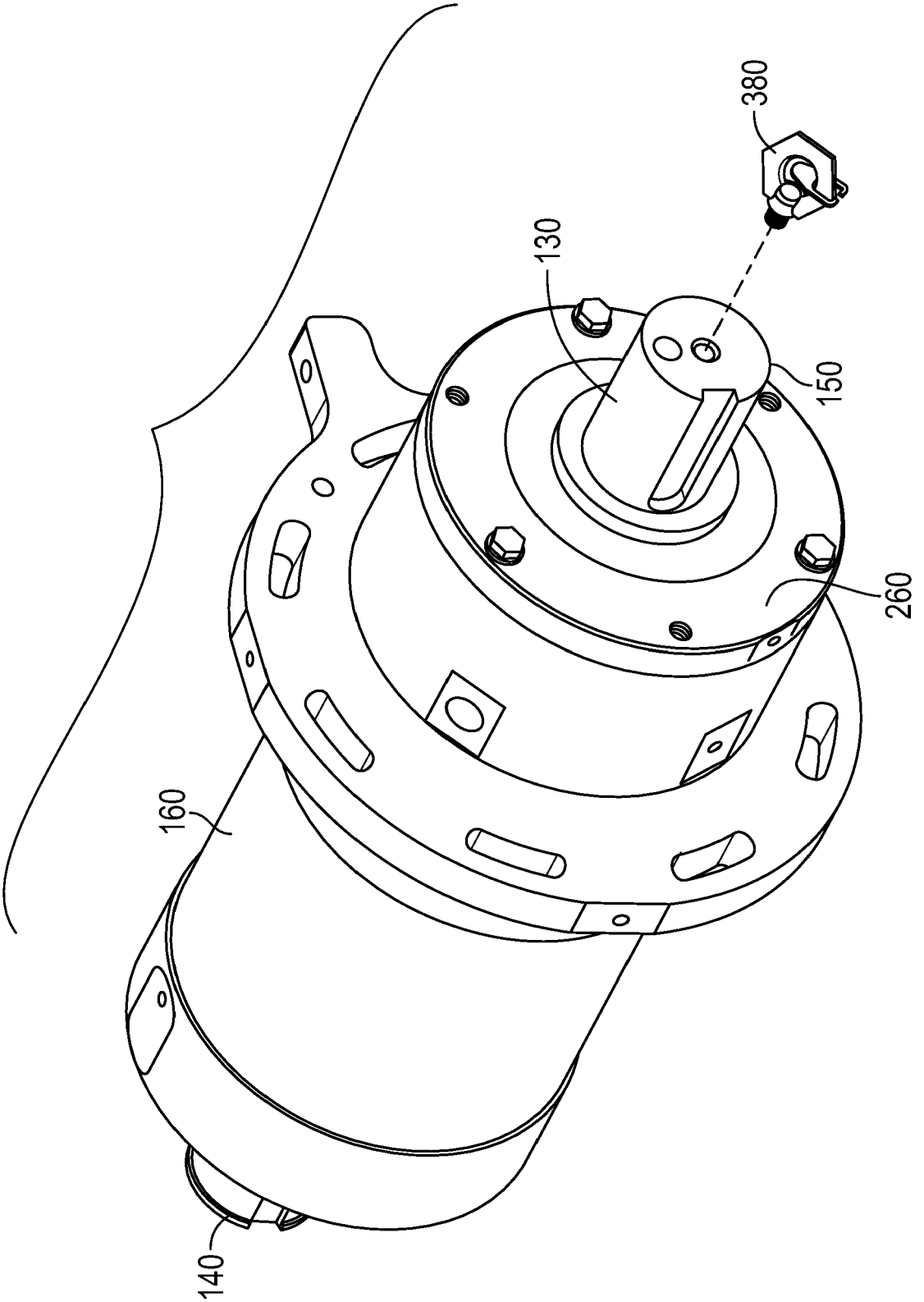

FIG. 20

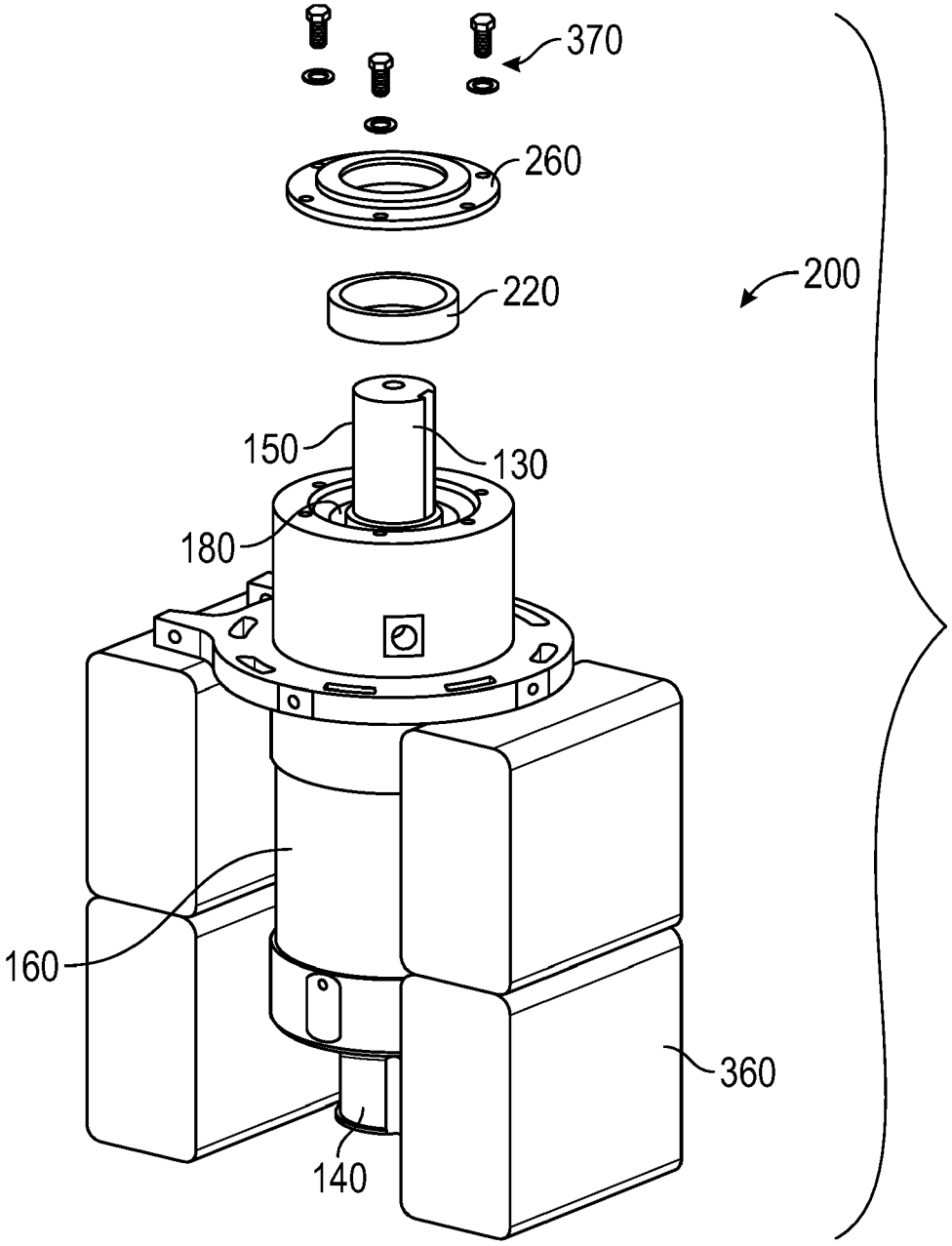

FIG. 21

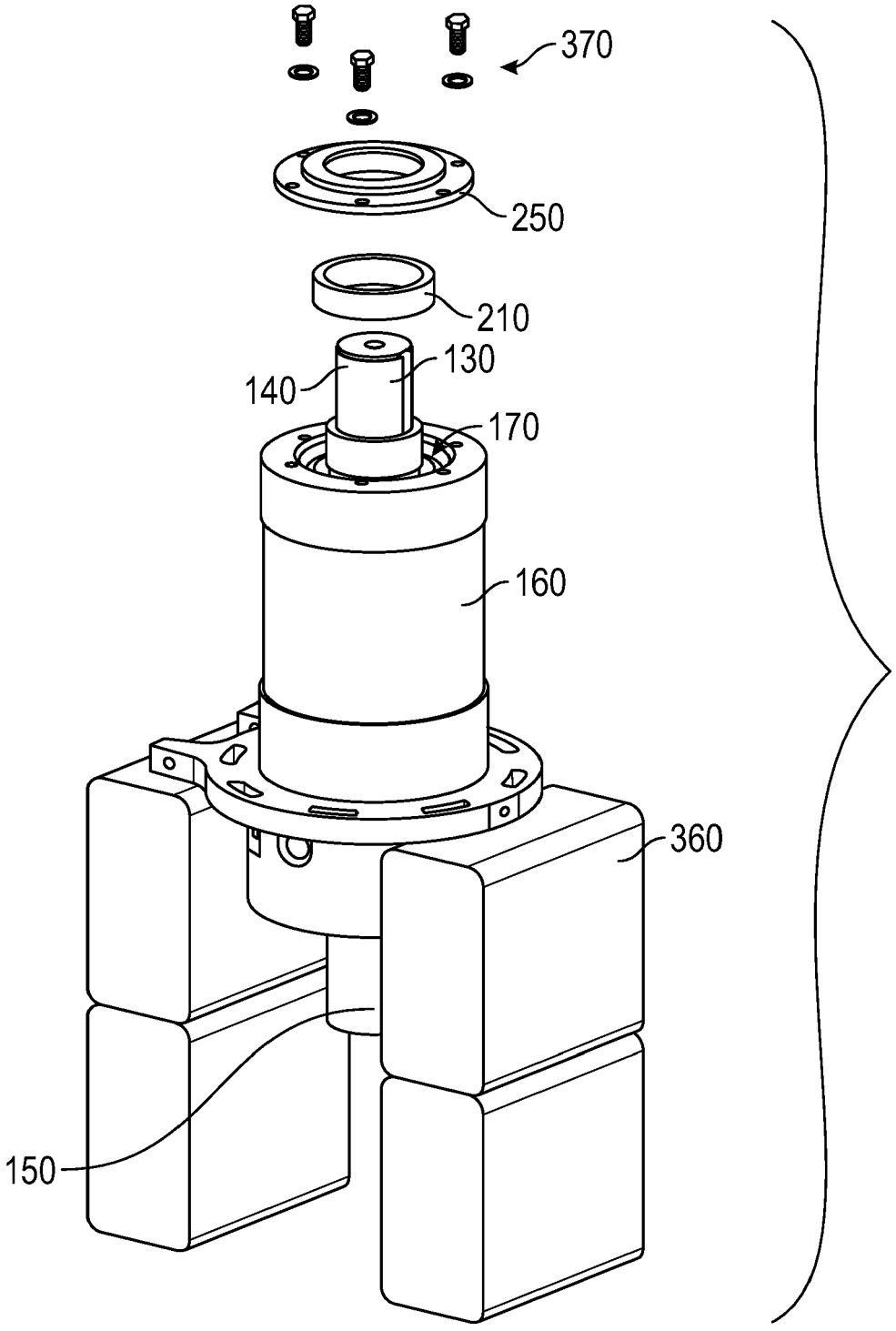

FIG. 22

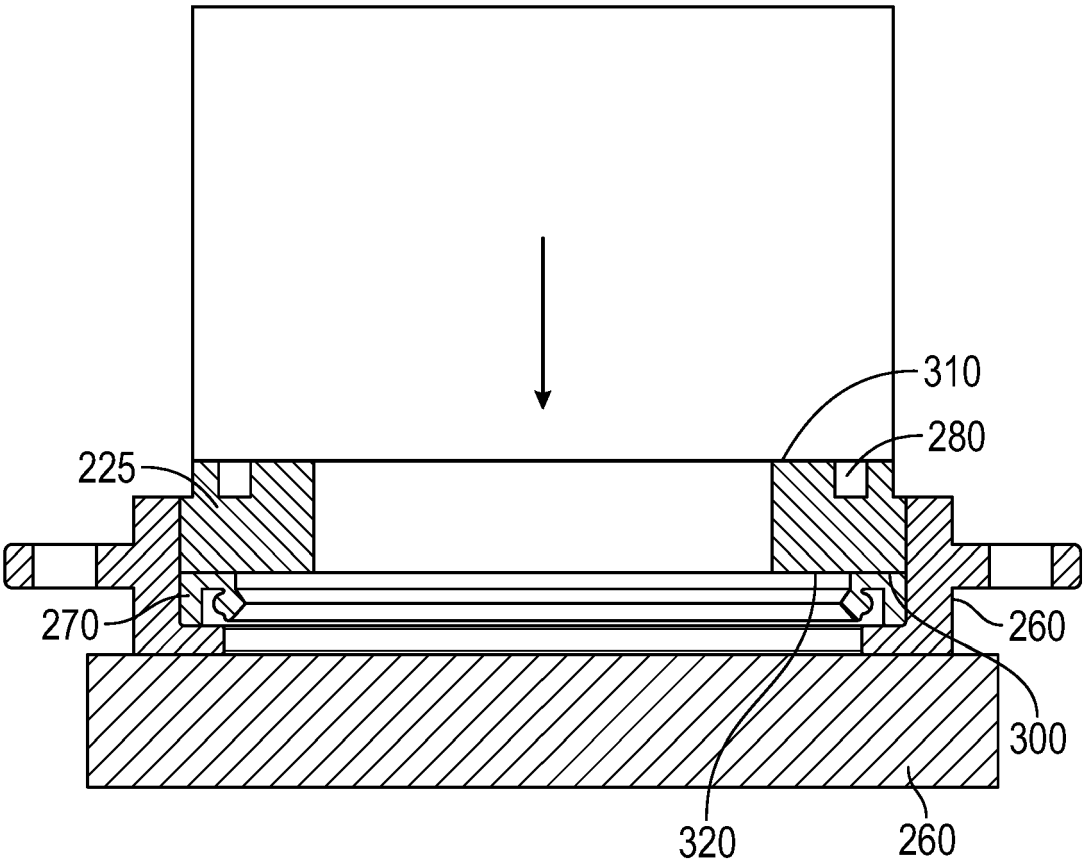

FIG. 23

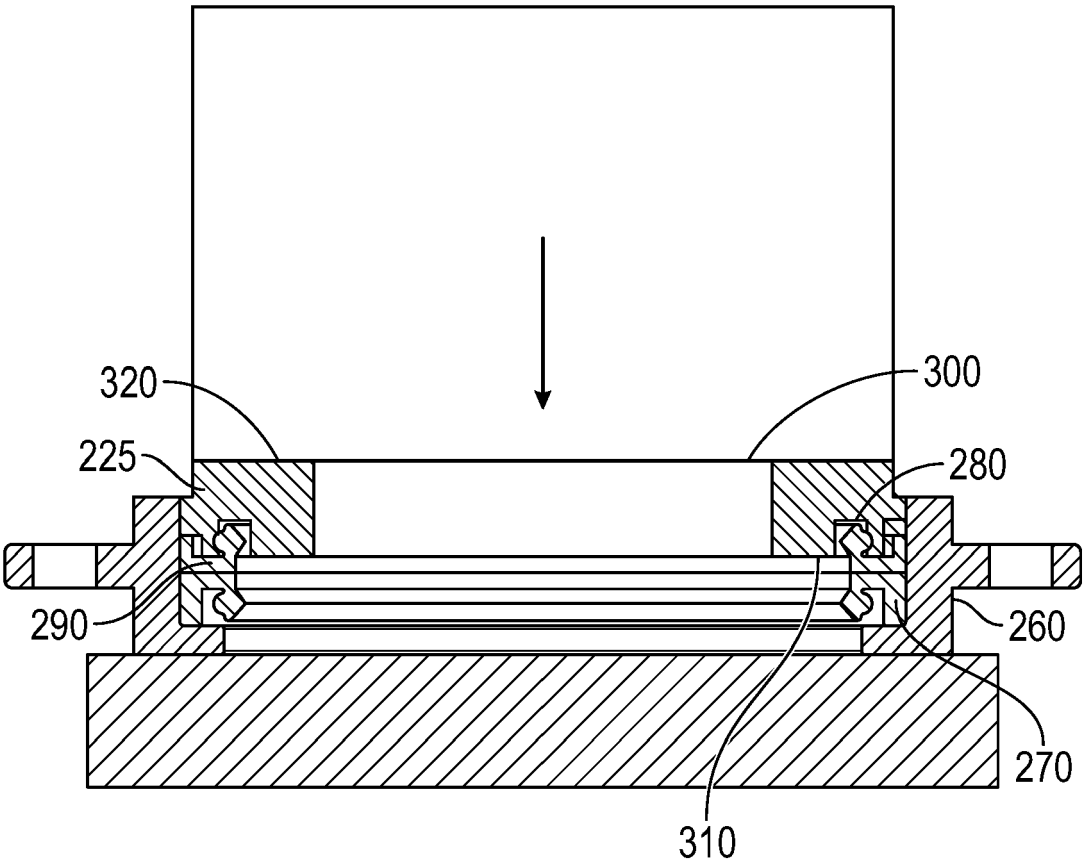

FIG. 24

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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 4223

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 110 801 885 B (NANCHANG MINERAL SYS CO LTD) 6 July 2021 (2021-07-06)	1-8	INV. B02C2/00
A	* abstract; claim 4; figures 2,4,6,12,14 *	9-12	B02C2/04
A	US 2 829 842 A (PHILADELPHI THE FIRST NATIONAL) 8 April 1958 (1958-04-08) * column 3, lines 9-64; figure 1 *	1,9	

TECHNICAL FIELDS SEARCHED (IPC)

B02C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 July 2022	Iuliano, Emanuela

CATEGORY OF CITED DOCUMENTS

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22-07-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 110801885 B	06-07-2021	NONE	
US 2829842 A	08-04-1958	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82