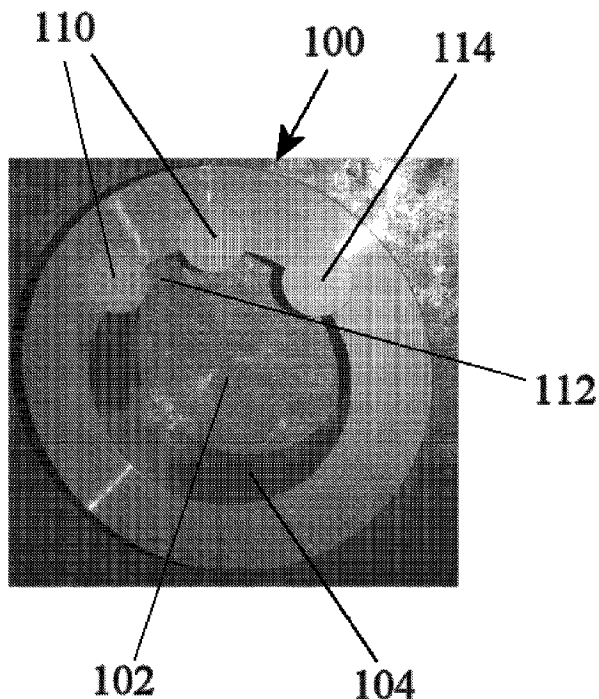




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(57) **Abrégé/Abstract:**

Modified thrust bearing inserts and clamps (100) using ceramic cylindrical bars (110) for submerged roll assemblies in a continuous hot-dipping apparatus are provided.

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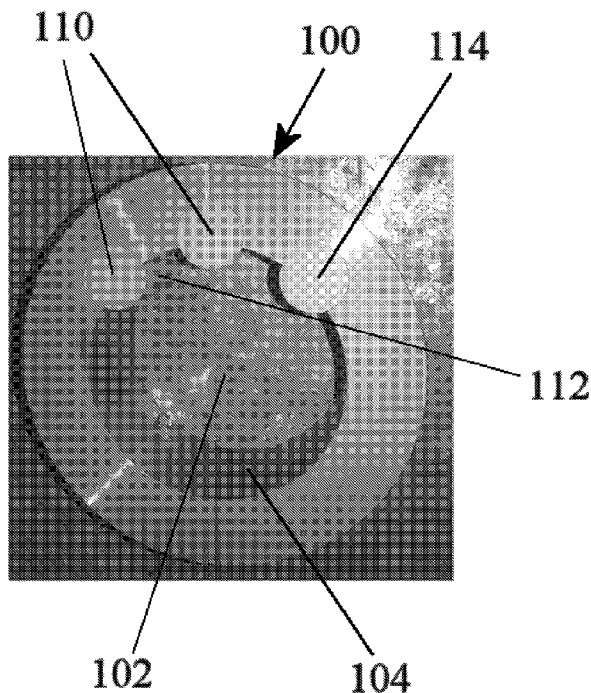


Figure 3

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THRUST BEARING AND CLAMP IN ROLL JOURNAL ASSEMBLY

FIELD

[0001] The present description relates to thrust bearings and clamps for submerged roll assemblies in a continuous hot-dipping process.

BACKGROUND

[0002] Hot-dip galvanizing is a process used for rust proofing materials such as iron and steel by coating the iron and steel with the desired coating such as zinc. For example, a sheet of steel is immersed into a bath of molten zinc using journal roll assemblies at temperatures around 465°C. The bearings for journal roll assemblies submerged in molten baths are known in the art. They are used in different processes such as galvanizing flat sheet steel using cold mill substrate, galvanizing anneal flat sheet/strip steel using cold mill substrate, or galvanizing aluminum flat sheet/strip steel using cold mill substrate or other applications as will be known in the art.

[0003] As the roll assemblies turn in the molten bath of speeds sometimes around 170 meters/minute, the strip of steel or metal is pulled through the molten bath. The exposure of sink roll assemblies to hot molten liquid, for example, molten zinc, generally around 465°C, subjects the assembly to significant damage. Additionally, as the steel flat strip is fed into the molten bath, a side thrust is induced in the journal roll that makes it move in a linear axis.

[0004] Present designs for sink roll assemblies use stainless steel clamps or shells having a generally round cross section (cylindrical clamps) as shown in Figure 1 "Prior Art". Rectangular prism ceramic bars are embedded into corresponding slots machined into the cylindrical clamp's inner wall so that a portion of each of the rectangular ceramic bars is exposed in the interior of the cylindrical clamp. Roll journals that rotate are inserted into the interior of the cylindrical clamp and the rectangular ceramic bars function to limit friction during rotation while also permitting the flow of molten zinc or other coating through the clearances. To limit the displacement of the rectangular ceramic bars into the interior of the cylindrical clamp, wedges are generally installed between the corresponding slots and the rectangular ceramic bars and may be welded in place.

[0005] However, the installation of these wedges may be user dependent leading to inconsistencies in installation and inconsistent wedge pressure on the rectangular ceramic bars. Further, the welding process to install the wedges exposes the brittle ceramic bars to localized heating that can affect the properties of the ceramic bars. Wedges that are machined differently can also subject the rectangular prism ceramic bars to various pressure points, which can contribute to the cracking and breaking of these rectangular prism ceramic bars. Failure of these rectangular prism ceramic bars to stay in place with the wedges due to cracking, breaking, or other reasons can result in vibration of the roll journal during rotation, again causing breakage, failure (sometimes permanent), and sleeve damage all leading to increased costs for repairs and production delays due to repairs or changing the equipment.

[0006] A further potential issue with rectangular ceramic bars is the dross or hard floating particles that move in the molten bath. During roll journal rotation, dross may be trapped inside the corresponding slots between the wedges and rectangular ceramic bars. The sharp edges of these rectangular prism ceramic bars can render more difficult the flow of dross during rotation. Thus, the trapping of the dross can lead to scoring of the roll journals and premature wear or failure. Thus, dross drawn in between the rectangular ceramic bars and hardened sleeve can score both the ceramic bars and sleeves leading to premature wear of the sleeves. This can also, in turn, lead to breaking or cracking of the ceramic bars. Equipment failure or damage may not be readily detected because the equipment is submerged in molten baths. In some situations, the sleeve may be worn away permitting the rotating roll journal to break free in the molten bath causing significant safety issues.

[0007] Present designs also use thrust bearings to limit the side thrusts of the roll journal. These thrust bearings include a 316L button to register with a 316L stainless steel block that is welded in place. During rotation, this design similarly suffers from premature wear. Premature wear can widen the requisite clearances between the roll and the bearing and can lead to disruption of the rotation of the rolls. This rotation disruption, in turn, can cause skidding of the sheet being rotated through the molten bath, and can result in quality defects. Additionally, this disruption can require shutting down the equipment to replace or fix the equipment resulting in delays.

[0008] Thus, it is desired to improve one or components of a roll bearing assembly in order to overcome at least one of the above disadvantages.

SUMMARY

[0009] An improved clamp and thrust bearing for use in a roll bearing assembly is provided herein.

[0010] Thus, according to an aspect of the present invention, a clamp having an inner wall defining a substantially cylindrical passage therethrough for use in a roll bearing assembly is provided. The clamp comprises a plurality of semi-cylindrical slots extending longitudinally along its inner wall and extending the length of the cylindrical passage. A plurality of corresponding cylindrical ceramic bars having a body and two ends are embedded within said semi-cylindrical slots so that at least a portion of the body of the cylindrical ceramic bars extend into the passage.

[0011] According to another aspect of the present disclosure there is provided a roll journal assembly for use in a molten bath environment having roll arms supporting a clamp as above defined for receiving a roll journal rotatable about a central longitudinal axis, the axis defining the center of two roll ends of the rotatable roll journal, the rotatable roll journal surrounded by a journal sleeve and the roll arms further having a thrust bearing insert mounted within an aperture in the roll arm for dampening side thrusts of the roll journal during rotation.

[0012] In another aspect of the disclosure, the thrust bearing insert comprises a thrust sleeve having an open flanged end and a closed other end defining a cylindrical interior cavity. The thrust sleeve is inserted into an aperture of the roll arm so that the cylindrical interior cavity axially aligns with the central longitudinal axis of the roll arm and the flanged end faces the roll journal for limiting lateral movement of the thrust sleeve away from the roll journal. The thrust cylindrical ceramic bar is of substantially the same length as said cylindrical interior cavity of the sleeve and has a first end receivable in the sleeve and a second end for registration with the roll journal. An insert protection cover is installed over the closed other end of the thrust sleeve for limiting the flow of molten material onto the thrust sleeve.

[0012a] In another aspect of the present disclosure, there is provided a roll journal assembly for use in a molten bath environment having roll arms supporting a clamp, the clamp having an inner wall defining a substantially cylindrical passage therethrough for receiving a roll journal rotatable about a central longitudinal axis, said axis defining the center of two roll ends of the rotatable roll journal, the rotatable roll journal surrounded by a journal sleeve and the roll arms further having a thrust bearing insert mounted within an aperture in the roll arm for dampening side thrusts of the roll journal during rotation, the roll journal assembly comprising: a plurality of semi-cylindrical slots extending longitudinally along the inner wall of the clamp and extending the length of the cylindrical passage; a plurality of corresponding cylindrical ceramic bars having a body and two ends, said cylindrical ceramic bars installed into said semi-cylindrical slots so that at least a portion of said body of the cylindrical ceramic bars extends into said passage for registration with the journal sleeve; and wherein each end of the roll journal is in registration with the thrust bearing insert; and wherein the thrust bearing insert of the roll journal comprises: a thrust sleeve having an open flanged end and an open other end defining a substantially cylindrical interior passage therethrough; said thrust sleeve inserted into an aperture of the roll arm so that the cylindrical interior passage axially aligns with the central longitudinal axis of the roll arm and said flanged end faces the roll journal for limiting lateral movement of said thrust sleeve away from the roll journal; a thrust cylindrical ceramic bar having a first end receivable in said sleeve and a second end for registration with the roll journal; and an insert protection cover installed over the open other end of the thrust sleeve for limiting the flow of molten material onto the thrust sleeve.

[0013] In another aspect of the present disclosure, the above thrust sleeve has an open flanged end and an open other end defining a substantially cylindrical interior passage therethrough for receiving the cylindrical ceramic bar above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] These and other features of the disclosure will become more apparent from the following description in which reference is made to the appended drawings wherein:

FIGURE 1 shows a cross-section of a prior art design of a clamp having embedded rectangular prism ceramic bars;

FIGURE 2 shows a front perspective view of a clamp having embedded cylindrical bars in accordance with an embodiment of the present disclosure;

FIGURE 3 shows a front perspective view of the clamp of Figure 2 prior to the stop tabs being added.

FIGURE 4 shows a front perspective view of the clamp of Figure 2 following exposure to molten zinc;

FIGURE 5 shows a side perspective view of the clamp of Figure 2 with the journal inserted concentrically in accordance with an embodiment of the present disclosure;

FIGURE 6 shows a perspective view of the clamp and thrust assembly in accordance with one embodiment of the present disclosure;

FIGURE 7 shows a perspective view of the thrust bearing in accordance with an embodiment of the present disclosure; and

FIGURE 8 shows a perspective view of the stainless steel insert used in the thrust bearing of Figure 7 and the button installed on the clamp of Figure 3.

FIGURE 9 shows a shows a cross-sectional and partial cut-away view of a clamp and thrust bearing assembly used in continuous hot-dipping in accordance with an embodiment of the present disclosure;

FIGURE 10A shows a front view of the clamp of Figure 9;

FIGURE 10B shows a side view of the clamp of Figure 9;

FIGURE 11A shows a side cross-sectional view of the thrust bearing insert of Figure 5; and

FIGURE 11B shows a side view of the button installed in Figure 9.

100	clamp	170	thrust ceramic bar
102	passage	172	first end
104	inner wall	173	second end
106	roll journal	174	insert protection cover
108	journal sleeve	176	cover aperture
		178	cap screw
110	cylindrical bars	180	head
112	body	200	roll arm
114	ends	202	aperture
116	semi-cylindrical slots		
118	stop tabs		
160	button		
162	apex		
164	stainless steel sleeve		
165	thrust bearing insert		
166	cavity		
167	interior passage		
168	flanged end		
169	closed other end		
171	open other end		

DETAILED DESCRIPTION

[0014a] The following text provides further information which was included in the drawings as originally filed and were removed from the drawings during examination of this application:

[0014b] As shown in Figure 1: a stainless steel insert 10, ends stops welded on 40, square ceramic bars 20 and wedges welded in place to hold ceramic bars 30.

[0014c] As shown in Figure 9, the CT thrust bearing ceramic insert with clamp comprises a ceramic bar (cylindrical) 300, graphite gaskets 310, a 316L capscrew 320, an insert protection cover 330, a thrust bearing ceramic bar insert 340, with two clearances 350 shown. Note: shoulder widths vary according to clearances required. A roll shaft journal sleeve 360 is shown, a laser clad button 370, a roll shaft journal 380, a roll body 390, a ceramic bar (cylindrical) 400, a stop tab 410, and a clamp 420.

[0014d] As shown in Figure 10A, the CT ceramic clamp design comprises a roll shaft journal sleeve 500, a roll shaft journal 510, a ceramic clamp 520, a stop tab (welded in place) 530, a ceramic bar (cylindrical) 540, and a groove for assembly in the field 550.

[0014e] As shown in Figure 11A, the ceramic bar (cylindrical) 600 is inside the 316L stainless steel insert 610.

[0014f] As shown in Figure 11B, the button 620 is installed and welded on center, each end of every roll shaft. The tungsten carbide coated button with radius is used to contact and rotate against insert ceramic bar. The hardened coating is .050" thick. [0015] Reference is now made to the accompanying drawings.[0016] A clamp suitable for incorporation in a roll journal assembly having roll arms 200 for use in a molten bath environment is provided. In one aspect of the present disclosure, the clamp 100 has an inner wall 104 defining a substantially cylindrical passage 102 therethrough for receiving a roll journal 106 rotatable about a central longitudinal axis. The axis defines the center of two roll ends of the rotatable roll journal 106, and the rotatable roll journal 106 is surrounded by a journal sleeve 108.

[0017] As shown in Figures 2, the roll journal assembly comprises a clamp 100 having a plurality of semi-cylindrical slots 116 extending longitudinally along the inner wall 104 of the clamp 100 and extending the length of the cylindrical passage 102. A plurality of corresponding cylindrical ceramic bars 110 having a body 112 and two ends 114 are installed into the semi-cylindrical slots 116 so that at least a portion of the body 112 of the cylindrical ceramic bars 110 extends into the passage 102 for registration with the journal sleeve 108.

[0018] In the accompanying drawings, three cylindrical bars 110 are used. These cylindrical bars 110 limit friction during rotation and may support the tension force of the strip as it is pulled through the assembly. A greater number of cylindrical ceramic bars 110 may also be used. The cylindrical ceramic bars 110 may be installed by shrink or interference fit. For example, a clamp 100 having an inner wall 104 may be machined to provide the semi-cylindrical slots 116. Next, the clamps 100 may be heated, for example in a furnace, to provide expansion clearance to permit sliding the cylindrical bars 110 into the corresponding semi-cylindrical slots 116. Once the cylindrical bars 110 are inserted into the semi-cylindrical slots 116, the clamp 100 having the cylindrical bars 110 installed may be left to cool at a controlled rate to limit shock or damage to the cylindrical bars 110.

[0019] To limit longitudinal displacement of the cylindrical bar 110 out of the passage 102, stop tabs 118 may be applied over the ends 114 of the cylindrical bars 110 that are embedded

within the clamp 110. These stop tabs 118 may take the form of a strip of 316L stainless steel that is welded in place as shown in Figs. 2, 4, 5, and 10B. Although shown to completely cover the ends 114 of the cylindrical bars 110, the stop tabs may be a small strip that covers a portion of the ends 114 of the cylindrical bars 110 and may be welded or otherwise secured in place. In other embodiments, multiple strips may be used and may be applied in parallel or cross over each other. Alternatively, the stop tabs 118 may take the form of a ring of 316L that is machined and tack welded in place. The stop tabs may be of any material suitable for high temperatures as known to one skilled in the art. Still other means of limiting the longitudinal displacement of the cylindrical bar 110 may be employed as will be known to one skilled in the art.

[0020] Use of the cylindrical bars 110 within the clamp advantageously circumvents the use of wedges for stabilization purposes. The elimination of wedges alleviates the problems associated with inconsistent wedging and inconsistent pressure applied to the bars that would otherwise lead to cracks and failure of the bars. Rather, the cylindrical bar 110 is shrink fitted into the slot 116 formed in the inner wall 104 of the clamp 100, thus avoiding the use of welding for the wedges and attendant localized heating that may otherwise result which can also adversely affect the properties of the bar. Additionally, use of a shrink fitted cylindrical bar 110 helps limit the displacement of the cylindrical bar 110 into the cylindrical interior of the clamp 100 or out of the corresponding slot 116.

[0021] Further, the use of cylindrical bars 110 also alleviates issues associated with dross trapping that occur in prior art clamps comprising rectangular prism bars. For example, the use of cylindrical bars 110 improves the movement of the debris or dross that may otherwise be trapped by the edges or corners of the prior art rectangular prism bar. This flow of dross during rotation of the roll helps reduce scoring of the roll or sleeve which in turn reduces wear.

[0022] As illustrated in Figs. 5 and 6, the clamp 100 is designed to receive within the cylindrical passage 102 the substantially cylindrical rotatable roll journal 106. The roll journal may be made of 316L stainless steel, stellite, or other suitable material known to one

skilled in the art. The substantially cylindrical journal sleeve 108 surrounds the rotatable roll journal 106. This journal sleeve 108 may be coated with a hardened surface material. For example, the journal sleeve 108 may be carbide coated or tungsten carbide coated having a thickness from about 0.050 inches to about 0.070 inches and serves to protect the rotatable roll journal 106 from the high temperatures and damaging conditions of the molten bath. It also provides a hardened surface against which the ceramic cylindrical bars 110 are rotated. This improves the projected life of the sleeve in the molten environment. As will be known to one skilled in the art, the journal sleeve 108 may be changed after some time.

[0023] Referring now to Figure 9, the roll arms 200 further comprise a thrust bearing insert 165 mounted within an aperture 202 in the roll arm 200 for dampening side thrusts of the roll journal 106 during rotation. Thus, during use in the roll assembly, each end of the roll journal 106 is in registration with the thrust bearing insert 165.

[0024] Referring now to Figs. 5, 6, 9, and 11B, a generally dome-shaped button 160 having an apex 162 defines each end of the roll journal 106. The apex 162 of the button 160 is in line with the central longitudinal axis of the roll end for registration with the thrust bearing insert discussed below and to dampen the side thrusting of the roll journal 106 during rotation. The button 160 is of a hardened material or coated with a hardened material such as tungsten carbide to limit wearing when the apex 162 of the button contacts the thrust bearing insert 165 of the assembly as described below, and ultimately to limit wear on the shaft 106. The hardened coating may be of a thickness suitable to endure wear on the shaft 106 for a period of time, for example, 0.01-0.1 inches thick, e.g. 0.05 inches thick.

[0025] The button 160 may be integral with the roll journal 106. Alternatively, the button 160 may be welded or otherwise secured in place to permit removal during reconditioning or machining of the roll journal 106 or roll sleeve 108. As shown in Fig. 8, the button 160 is of a circular base shape having approximately the same diameter as the end of the shaft 106. However, the button 160 may be of a smaller diameter than the shaft 106 as long as the apex 162 is in registration with the center of the shaft of the roll journal 106 to ensure contact with the thrust bearing insert. The button 160 may also have a rectangular, trapezoidal, or any

other base shape so long as it is generally dome shaped in that it has an apex 162 extending from the center of the shaft 106. The point contact of the apex 162 of the button 160 with the ceramic insert as discussed below limits friction, thus permitting rotation of the roll journal 106.

[0026] The apex 162 of the button 160 meets the thrust bearing insert 165 and rotates against the thrust bearing insert 165 discussed below. This, in turn, dampens the side thrusting of the journal 106 while permitting roll rotation. Accordingly, this provides for clearance between the thrust bearing insert 165 and the roll journal 106 and limits the contact of the roll journal 106 with the roll arm 200 that could otherwise limit roll rotation. Advantageously, the point contact between the thrust cylindrical ceramic bar (discussed below) in the thrust bearing insert 165 and the button reduces wear on the thrust cylindrical ceramic bar (discussed below), alleviating problems, such as roll rotation disruption.

[0027] As shown in Fig. 9, the thrust bearing insert 165 sits within an aperture 202 of the roll arm 200 in the assembly. The thrust bearing insert 165 comprises a thrust sleeve 164 having an open flanged end 168 and a closed other end 169 defining a cylindrical interior 166 for receiving a thrust cylindrical ceramic bar 170 of substantially the same length as the cavity 166 as shown in Fig. 11A. The sleeve 164 may be stainless steel, e.g. 316L, or any other suitable material as will be known to one skilled in the art. The thrust bearing insert 165 sitting within the aperture 202 of the roll arm 200 is inserted so that the cylindrical interior cavity 166 axially aligns with the central longitudinal axis of the roll arm 200 and the flanged end 168 faces the roll journal 106 for limiting lateral movement of the thrust sleeve 164 away from the roll journal 106 in the assembly. Thus, the flanged end 168 rests against the roll arm 200 for limiting lateral movement of the thrust bearing insert 165 from the force applied by the side thrusts of the journal shaft 106.

[0028] To limit the molten metal, for example, molten zinc, from entering any spacing between the flange 168 and the roll arm 200, a graphite gasket or other material as will be known to one skilled in the art may be installed between the flange 168 and the roll arm 200.

[0029] The thrust cylindrical ceramic bar 170 of substantially the same length as the interior cavity 166 into which it is inserted has a first end 172 receivable in the sleeve and a second end 173 for registration with the roll journal 106. To permit contact between the second end 173 of the ceramic bar 170 and the button 160, the second end 173 of the ceramic bar 170 may extend from within the interior cavity 166 beyond the edge of the flange 168. The thrust ceramic bar 170 is held in place within the interior cavity 166 by interference shrink fit to limit movement out of the interior cavity 166. To achieve the interference shrink fit, the sleeve 164 may be heated to get the clearance needed to insert the thrust cylindrical ceramic bars 170. The insert including the ceramic bar is then left to cool in a controlled fashion to limit cracking.

[0030] To further limit movement of the thrust ceramic bar 170 out of thrust bearing insert 165, for example, due to side thrusts of the roll journal 106, an insert protection cover 174 may be employed as shown in Fig. 9. Thus, the insert protection cover 174 may be installed over the closed other end 169 of the thrust sleeve 164 for limiting the flow of molten material into the thrust sleeve 164. This insert protection cover 174 may be made of any suitable material capable of withstanding heat, such as 316L stainless steel. The insert protection cover 174 may be of any shape and may be installed over the closed end of the insert 165, for example, by welding the insert protection cover 174 to the arm roll 200. This protection cover 174 limits the flow of molten metal into any potential space between the roll arm 200 and the insert 165 on the exterior side of the roll arm 200.

[0031] A cover aperture 176 is formed in the insert protection cover 174 in axial alignment with the interior cavity 166 of the insert 164. Thus, the cover aperture 176 in the insert protection cover 174 is in axial alignment with the central longitudinal axis of the roll arm 200. A cap screw 178 having an elongated body is insertable into the cover aperture 175 for engagement with the closed end 169 of the thrust sleeve 164. The cap screw 178 may have a head 180 for engaging the insert protection cover 174 and for limiting lateral movement of the thrust sleeve 164 toward the roll journal 106.

[0032] In this embodiment, the cap screw may not contact the ceramic bar 170. For example, if ceramic bar 170 is installed in the cavity 166, then the cap screw 178 may simply connect with the insert 165 but not the ceramic bar 170. In the accompanying drawings, the cap screw 178 is shown to have a head 180 that engages the insert protection cover 174. Graphite gasket or other material as known to one skilled in the art may be installed between the head 180 and the protection cover 174 to limit the molten metal from entering any spacing between the head 180 and the protection cover 174.

[0033] In an alternate embodiment, the thrust sleeve 164 has an open flanged end 168 and an open other end 171 defining a substantially cylindrical interior passage 167 therethrough for receiving the thrust cylindrical ceramic bar 170. Thus, the thrust sleeve 164 is inserted into the aperture 202 of the roll arm 200 so that the cylindrical interior passage 167 aligns with the central longitudinal axis of the roll arm 200 and the flanged end 168 faces the roll journal for limiting lateral movement of the thrust sleeve 164 away from the roll journal 106.

[0034] Thus, the cover aperture 176 in the insert protection cover 174 may be in axial alignment with the interior passage 167 of the insert 164. Thus, the cap screw 178 is insertable into the cover aperture 176 and through the interior passage 167 of the insert 165. This cap screw 178 contacts the first end 172 of the ceramic bar 170 placed within the interior passage 167 to limit lateral movement of the ceramic bar 170. Accordingly, the second end 173 of the thrust ceramic bar 170 inserted within the interior passage 167 can contact the button 160, while the first end 172 is not contained within a cavity but terminates within the passage 167 for contact with the cap screw 178. As above, the cap screw 178 may optionally threadedly engage the insert 165 or otherwise engage with the insert 165.

[0035] Tightening the cap screw 178 helps to maintain the seal on the graphite gaskets and permit the insert 165 to be repositioned if the journal sleeve 108 of the roll assembly is changed. For example, when removing the journal sleeve 108, the roll journals 106 may be machined for removal of the button 160 that results in an overall shortening of the length of the roll journal 106. Accordingly, the insert 164 may either be shimmed to compensate for

the shortening of the roll journal, or new inserts 164 of a suitable length may be installed to maintain the desired clearance between the button 160 and the ceramic insert 164.

[0036] The present clamp 100 may be provided separately for insertion into a roll assembly, either in complete form e.g. with a plurality of cylindrical embedded bars 110, or may be provided in kit form, e.g. with clamp 100 having semi-cylindrical slots 116 formed therein, and cylindrical bars 110 to be embedded into the slots 116. The clamp 100 may optionally be provided with one or more other elements to modify a roll assembly as described including a roll journal button(s) 160, and elements to modify the roll arm 200, e.g. thrust bearing insert 165 comprising a thrust sleeve 164 with thrust ceramic bar 170, thrust bearing insert protection cover 174, cover aperture 176, and cap screw 178.

[0037] Alternatively, the present thrust bearing insert 165 may be provided separately for insertion into a roll assembly, either in complete form e.g., with a thrust ceramic bar 170 inserted into a thrust sleeve 164 and having installed a thrust bearing insert protection cover 174 having a cap screw 178 inserted through the cover aperture 176 of the thrust bearing insert protection cover 174. The thrust bearing insert 164 may optionally be provided with one or more other elements to modify the roll assembly as described including a roll journal button(s) 160, and a modified clamp as described above.

[0038] Alternatively, a modified roll assembly may be provided incorporating one or more of the elements described herein.

[0039] To enhance the above embodiments, a flush line or piping (not shown) may optionally be installed in the clamp 100 and thrust bearing insert 165 to flush dross build-up. The flush line may be 316L stainless steel or other suitable material known in the art able to withstand the molten conditions into which it is inserted. The flush line or piping may be used to inject nitrogen gas into the areas of dross build-up, for example, in the location of the installed ceramic cylindrical bars 110 or ceramic bars 170. In these embodiments, the flush lines may be mounted on the roll arms 200 and may be regulated using a control that controls the amount of gas required for cleaning or flushing. In some embodiments, the flush lines may be

constantly delivering nitrogen gas for cleaning. In other embodiments, the flush lines may be periodically used to clean or flush the dross in predetermined periods or as required.

[0040] One or more currently preferred embodiments have been described by way of example. It will be apparent to persons skilled in the art that a number of variations and modifications can be made without departing from the scope of the invention as defined in the claims.

WHAT IS CLAIMED IS:

1. A roll journal assembly for use in a molten bath environment having roll arms supporting a clamp, the clamp having an inner wall defining a substantially cylindrical passage therethrough for receiving a roll journal rotatable about a central longitudinal axis, said axis defining the center of two roll ends of the rotatable roll journal, the rotatable roll journal surrounded by a journal sleeve and the roll arms further having a thrust bearing insert mounted within an aperture in the roll arm for dampening side thrusts of the roll journal during rotation, the roll journal assembly comprising:

- a plurality of semi-cylindrical slots extending longitudinally along the inner wall of the clamp and extending the length of the cylindrical passage;
- a plurality of corresponding cylindrical ceramic bars having a body and two ends, said cylindrical ceramic bars installed into said semi-cylindrical slots so that at least a portion of said body of the cylindrical ceramic bars extends into said passage for registration with the journal sleeve; and

wherein each end of the roll journal is in registration with the thrust bearing insert; and

wherein the thrust bearing insert of the roll journal comprises:

- a thrust sleeve having an open flanged end and an open other end defining a substantially cylindrical interior passage therethrough;
- said thrust sleeve inserted into an aperture of the roll arm so that the cylindrical interior passage axially aligns with the central longitudinal axis of the roll arm and said flanged end faces the roll journal for limiting lateral movement of said thrust sleeve away from the roll journal;
- a thrust cylindrical ceramic bar having a first end receivable in said sleeve and a second end for registration with the roll journal; and

- an insert protection cover installed over the open other end of the thrust sleeve for limiting the flow of molten material onto the thrust sleeve.

2. The roll journal assembly of claim 1, further comprising stop tabs applied to said ends of said cylindrical ceramic bars for limiting the longitudinal displacement of said cylindrical ceramic bars out of said slots;

3. The roll journal of claim 1, further comprising:

- a generally dome-shaped button having an apex defining each end of the roll journal, said apex of the button in line with the central longitudinal axis of the roll end for registration with the thrust bearing insert.

4. The roll journal of claim 1, wherein the thrust bearing insert comprises:

- a thrust sleeve having an open flanged end and a closed other end defining a cylindrical interior cavity;

- said thrust sleeve inserted into an aperture of the roll arm so that the cylindrical interior cavity axially aligns with the central longitudinal axis of the roll arm

and said flanged end faces the roll journal for limiting lateral movement of said thrust sleeve away from the roll journal;

- a thrust cylindrical ceramic bar of substantially the same length as said cylindrical interior cavity of the sleeve and having a first end receivable in said sleeve and a second end for registration with the roll journal; and

- an insert protection cover installed over the closed other end of the thrust sleeve for limiting the flow of molten material onto the thrust sleeve.

5. The roll journal of claim 4, the thrust bearing insert further comprises:

- a cover aperture in the insert protection cover in axial alignment with the central longitudinal axis of the roll arm;

- a cap screw having an elongated body insertable into said cover aperture for engagement with the closed end of the thrust sleeve; and
- said cap screw having a head for engaging said insert protection cover and for limiting lateral movement of said sleeve toward the roll journal.

6. The roll journal of claim 1, the thrust bearing insert further comprises:

- a cover aperture in the insert protection cover in axial alignment with the central longitudinal axis of the roll arm;
- a cap screw having an elongated body insertable into said cover aperture for engagement with the other open end of the thrust sleeve; and
- said cap screw having a head for engaging said insert protection cover and for limiting lateral movement of said sleeve toward the roll journal.

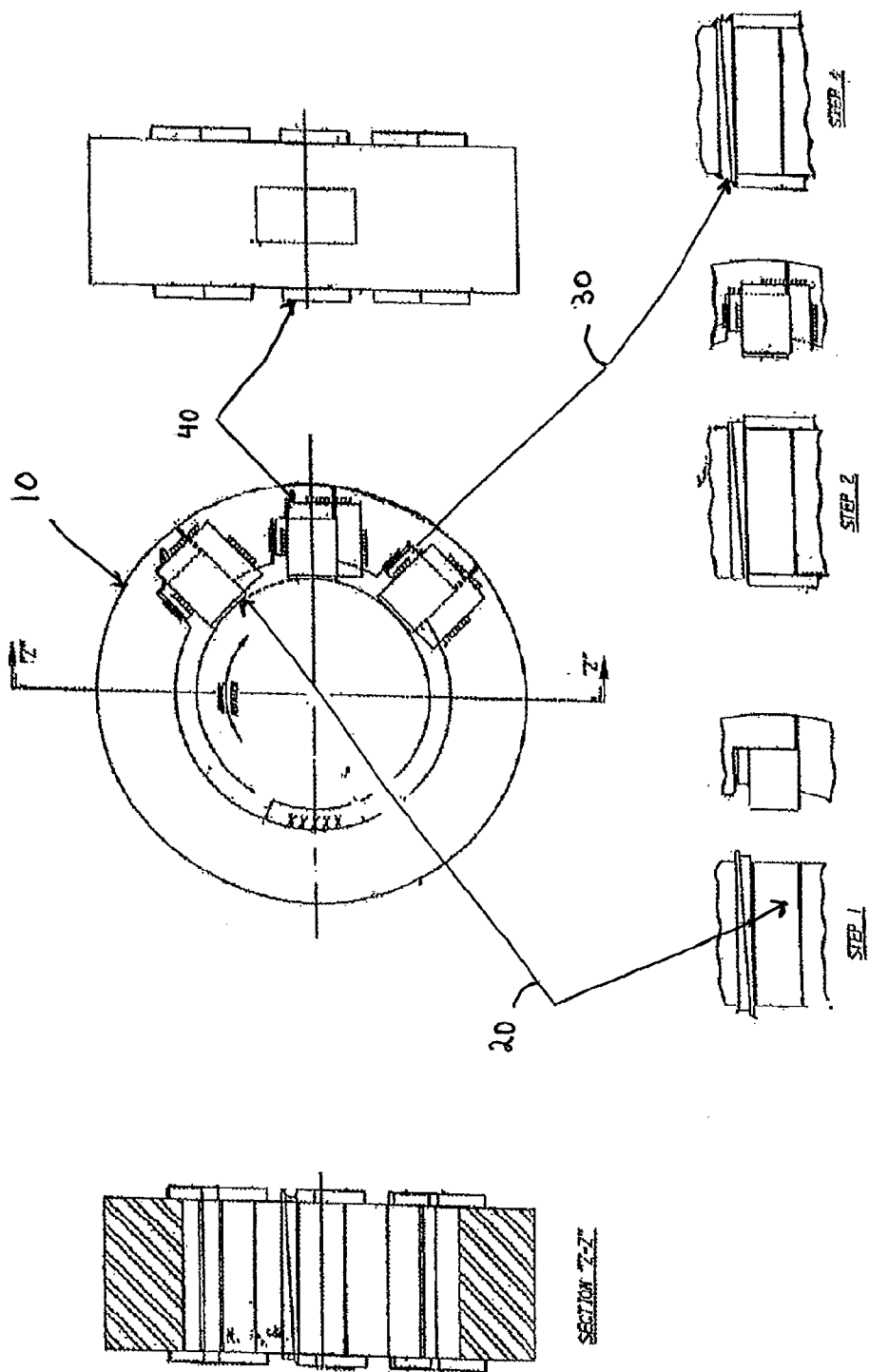


Figure 1 (Prior Art)

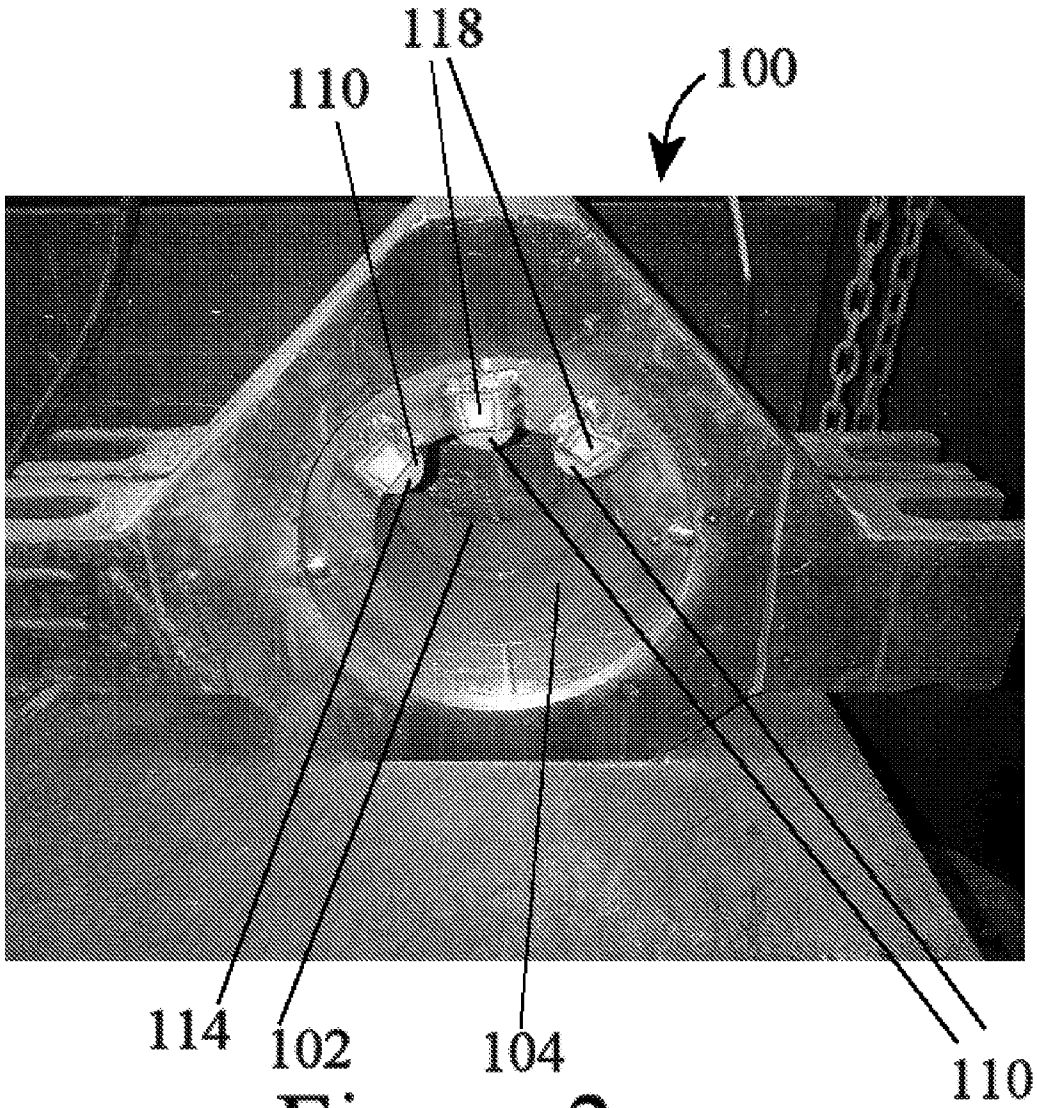


Figure 2

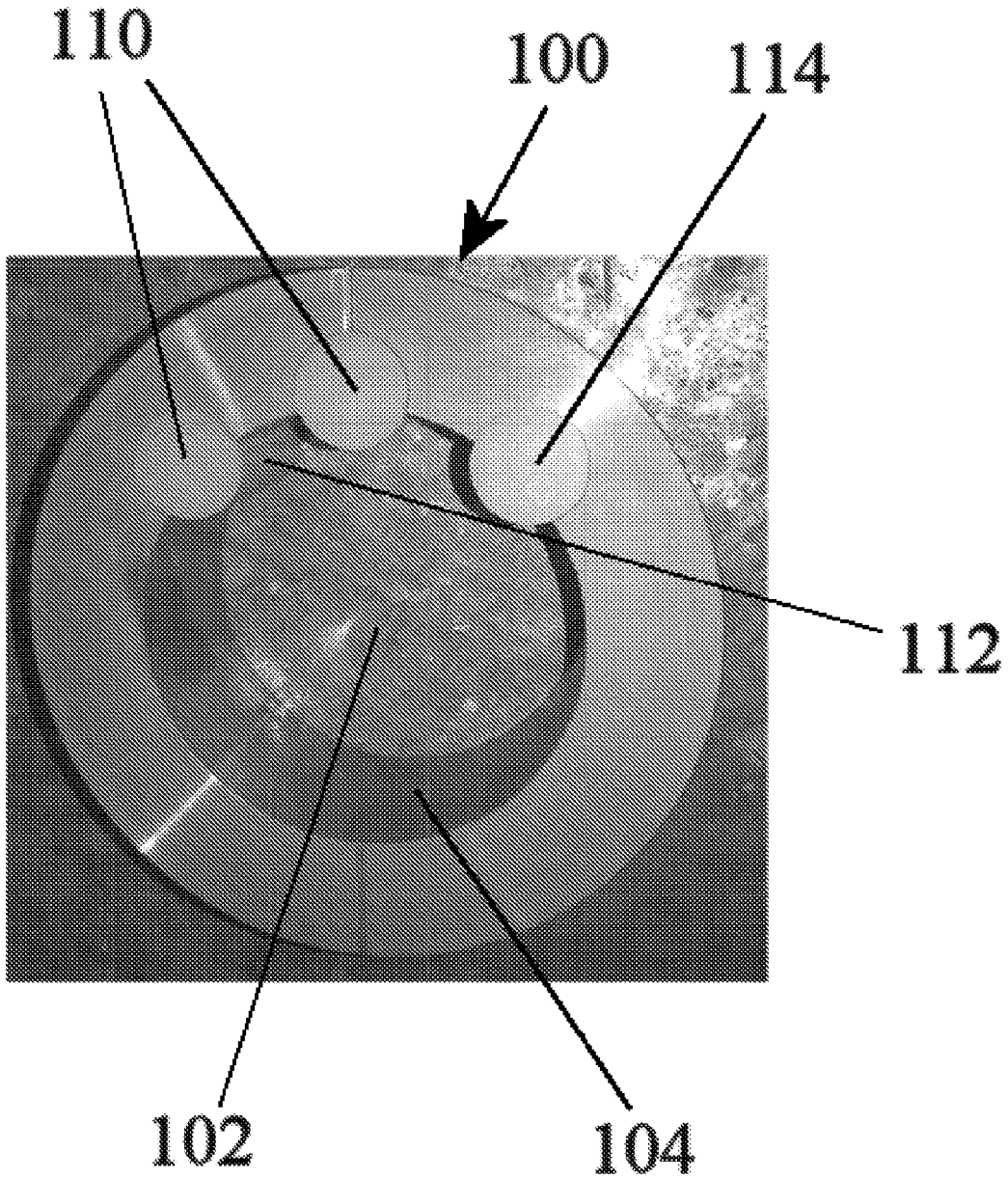


Figure 3

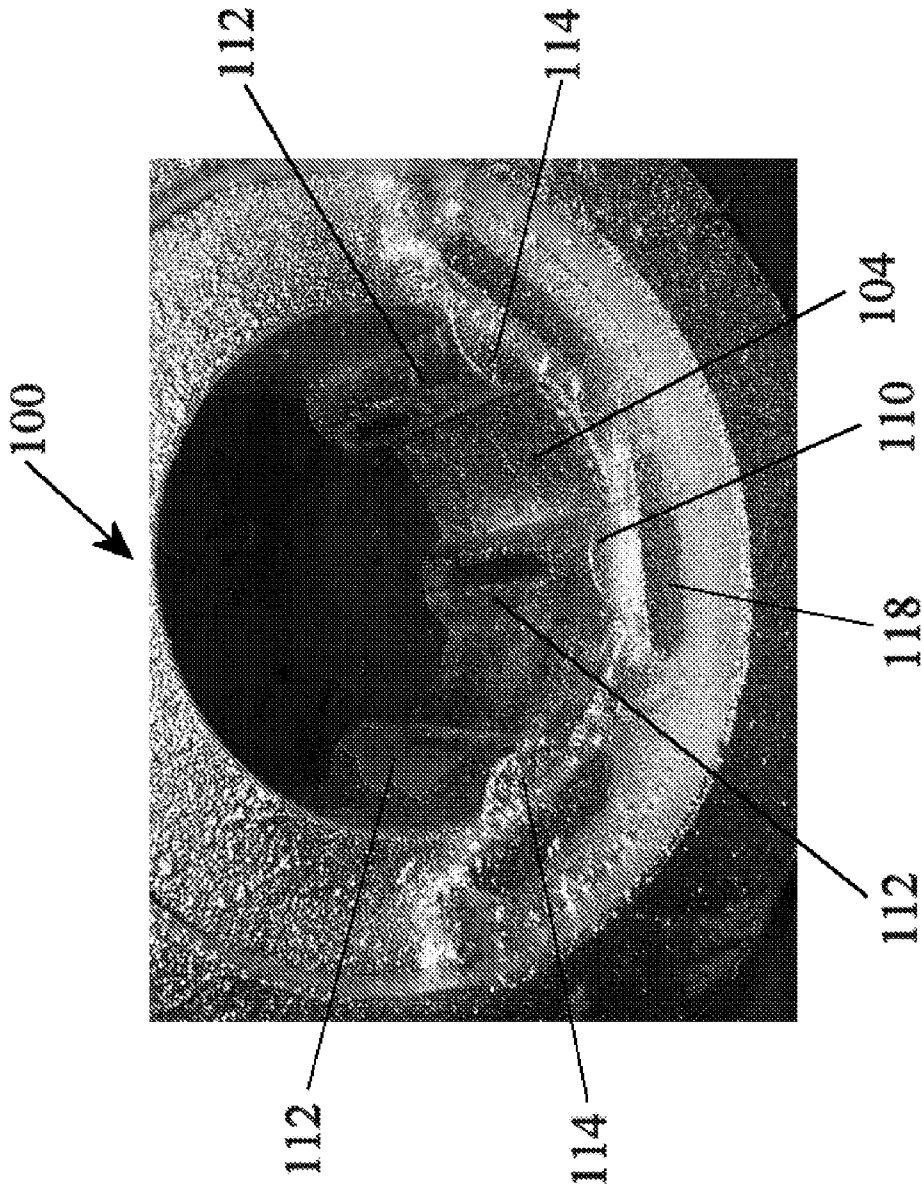
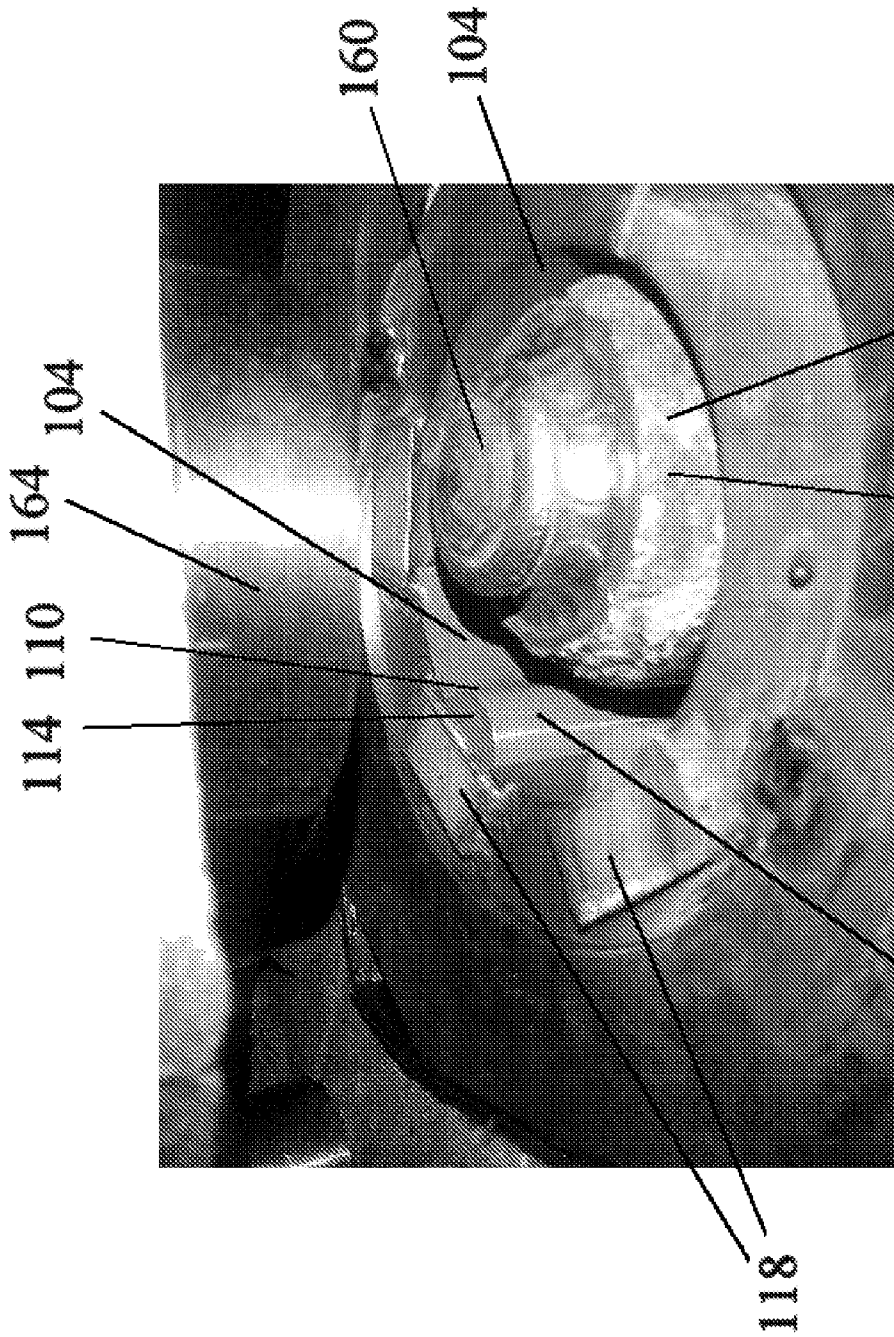


Figure 4



112 Figure 5 106 108

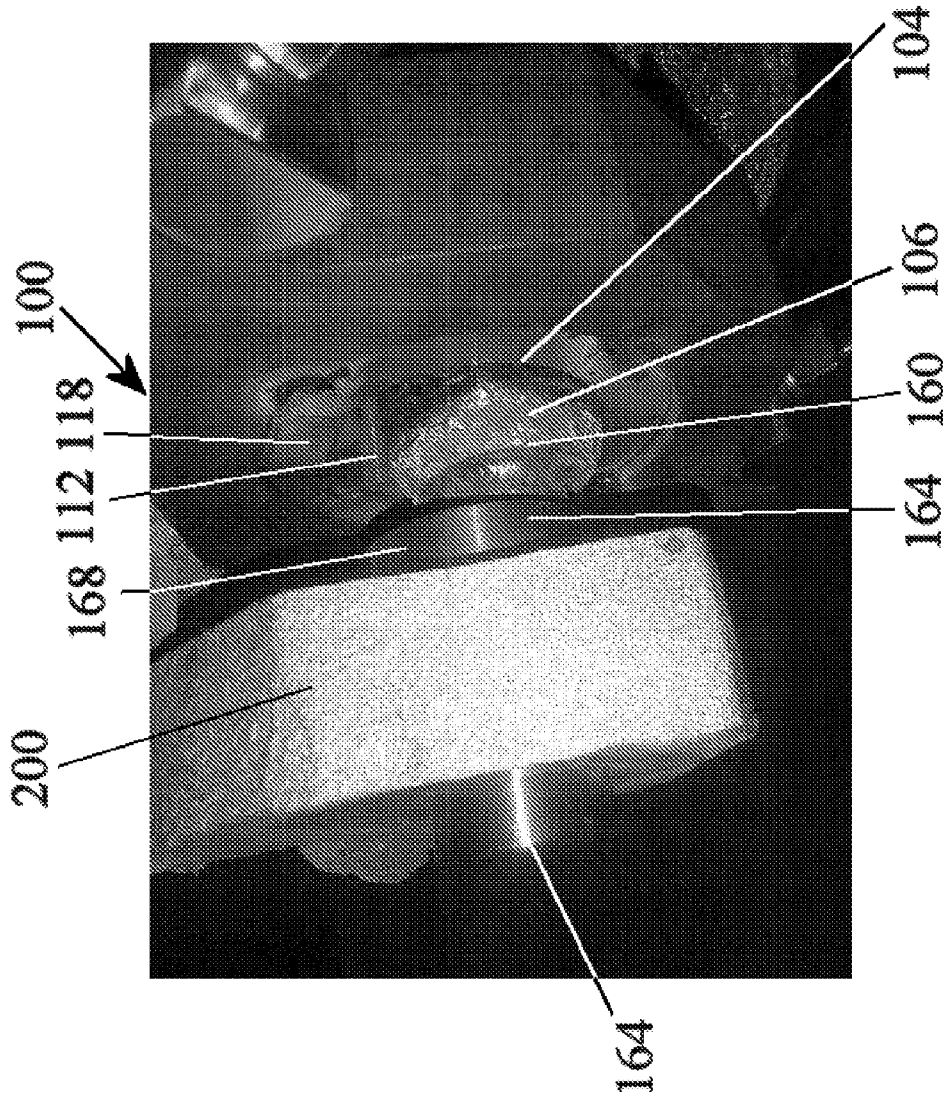


Figure 6A

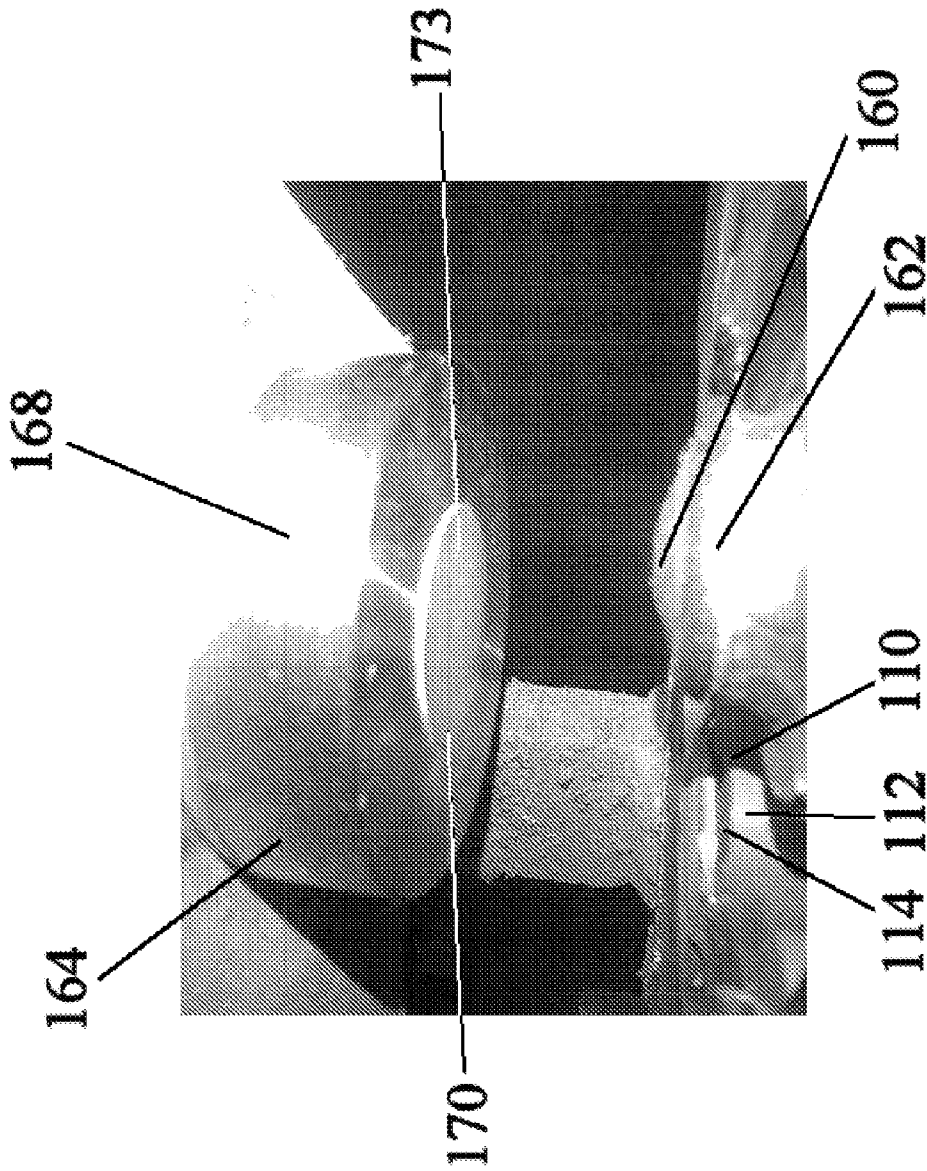
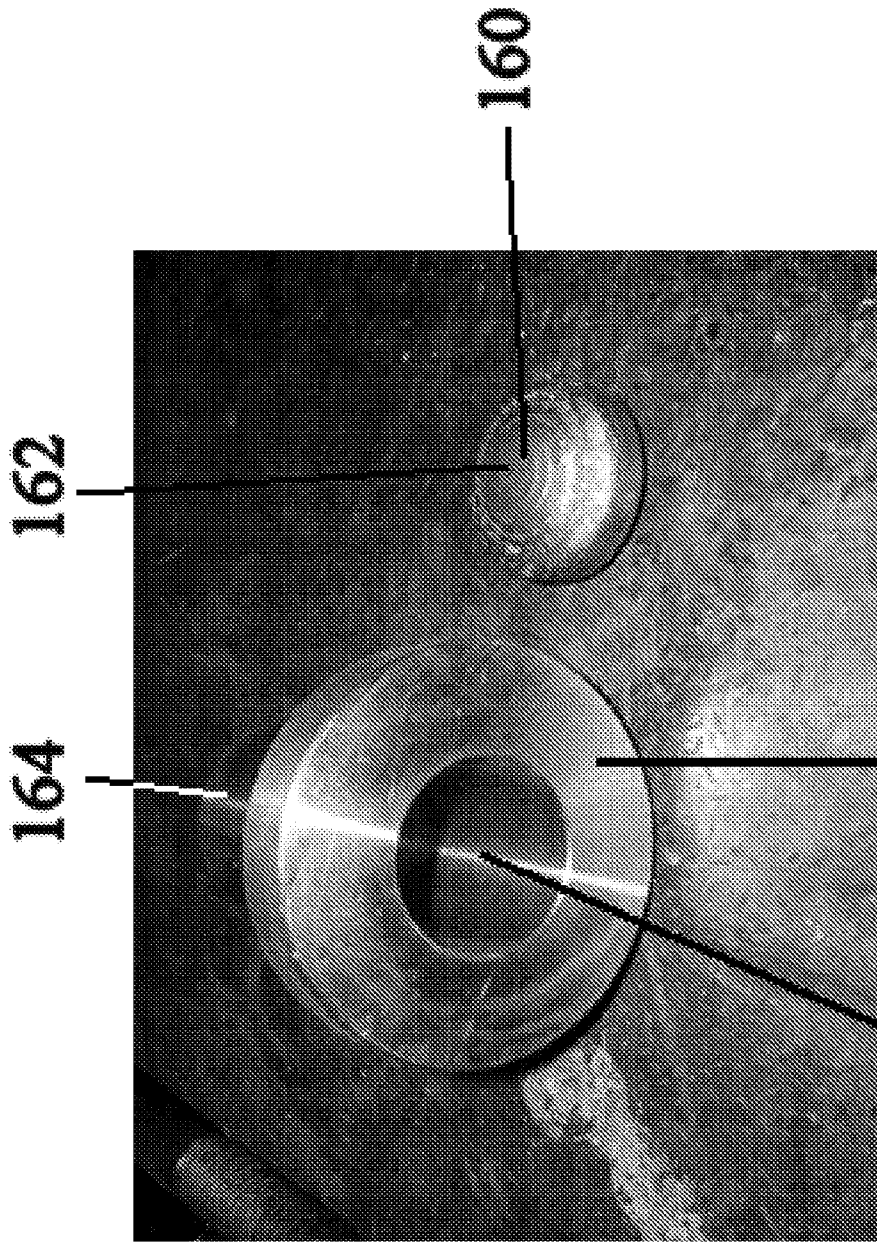


Figure 7



168 Figure 8A

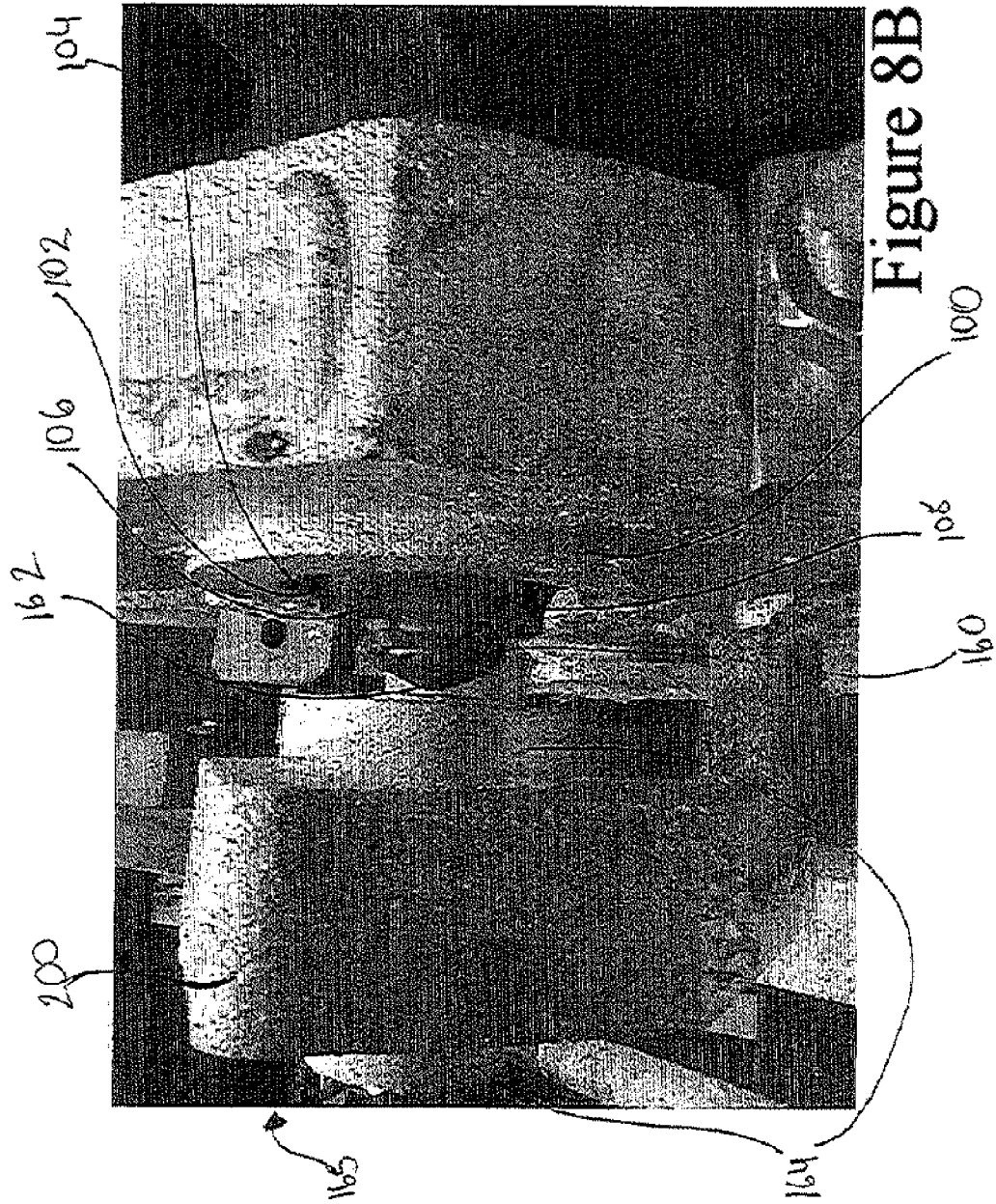


Figure 8B

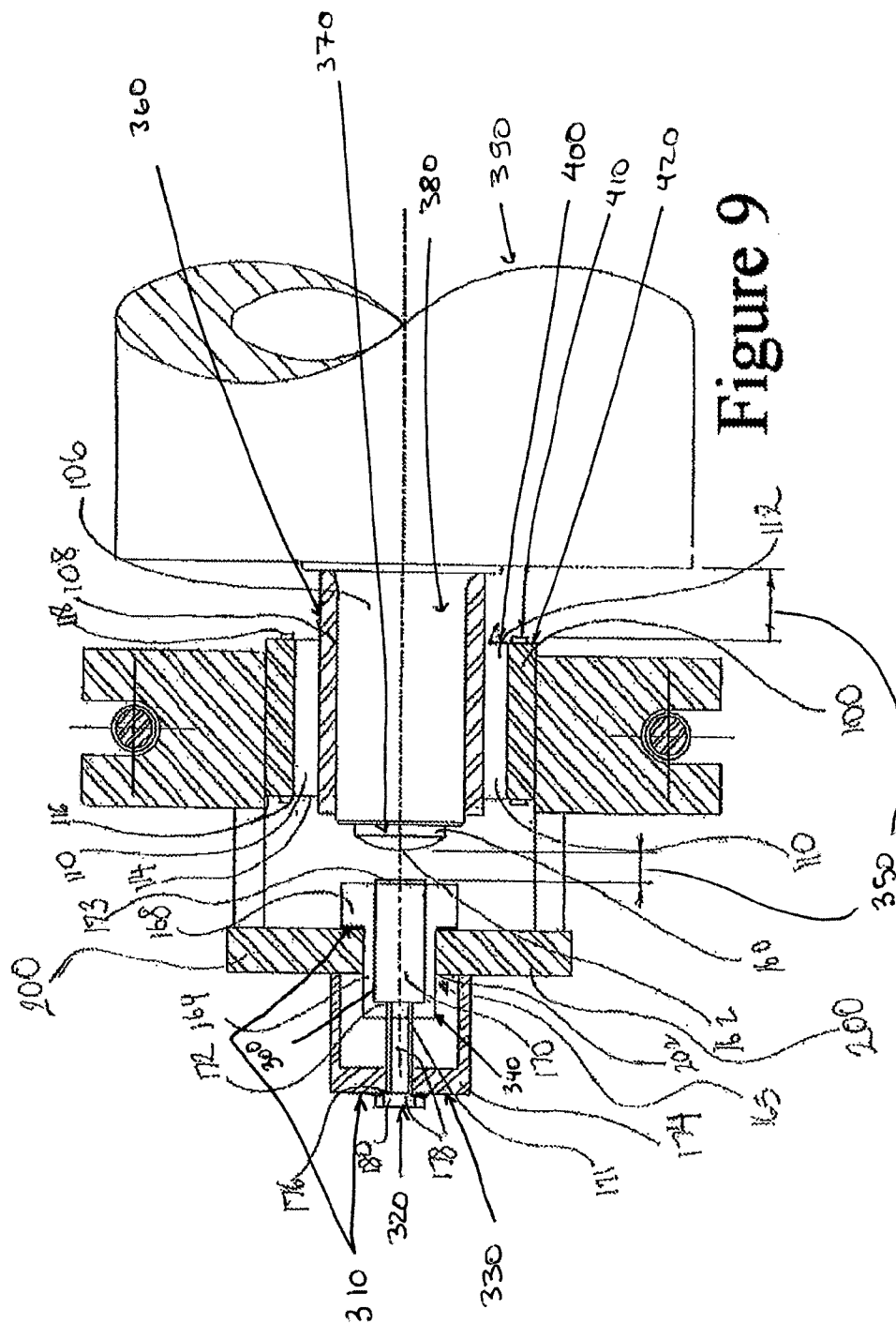


Figure 9

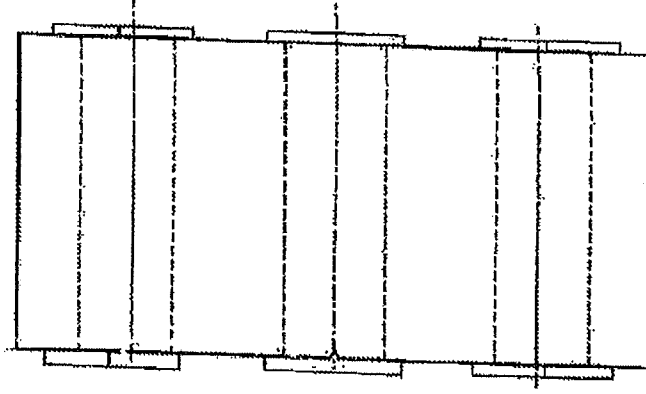


Figure 10B

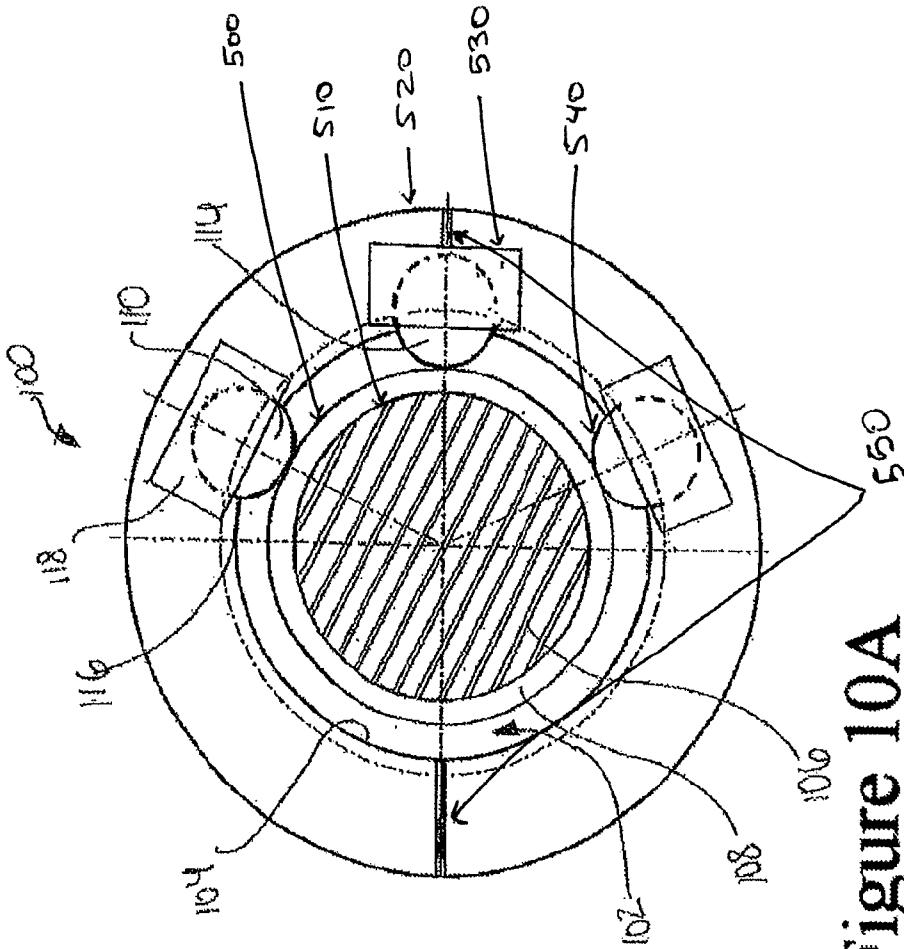


Figure 10A

