

(19)



(11)

EP 4 190 453 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
07.06.2023 Bulletin 2023/23

(51) International Patent Classification (IPC):
B02C 2/00 (2006.01) **B02C 2/04** (2006.01)

(21) Application number: **21211994.5**

(52) Cooperative Patent Classification (CPC):
B02C 2/005; B02C 2/04

(22) Date of filing: **02.12.2021**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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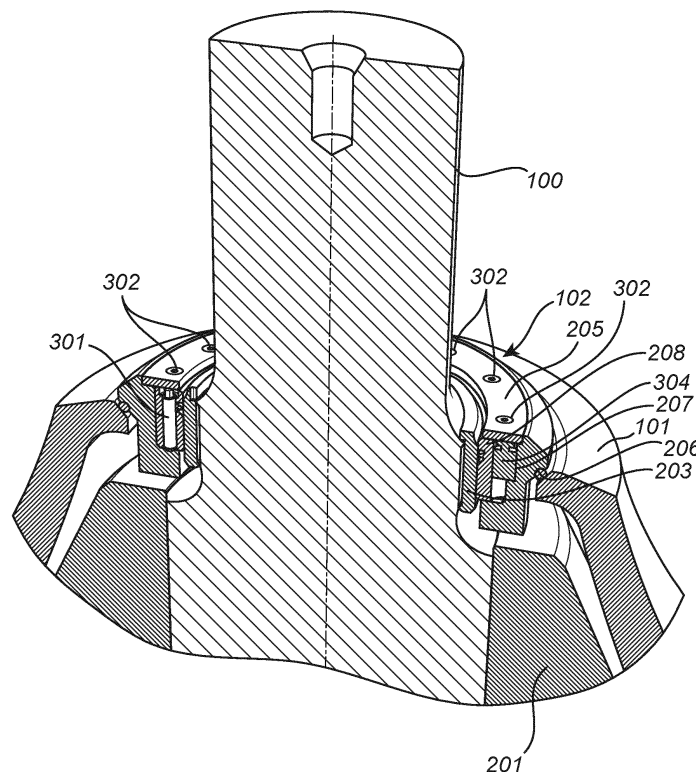
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(54) RETAINING ASSEMBLY FOR INNER CRUSHING SHELL OF GYRATORY CRUSHER

(57) The present disclosure relates to a retaining assembly (102) to secure an inner crushing shell (101) at a shaft-mounted head center (201) of a gyratory crusher. The retaining assembly (102) has a modular construction comprising an inner head nut (203), an inner ring element (208), an outer ring element (207), first fastening members (301) and second fastening members (302) and a

cover plate (205). The inner ring element (208) and the outer ring element (207) are rotationally locked together preferably with the help of locking elements (304) which are positioned radially between the two ring elements (207, 208). After the retaining assembly (102) is tightened, the attachment ring (206), upon application of heat, welds the shell (101) to the outer ring element (208).

**Figure 2****EP 4 190 453 A1**

Description**Technical field**

5 **[0001]** The present disclosure relates to gyratory crushers. More specifically, the present disclosure relates to a retaining assembly for securing an inner crushing shell on to a head center mounted on a main shaft of a gyratory crusher.

Background art

10 **[0002]** Gyratory crushers are used for crushing ore, mineral and rock material to smaller sizes. Typically, the crusher comprises a head center mounted upon an elongate main shaft. A first crushing shell or the inner crushing shell (typically referred to as a mantle) is mounted on the head center and a second crushing shell or the outer crushing shell (typically referred to as the concave) is mounted on a frame such that the first and second crushing shells define together a crushing chamber through which the material to be crushed is passed. A driving device positioned at a lower region of the main shaft is configured to rotate an eccentric assembly positioned about the shaft to cause the head center to perform a gyratory pendulum movement and crush the material introduced in the crushing chamber.

15 **[0003]** In the course of the crushing operation, the crushing shells are worn down, which means that they need to be replaced at regular intervals. A variety of different assemblies have been proposed for mounting the inner crushing shell at the main shaft in an attempt to provide a reliable lock as well as convenient mounting and dismounting of the inner crushing shell. Replacing the inner crushing shell usually involves the use of a cutting blowpipe and a sledgehammer. Use of this technique is potentially hazardous for the operator since the operator is required to use a heavy hammer or bar to tighten the head nut.

20 **[0004]** Some of the above problems were addressed in WO2021013329. This disclosure included a tensioned bolt to retain or fasten the inner crushing shell on to the head center of the shaft. The disadvantage of such a tensioned bolt was that it bent and broke when the machine was in operation since the inner and outer ring elements moved differently ultimately leading to the failure of the retaining assembly.

25 **[0005]** Accordingly, there is a need for a retaining assembly for securing the mantle on to the head center of the shaft which addresses the above-mentioned drawbacks.

30 **Summary**

[0006] The aim of the present disclosure is to overcome or at least reduce the above-mentioned problems that exist in the prior-art.

35 **[0007]** It is an objective of the present disclosure to provide a retaining assembly for securing the inner crushing shell on to the head center mounted at the main shaft, that allows convenient and easy mounting and dismounting of the shell.

[0008] It is another objective of the present disclosure to provide a retaining assembly for securing the inner crushing shell on to the head center mounted at the main shaft, that does not compromise the safety of the operator for tightening of the inner crushing shell and is easy to maintain.

40 **[0009]** It is a further specific objective of the present disclosure to minimize the risk of failure of the retaining assembly and to extend as far as possible the service lifetime of components of the assembly.

[0010] The objectives are achieved by providing a retaining assembly which secures the inner crushing shell to the head center mounted on the main shaft. This retaining assembly comprises of components which are rotationally locked thereby rendering the assembly stable and resistant to early failure.

45 **[0011]** According to a first aspect of the present disclosure, there is provided a retaining assembly for securing an inner crushing shell on a head center mounted on a main shaft of a gyratory crusher, the assembly comprising: an annular inner head nut having a threaded outer surface positioned radially around an axial upper region of the shaft; an inner ring element positioned radially around the annular inner head nut, the inner ring element having an outer surface and a threaded inner surface configured to engage with the threaded outer surface of the inner head nut; an outer ring element positioned radially around the inner ring element, the outer ring element comprising an annular wall portion and a flange projecting radially inwards from the bottom edge of the wall portion; a cover plate positioned on top of the inner ring element and the outer ring element characterized in that the assembly further comprises a plurality of radially distributed first fastening members arranged to be removably embedded into the inner ring element.

50 **[0012]** The advantage of this characterizing feature is that the first fastening member causes the shell to be pressed on to the seating surface of the head center mounted on the main shaft. The first fastening member applies axial load in vertically downward direction, which is transferred across the outer ring element and the inner crushing shell, thereby pressing the inner crushing shell down to the seating surface of the head center. This results in good frictional force between the contacting surfaces of the inner crushing shell and the head center. The downward force applied by the first fastening member enables the assembly to provide a strong and durable hold to the inner crushing shell.

[0013] The annular inner head nut is positioned radially around the axial upper region of the main shaft of the crusher and is provided with a threaded radially outer surface for mechanically engaging with the threaded radially inner surface of the inner ring element. The advantage is that the corresponding threaded surfaces of the inner head nut and the inner ring element form a mechanical attachment which further aides the retaining assembly to be stable.

[0014] Preferably, the inner ring element is provided with a plurality of threaded apertures extending through the depth of the inner ring element, said apertures being configured to receive a plurality of first fastening members. The apertures preferably have a cylindrical shape to accommodate a preferred cylindrical first fastening member.

[0015] Preferably, the inner ring element and the outer ring element are rotationally locked by a plurality of radially distributed locking elements which are positioned radially between the inner ring element and the outer ring element. Advantageously, the locking elements enable efficient and robust rotational locking of the inner and the outer ring elements. As a result, the retaining assembly stays locked together throughout the duration of the operation of the machine.

[0016] Preferably, the first fastening members are in the form of a cylindrical push-bolts provided with threaded outer surface, arranged to be screwed down by cooperating with threaded inner surface of the preferably cylindrical apertures of the inner ring element. Advantageously, a cylindrical threaded push-bolt is easier and quicker to cooperate with the threaded apertures of the inner ring element, than other kinds of fasteners.

[0017] Preferably, the lower surface of the first fastening member is arranged to abut with the upper surface of the flange of the outer ring element when the first fastening member is screwed down by cooperating with a threaded inner surface of the aperture of the inner ring element. Accordingly, the first fastening member or the preferred push-bolt after being screwed down the threaded aperture of the inner ring element, is not mechanically engaging with the outer ring element, and only touches the top of the flange portion. Therefore, it does not hinder the movement of the inner ring element and enables it to move irrespective of the outer ring element. The advantage of this attribute of the push-bolt is that there will be no bending or breaking of the bolt when the machine is in operation, since the outer and inner ring elements are not connected using a single tensioned element, and hence free to move irrespective of each other. This prevents the bolt from bending or breaking during operation.

[0018] Preferably, the retaining assembly further comprises a metallic attachment ring which is also known as a torch ring or a burning ring, the ring being capable of welding together the inner crushing shell and the outer ring element on application of heat. This ring is preferably disposed between the lower surface of the outer ring element and the top edge of the inner crushing shell.

[0019] The metallic attachment ring is preferably made of mild steel, and on application of heat, the ring welds together the outer ring element and the inner crushing shell. The advantage of having an attachment ring is that it provides a strong hold of the inner crushing shell and provides a safe alternative for the operator since the operator no longer needs to use a sledgehammer for tightening the shell on the retaining assembly. The welding facilitates self-tightening of the inner crushing shell, removing the need for sledgehammering which can be hazardous for the operator. Another advantage of the attachment ring is that dismounting of the shell is easy and convenient since the ring would have burned away, and by releasing the forces on the bolts, it is easy to remove the shell.

[0020] Preferably, the attachment ring has a rounded profile. Optionally, it can have a square or any other profile.

[0021] Preferably, the inner ring element is provided with a plurality of circumferentially distributed vertical grooves on the outer surface of the inner ring element and; the outer ring element is provided with a plurality of circumferentially distributed vertical grooves complementary to the grooves on the inner surface of the wall portion of the outer ring element.

[0022] Preferably, the grooves on the inner and the outer ring elements are arranged to align and enclose the locking element when the inner ring element and the outer ring element are rotationally locked. When these complementary grooves align with each other, they form cylindrical apertures which are configured to accommodate and enclose the locking elements.

[0023] Preferably, the locking elements are in the form of a plurality of cylindrical pins. The advantage is that the pins can be easily and quickly pushed down the cylindrical apertures created upon alignment of the complimentary vertical grooves of the inner ring element and the outer ring element. Once pushed, the pins immobilize or rotationally lock together the inner and outer ring elements. The pins being easy to use for locking and unlocking, facilitate the mounting and dismounting of the inner crushing shell using the retaining assembly.

[0024] Preferably, the cover plate is affixed to the inner ring element with the help of a plurality of second fastening members. Preferably, the second fastening members are in the form of pin and sleeve assemblies. Advantageously, the second fastening members enable strong mechanical engagement of the inner ring element and the cover plate and provide stability to the assembly during the crushing operation. The retaining assembly is hence rendered capable of holding together the inner crushing shell when the crusher is in operation. The advantage of use of the second fastening members is that they provide an easy, safe and quick solution for immobilizing the cover plate on top of the inner ring element when the retaining assembly is ready for operation. These fastening members are also convenient to dismount when the retaining assembly is being dismantled. Pin and sleeve assemblies are preferred as they are easy to manufacture and use.

[0025] Further, the cover plate is provided with a plurality of radially distributed apertures configured to receive the plurality of the second fastening members. First, the sleeve is inserted into this aperture, and then the pin is pushed down into the sleeve and through the inner ring element placed below the cover plate. The apertures of the cover plate enable the second fastening members, preferably the pin and sleeve assemblies to affix the cover plate on top of the inner ring element.

[0026] Preferably, the inner ring element is provided with a plurality of radially distributed apertures for receiving the second fastening members. When the cover plate is placed on top of the inner ring element, the apertures of the cover plate and the apertures of the inner ring element align together vertically to receive the second fastening members, which are instrumental in attaching the cover plate with the inner ring element.

[0027] Optionally, the retaining assembly is provided with an eccentric locking solution for the inner ring element and the outer ring element. According to this solution, the inner ring element and the outer ring element are eccentric with respect to a longitudinal axis, and wherein the inner ring element and the outer ring element rotate and create a cylindrical pocket between them which is configured to accommodate a locking ring enabling rotational locking of the inner ring element and the outer ring element. The advantage of this alternate solution is that no additional locking elements are needed to mechanically fix together the inner and the outer ring elements. Being eccentric, they rotate with respect to each other and lock together. Further strength is provided to this locking arrangement, with the help of the locking ring which accommodates itself in the cylindrical pocket created when the eccentric inner and outer ring elements rotate relative to each other. This eliminates the need to have additional components in the retaining assembly for the purpose of locking the nut and the plate together, thereby reducing the overall cost and weight of the retaining assembly. The advantage offered by this feature is the ease of fabrication of the components, and also strong and durable mechanical hold within the retaining assembly.

[0028] According to a second aspect of the present disclosure, there is provided a method for securing the inner crushing shell on the shaft mounted head of the gyratory crusher.

[0029] The steps of the method include, placing the outer ring element along with the attachment ring on top of the inner crushing shell; positioning the inner ring element between the inner head nut and the outer ring element until the lower surface of the inner ring element is in physical contact with the upper surface of the flange of the outer ring element and the plurality of apertures of the outer ring element align with the apertures of the inner ring element; inserting the plurality of locking elements into the cavities created by aligned complimentary apertures of the inner and the outer ring element, causing rotational locking of the inner ring element and the outer ring element; inserting the first fastening members into the apertures of the inner ring element and screwing them down while pressing the flange of the outer ring element; positioning the cover plate on top of the inner ring element, and fastening it to the inner ring element by inserting fasteners into the sleeves; and welding the attachment ring causing the inner crushing shell to be attached to the head center.

[0030] Advantageously, this method results in a strong retention of the inner crushing shell as it gets tightened on to the head center by means of the retaining assembly. This method also removes the need for sledgehammering for tightening of the inner crushing shell, which can be hazardous for the operator. Such a method provides for a fast and easy way of achieving retention of the inner crushing shell on to the head center of the crusher.

[0031] According to a third aspect of the present disclosure, there is provided a gyratory crusher comprising an elongate main shaft for gyroscopic precession within the crusher; a head mounted at the main shaft; an inner crushing shell mounted at the head; and a retaining assembly as explained above, configured to mount the inner crushing shell on to the head.

[0032] Other aspects and advantages of the present disclosure will be more apparent from the following description, which is not intended to limit the scope of the present disclosure.

Brief description of drawings

[0033] A specific implementation of the present invention will now be described, by way of example only, and with reference to the accompanying drawings in which:

Figure 1 is an external perspective view of a main shaft mounting an inner crushing shell suitable for gyroscopic precession within a gyratory crusher, the shell secured at the main shaft via a retainer assembly according to a specific implementation of the present disclosure;

Figure 2 is a perspective cross-sectional view of the shaft, inner crushing shell, head and the retainer assembly of Figure 1;

Figure 3 is a perspective view of the inner ring element, showing all the different kinds of apertures for accommodating fastening elements and locking elements according to a specific implementation of the present disclosure;

Figure 4 is an exploded view of the retaining assembly with each component being clearly visible, along with the inner crushing shell, the head center and the shaft, according to a specific implementation of the present disclosure;

Figure 5 is a perspective view of the cross-section of the retaining assembly, when all the components are assembled together and the assembly is tightened to retain the inner crushing shell on to the head center of the shaft, according to a specific implementation of the present disclosure;

Figure 6a is a perspective view of the eccentric inner ring element and the eccentric outer ring element as they mechanically engage into a form-fitting arrangement according to a specific embodiment of the present disclosure;

Figure 6b is a cross-sectional view of the eccentric inner ring element and the eccentric outer ring element when locked together according to a specific embodiment of the present disclosure.

List of reference numerals with their meaning

[0034]

Main shaft	100
Inner crushing shell (mantle)	101
Retaining assembly	102
Head center	201
Inner head nut	203
Cover plate	205
Attachment ring	206
Outer ring element	207
Inner ring element	208
Upper surface of flange	210
Outer surface of inner ring element	211
Inner surface of wall portion of outer ring element	212
Threaded inner surface of inner ring element	213
Outer surface of inner head nut	214
Lower surface of inner ring element	215
First fastening member (push-bolt)	301
Second fastening member (cover plate fastener)	302
Sleeve for second fastening member	303
Locking element (pin)	304
Aperture for locking pin	305
Aperture for first fastening member	306
Aperture for second fastening member	307

Cover plate aperture for second fastening member	307
Grooves on inner surface of wall portion 207a	308
Lower surface of first fastening member	309
Eccentric locking system	401

(continued)

Cylindric pocket in eccentric locking system	402
Ring inserted in cylindric pocket in eccentric locking system	403
Wall portion of outer ring element	207a
Flange of outer ring element	207b

Detailed description of preferred embodiment of the invention

[0035] Embodiments of the present disclosure will now be described with reference to the accompanying drawing. Embodiments are provided so as to thoroughly and fully convey the scope of the present disclosure to the person skilled in the art. It will be apparent to the person skilled in the art that the details provided in the embodiments should not be construed to limit the scope of the present disclosure.

[0036] Referring to Figure 1, an inner crushing shell (mantle) 101 of a gyratory crusher is mounted at the main shaft 100 via a head center 201 (not shown) which is generally conical in shape. Longitudinal axis 103 passes vertically from the center of the main shaft 100. The head center 201 is mounted to surround a lengthwise region of the main shaft 100. The shaft 100 is rotatably driven by suitable drives and gears (not shown) to enable precession within the crusher to displace shell 101 radially relative to the outer crushing shell (not shown), which results in crushing of the material when the crusher is in operation. The shell 101 is retained at the head center 201 via a retainer assembly 102 which is generally concentric relative to the shell 101 and the shaft 100 so as to be centered on a longitudinal axis 103 extending through the shaft 100.

[0037] Referring to Figure 2, a cross-section of the different components of the retaining assembly 102 can be seen as they retain the inner crushing shell 101 mounted on the head center 201 on the shaft 100. The components of the retaining assembly 102 as shown, include an annular head nut 203 which is positioned radially around the axial upper region of the shaft 100, an inner ring element 208 which is positioned radially around the head nut 203, an outer ring element 207 which is positioned radially around the inner ring element 208, a locking element 304 which is radially in between the inner ring element 208 and the outer ring element 207 and is used for rotationally locking the inner and outer ring elements 208, 207 together, and a cover plate 205 positioned on top of inner ring element 208. Another important component of the retaining assembly 102 is the first retaining member 301 which is provided in order to retain the inner crushing shell 101 mounted on top of the head center 201. It is shown in the form of a cylindrical push-bolt in the figure. The first fastening member 301 extends vertically downwards along the height of the inner ring element 208 and rests on the flange 207b of the outer ring element 207. Further, an attachment ring 206 is provided to strengthen the retention of the shell 101 on the head center 201. The attachment ring 206 is positioned radially between the lower surface of the outer ring element 207 and the top edge of the inner crushing shell 101. When all the components of the retaining assembly 102 are assembled together, the attachment ring 206 is torched to weld the inner crushing shell 101 with the outer ring element 207.

[0038] Referring to Figure 4, all the individual components of the retaining assembly 102 can be clearly visualized. The longitudinal axis 103 passes vertically through the center of the main shaft 100 of the gyratory crusher. Head center 201 is placed on the main shaft 100. The purpose of the retaining assembly 102 is to hold the inner crushing shell 101 in place, after it is mounted on to the head center 201 on the main shaft 100. The first component of the retaining assembly 102 is the annular inner head nut 201 which is positioned radially around the axial upper region of the main shaft 100. The inner head nut 201 comprises of a threaded radial inner surface (not shown) which is in contact with the axial upper region of the main shaft 100, and a threaded radial outer surface 214 which is configured to mechanically cooperate with the threaded radial inner surface 213 of the inner ring element 208 (second component of the retaining assembly 102) which is illustrated in detail in Figure 3. The inner ring element 208 is positioned radially around the inner head nut 203 when the corresponding threaded surfaces (214, 213) cooperate.

[0039] Referring to Figure 3, the inner ring element 208 further comprises of radial outer surface 211 which is configured to cooperate with the outer ring element 207 (third component of the retaining assembly 102). The inner ring element 208 is also provided with a plurality of radially distributed apertures 306 for accommodating the plurality of the first fastening members 301 which facilitate retention of the inner crushing shell 101 on the main shaft 100, as shown in Figure 4 and 5. The apertures 311 are provided to accommodate the second fastening members 302 which affix the cover plate 205 to the inner ring element 208.

[0040] On the outer surface 211 of the inner ring element 208, are provided a plurality of radially distributed vertical grooves 305 which accommodate a plurality of the locking elements 304 which rotationally lock and immobilize together the inner ring element 208 and the outer ring element 207 as is shown in Figure 2.

[0041] Referring to Figure 4 again, the outer ring element 207 is made up of a wall portion 207a and a radially projecting

flange portion 207b. The inner surface 212 of the wall portion 207a of the outer ring element 207 is provided with vertical grooves 308 which are configured to align with the complimentary grooves 305 of outer surface 211 of the inner ring element 208. When the grooves 305, 308 align, they create a plurality of cylindrical enclosures which can accommodate the locking elements 304 which for the purpose of representation, are shown in the form of cylindrical pins in Figures 2 and 4. The locking elements 304 facilitate the rotational locking together of the inner ring element 208 and the outer ring element 207.

[0042] The flange 207b of the outer ring element 207 projects radially inwards from the bottom of the wall portion 207a. The first fastening member 301 is inserted into the aperture 306 of the inner ring element 208, and pushed down until the lower surface 309 of the first fastening member 301 is in physical contact with the upper surface 210 of the flange 207a of the outer ring element 207. The flange 207a is configured to enable the first fastening members 301 to apply axial force in downward direction which would cause the inner crushing shell 101 to be pressed against the head center 201.

[0043] The cover plate 205 is a flat, circular plate designed for protection of the retaining assembly from the material debris which may fall on it during machine operation. The cover plate 205 is provided with a plurality of radially distributed apertures 307 for accommodating the plurality of second fastening members 302. Preferably, the second fastening members are usually in the form of pin and sleeve assemblies as shown in the Figure 4. The sleeve 303 fits into the aperture 307, followed by the insertion of the pin 302 which goes further down into the aperture 311 of the inner ring element 208 and locks the cover plate 205 with the inner ring element 208. The apertures 307 of the cover plate 205 and the apertures 311 of the inner ring element are suitably dimensioned to receive the pins 302 into them. The apertures 307, 311 align axially, receive the second fastening members 302, and facilitate the coupling of the cover plate 205 with the inner ring element 208.

[0044] The attachment ring 206 is disposed between the top edge of the inner crushing shell 101 and the lower surface of the outer ring element 207. After the tightening of the retaining assembly 102 is achieved, the inner crushing shell 101 is welded to the outer ring element 207 by application of heat which causes the attachment ring 206 to melt.

[0045] According to yet another implementation of the present disclosure, and as shown in Figure 6a and Figure 6b, the inner ring element 208 and the outer ring element 207 are in the form of corresponding eccentric components configured to mate via their physically contacting surfaces. Figure 6a shows the eccentric locking solution for the inner ring element 208 and the outer ring element 207 instead of the use of locking elements as described above. The inner ring element 208 and the outer ring element 207 are shown to be eccentric with respect to the longitudinal axis 103. When the eccentric inner ring element 208 and the outer ring element 207 interact and rotate, they create a cylindrical pocket 402 between them. Referring to Figure 6b, the cylindrical pocket 402 is configured to accommodate a locking ring 403 to enable the rotational locking of the inner ring element 208 and the outer ring element 207. The locking ring 403 provides additional strength to the locking solution. The locked arrangement is then protected using a cover plate 205.

[0046] The inner crushing shell 101 may be attached to the head center 201 using the method described as follows.

[0047] First, the inner head nut 203 is threaded on to the upper axial region of the main shaft 100. Then, the outer ring element 207 is placed along with the attachment ring 206 on top of the inner crushing shell 101, and then the inner ring element 208 is positioned between the inner head nut 203 and the outer ring element 207 and threaded onto the inner head nut 203, until the lower surface 215 of the inner ring element 208 is in physical contact with the upper surface 210 of the flange 207b of the outer ring element 207 and the plurality of apertures 308 of the outer ring element 207 align with the apertures 305 of the inner ring element 208. Thereafter, the plurality of locking elements 304 are inserted into the cavities created by aligned apertures 305, 308 causing rotational locking of the inner ring element 208 and the outer ring element 207. After locking together the inner and outer ring elements 207, 208, the plurality of the first fastening members 301 are inserted into the plurality of apertures 306 of the inner ring element 208. These fastening members 301 are screwed down while pressing the flange 207b of the outer ring element 207. Then the cover plate 205 is positioned on top of the inner ring element 208, and fastened to the inner ring element 207 by using second fastening members 302. The final step in retaining the inner crushing shell 101 on the shaft 101 is to weld the attachment ring 206 causing the inner crushing shell 101 to be attached to the head center 201.

Claims

1. A retaining assembly (102) for securing an inner crushing shell (101) on a head center (201) mounted on a main shaft (100) of a gyratory crusher, the assembly comprising:

an annular inner head nut (203) having a threaded outer surface (214) positioned radially around an axial upper region of the shaft (100);

an inner ring element (208) positioned radially around the annular inner head nut (203), the inner ring element (208) having an outer surface (211) and a threaded inner surface (213) configured to engage with the threaded

outer surface (214) of the inner head nut (203);
 an outer ring element (207) positioned radially around the inner ring element (208),
 the outer ring element (207) comprising an annular wall portion (207a) and a flange (207b) projecting radially
 inwards from the bottom edge of the wall portion (207a);
 5 a cover plate (205) positioned on top of the inner ring element (208) and the outer ring element (207)
characterized in that
 the assembly (102) further comprises a plurality of radially distributed first fastening members (301) arranged
 to be removably embedded into the inner ring element (208).

- 10 **2.** The assembly (102) as claimed in claim 1, wherein the inner ring element (208) further comprises of a plurality of
 radially distributed threaded apertures (306) extending through the depth of the inner ring element (208), said
 apertures (306) being configured to receive the plurality of the first fastening members (301).
- 15 **3.** The assembly (102) as claimed in claim 1 or claim 2, wherein the inner ring element (208) and the outer ring element
 (207) are rotationally locked by a plurality of radially distributed locking elements (304) which are positioned radially
 between the inner ring element (208) and the outer ring element (207).
- 20 **4.** The assembly (102) as claimed in any preceding claim, wherein the first fastening member (301) is in the form of
 a cylindrical push-bolt having a threaded outer surface, which is arranged to be screwed down into the aperture
 (306) by cooperating with a threaded inner surface of the aperture (306).
- 5.** The assembly (102) as claimed in any preceding claim, wherein a lower surface (309) of the first fastening member
 (301) is arranged to abut with an upper surface (210) of the flange (207b) of the outer ring element (207).
- 25 **6.** The assembly (102) as claimed in any preceding claim, wherein the assembly (102) further comprises of an attach-
 ment ring (206) positioned between the shell (101) and the outer ring element (207), said ring (206) being configured
 to join the shell (101) and the outer ring element (207) together upon heat treatment.
- 30 **7.** The assembly (102) as claimed in any preceding claim, wherein the inner ring element (208) is provided with a
 plurality of circumferentially distributed vertical grooves (305) on the outer surface (211) of the inner ring element
 (208), and the outer ring element (207) is provided with a plurality of circumferentially distributed vertical grooves
 (308) complementary to the grooves (305) on the inner surface (212) of the wall portion (207a) of the outer ring
 element (207).
- 35 **8.** The assembly (102) as claimed in claim 7, wherein the grooves (305, 308) are arranged to align and enclose the
 locking element (304) when the inner ring element (208) and the outer ring element (207) are rotationally locked.
- 9.** The assembly (102) as claimed in any preceding claim, wherein the locking element (304) is in the form of a cylindrical
 pin arranged to be pushed down the aperture created by the alignment of the grooves (305, 308) of the inner ring
 40 element (208) and the outer ring element (207).
- 10.** The assembly (102) as claimed in any preceding claim, wherein the cover plate (205) is affixed to the inner ring
 element (208) by a plurality of second fastening members (302).
- 45 **11.** The assembly (102) as claimed in any preceding claim, wherein the cover plate (205) is provided with a plurality of
 radially distributed apertures (307) arranged to receive a plurality of second fastening members (302).
- 12.** The assembly (102) as claimed in claim 11, wherein the second fastening member (302) is in the form of a pin and
 sleeve assembly.
- 50 **13.** The assembly (102) as claimed in any preceding claim, wherein the inner ring element (208) is provided with a
 plurality of radially distributed apertures (311) for receiving the second fastening members (302).
- 55 **14.** The assembly (102) as claimed in any preceding claim, wherein the inner ring element (208) and the outer ring
 element (207) are eccentric with respect to a longitudinal axis (103), and wherein the inner ring element (208) and
 the outer ring element (207) rotate and create a cylindrical pocket (402) between them which is configured to
 accommodate a locking ring (403) enabling rotational locking of the inner ring element (208) and the outer ring
 element (207).

15. A gyratory crusher comprising:

an elongate main shaft (100) for gyroscopic precession within the crusher;
a head center (201) mounted at the main shaft (100);
5 an inner crushing shell (101) mounted at the head center (201);
and a retaining assembly (102) as claimed in any of the preceding claims, configured to mount the inner crushing
shell (101) on to the head center (201).

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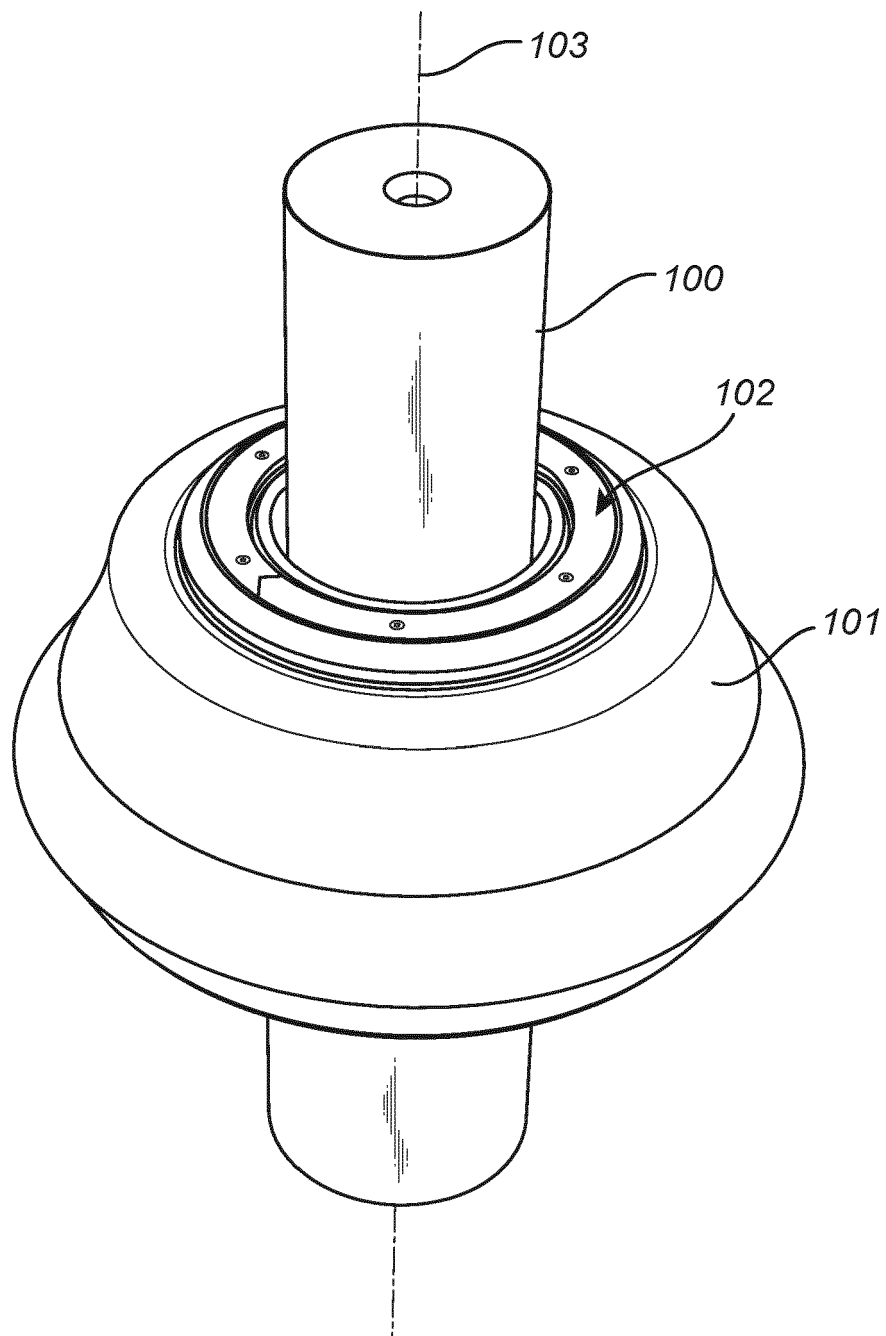


Figure 1

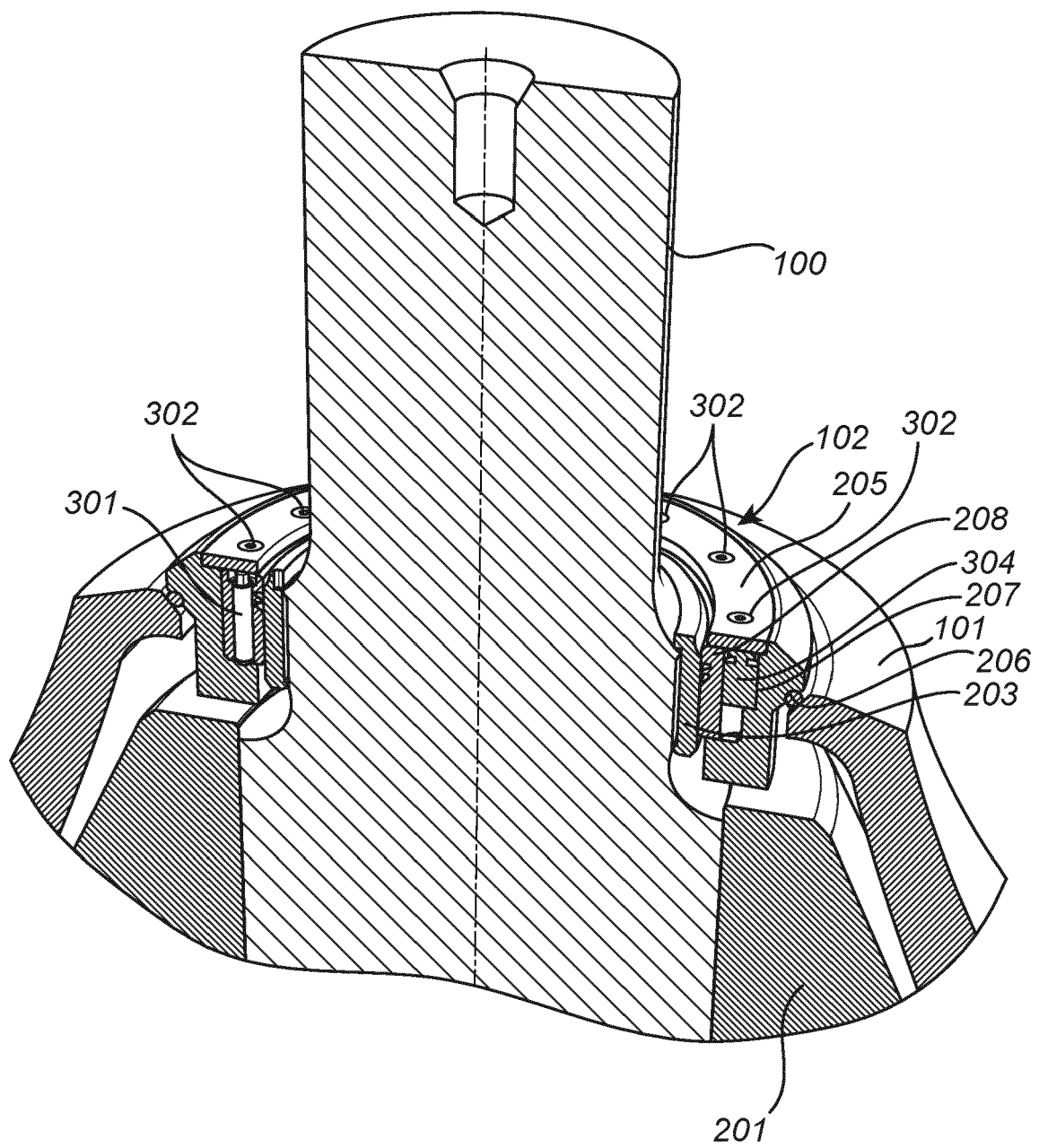


Figure 2

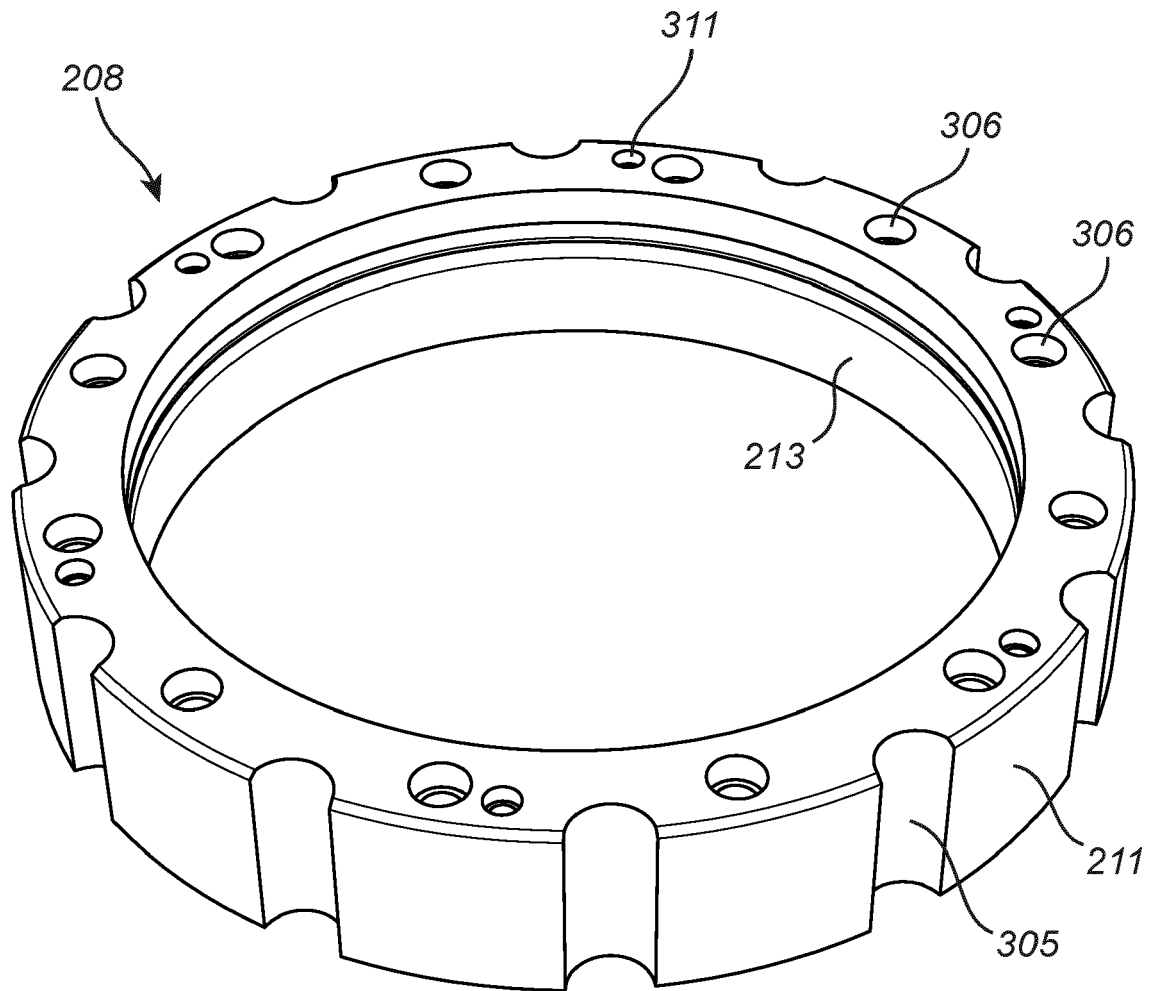


Figure 3

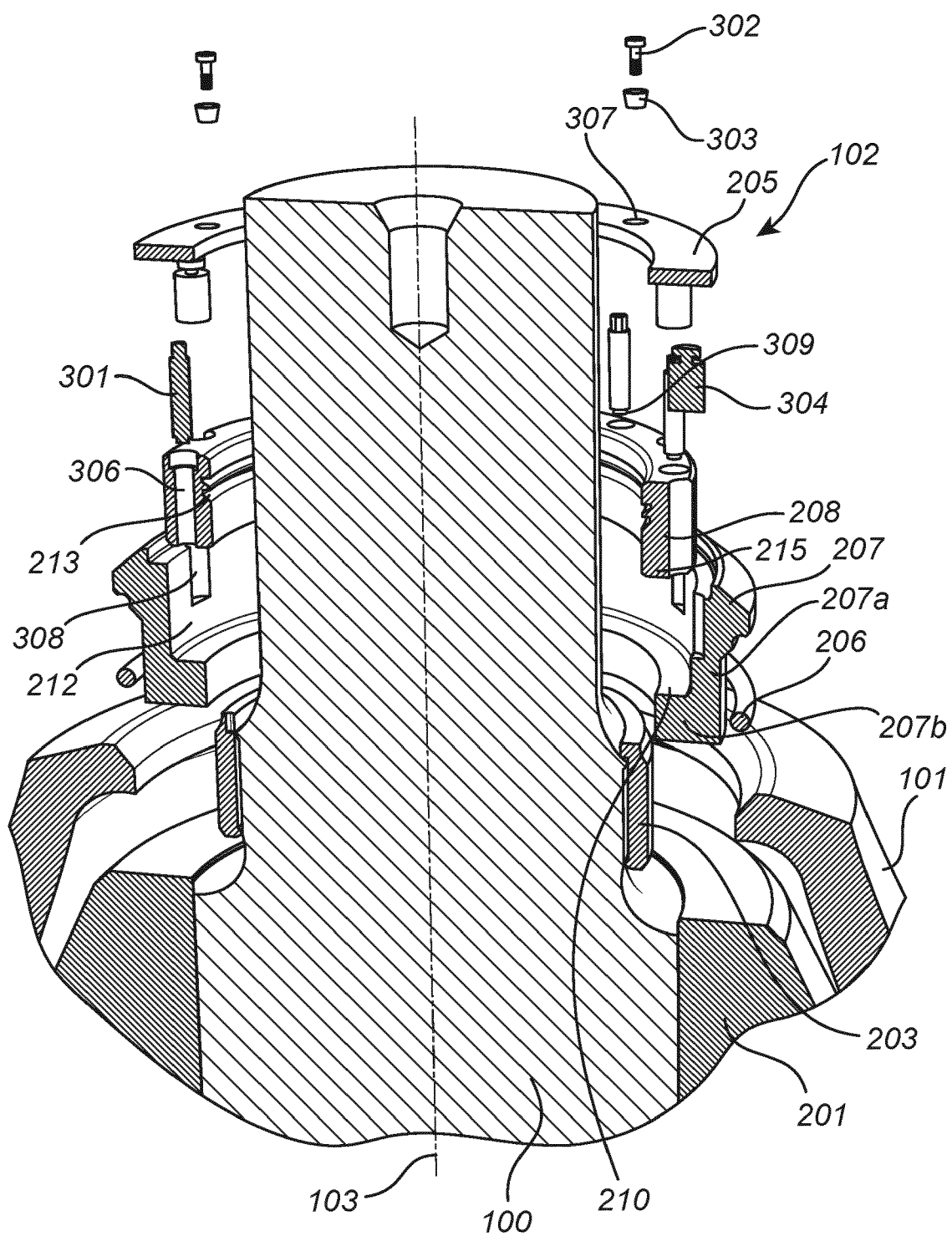


Figure 4

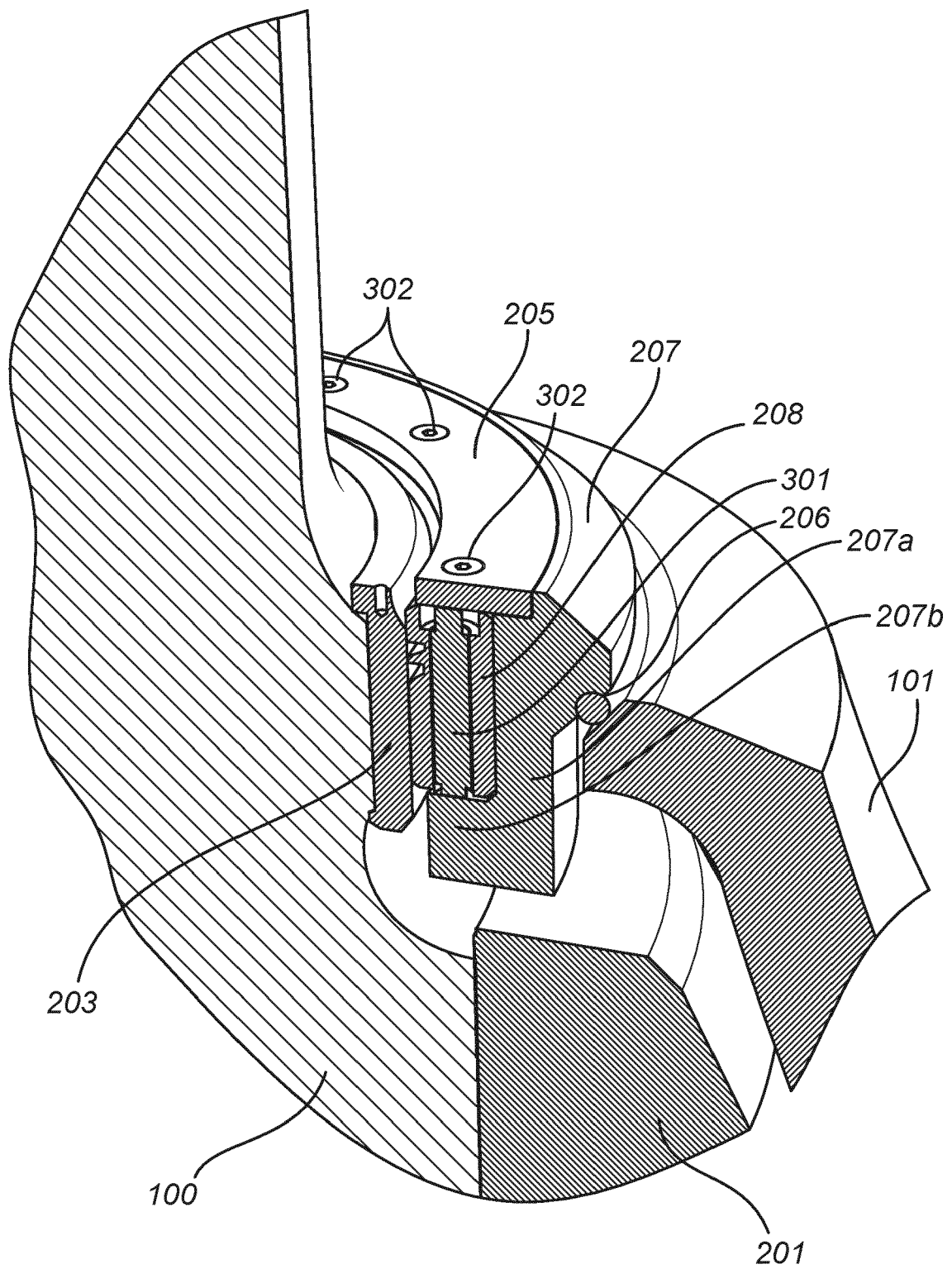


Figure 5

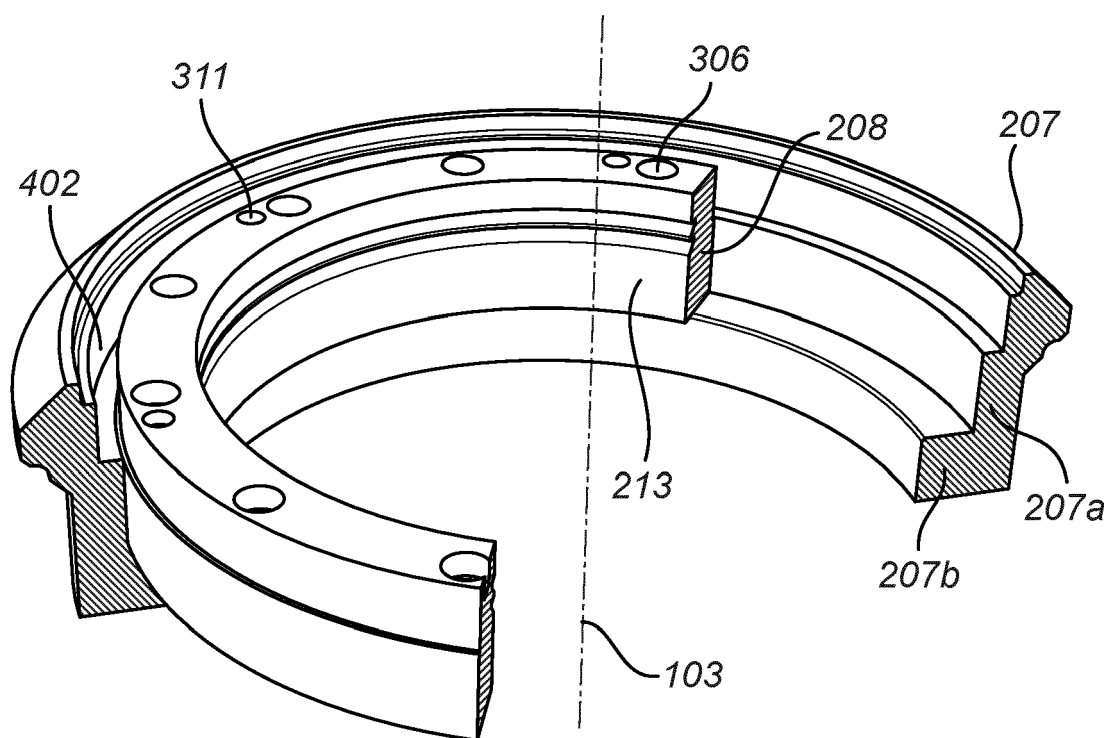


Figure 6a

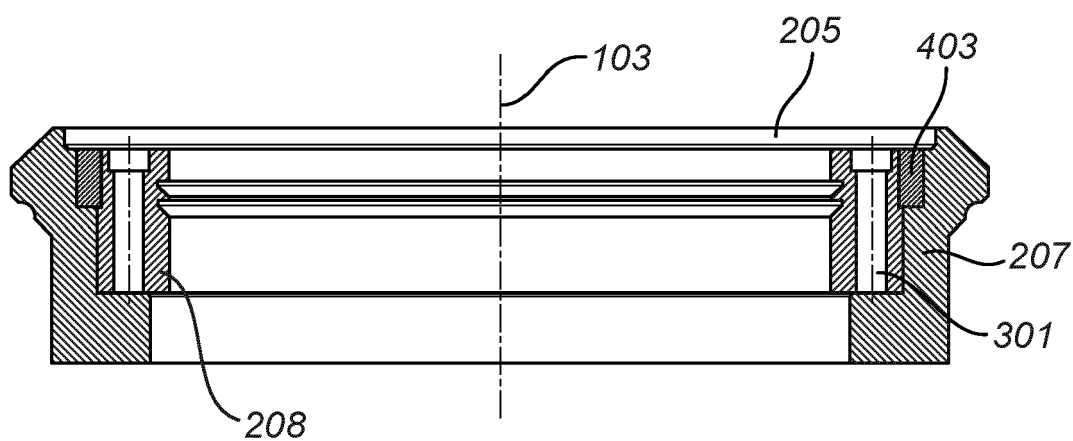


Figure 6b



EUROPEAN SEARCH REPORT

Application Number

EP 21 21 1994

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 June 2022	Examiner Iuliano, Emanuela
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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