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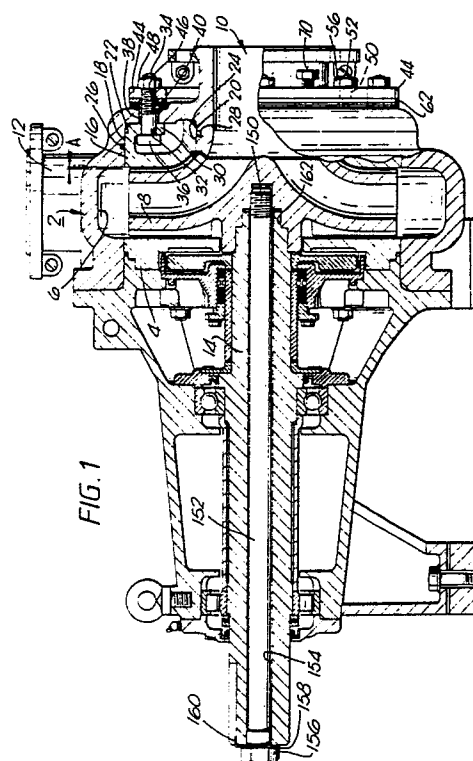
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54 **A pump.**

57 A centrifugal slurry pump has a volute casing (2) and a back wear plate (4) defining a pumping chamber (6) in which an impeller (8) is rotatably arranged. The front running clearance (A) is defined between the front surface of the impeller (8) and a facing surface of an adjustable wear plate (16). The wear plate (16) is substantially annular and has inner and outer axially extending cylindrical surfaces (18, 20) arranged to slide along corresponding surfaces (22, 24) defining a recess within the casing in which the wear plate is housed. This linear sliding movement of the wear plate (16) enables the front running clearance (A) to be adjusted. The wear plate (16) is secured to a retaining ring (44, 124) which is in turn secured to the casing (2) whereby rotation of the wear plate (16) is prevented.



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A PUMP

The present invention relates to a pump, for example, to a centrifugal slurry pump.

According to a first aspect of the present invention there is provided a pump comprising a casing in which a pumping chamber is defined, and an impeller arranged for rotation about its axis within said pumping chamber, the pump further comprising a wear plate supported by said casing to define a surface of said pumping chamber, and means for adjusting the position of said wear plate relative to said casing, said adjusting means permitting movement of the wear plate linearly with respect to the casing but preventing rotation of the wear plate.

In an embodiment, said wear plate is positioned at the front of the pumping chamber such that facing surfaces of the impeller and the wear plate define a front running clearance of the pump. The adjusting means are arranged to permit movement of the wear plate evenly in a direction parallel to the axis of the impeller. Advantageously, the adjusting means are mounted externally of the casing so that they are readily accessible and visible.

Advantageously, movement of only one component of the adjusting means is arranged to cause movement of the wear plate linearly with respect to said casing.

In an embodiment, the wear plate has an annular flange arranged coaxially relative to the impeller, and wherein the adjusting means comprises a retaining ring arranged to be releasably secured to an external surface of the casing coaxially with respect to said flange, and releasable means for securing the wear plate to said retaining ring. The spacing of the ring from said external surface of the casing is preferably determined by the interposition of one or more shims.

The invention also extends to a pump comprising a casing in which a pumping chamber is defined, and an impeller arranged for rotation about its axis within said pumping chamber, wherein said casing has a substantially cylindrical surface extending coaxially relative to said impeller and defining a recess within said casing, wherein a wear plate is received within said recess in the casing, said wear plate defining a surface of said pumping chamber, and wherein said wear plate has a substantially cylindrical surface arranged coaxial with, and to be slidable with respect to, the substantially cylindrical surface of said casing, and further comprising means for releasably securing said surface of said wear plate in a predetermined axial position relative to the corresponding surface of said casing, and for preventing rotation of the wear plate relative to said casing.

The releasable securing means may comprise a retaining member arranged to be fixed relative to the casing, and means for securing said retaining member to said wear plate. Preferably, the retaining member is a ring arranged to be releasably secured to a surface of the casing adjacent to said recess coaxially relative to the impeller, and wherein releasable means are provided for securing the wear plate to said retaining ring.

In one embodiment, the wear plate is provided with a substantially cylindrical threaded surface extending coaxially with said first cylindrical surface, and a rotatable adjusting ring having a corresponding thread or threads for engagement with said threaded surface is provided. The retaining ring is arranged to prevent axial movement of the adjusting ring relative to said casing, and said adjusting ring is arranged such that rotation thereof moves the wear plate axially relative to said substantially cylindrical surface of the casing.

In an alternative embodiment, the retaining ring is releasably secured to an external surface of the casing, and the spacing of said retaining ring from said external surface is arranged to be determined by the interposition of one or more shims. In addition, the wear plate has an annular flange arranged coaxially relative to the impeller and to extend within said recess, and wherein said releasable means for securing the wear plate to said retaining ring comprise three or more bolts carried by the annular flange of the wear plate and extending through bores in the casing and in the retaining ring, and respective locking nuts for engagement on said bolts.

Preferably, the wear plate has a second substantially cylindrical surface arranged coaxially with the first cylindrical surface, the surface of the wear plate defining the surface of the pumping chamber being fixed to and substantially at right angles to each of said cylindrical surfaces whereby the wear plate is substantially in the shape of an annulus having a substantially U-shaped radial cross-section. The second cylindrical surface of the wear plate is arranged to be slidable along a corresponding second substantially cylindrical surface of the casing. This makes it more difficult to twist the wear plate out of its correct alignment and thus increases the resistance to jamming. Further resistance against jamming could be provided by forming the casing with substantially cylindrical external surfaces along which corresponding surfaces of the retaining ring are arranged to slide.

According to a further aspect of the present invention there is provided a pump comprising a casing in which a pumping chamber is defined, and

an impeller arranged for rotation about its axis within said pumping chamber, the pump further comprising means for retaining the impeller within the pumping chamber and separate means for imparting rotation to the impeller.

In an embodiment, said means for imparting rotation to the impeller comprises a drive shaft rotationally fixed to said impeller, and wherein said impeller retaining means comprises a bolt extending through the drive shaft and releasably secured to said impeller.

Embodiments of the present invention will hereinafter be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 shows an axial section through a centrifugal slurry pump, and

Figure 2 shows a partial axial section through another embodiment of a slurry pump including rotatable adjusting means.

The centrifugal slurry pump illustrated in Figure 1 has a volute casing 2 with a back wear plate 4 defining a chamber 6 in which an impeller 8 is rotatably arranged. In known manner, rotation of the impeller 8 by way of a drive shaft 14 about the longitudinal axis of the shaft 14 is arranged to pump slurry from an input 10 to an output 12.

For efficiency, it is important that a front running clearance A between the front surface of the impeller 8 and a facing surface of the chamber 6 is kept as small as practicable. Of course, this clearance can initially be set to be very close. However, slurry is both abrasive and corrosive and during use of the pump there is soon considerable widening of the running clearance A.

The pump illustrated includes an arrangement enabling quick and accurate adjustment of the front running clearance to be made without it being necessary to dismantle the pump or adversely effect other running clearances in the pump. This arrangement includes a movable wear plate 16 mounted in the casing 2 so that the running clearance A is defined between the front surface of the impeller 8 and a corresponding facing surface of the wear plate 16.

The provision of a movable front wear plate has been proposed previously but has never been commercially acceptable, either because its adjustment has required dismantling of the pump and/or because it has not been possible to simply ensure accurate adjustment thereof. It is also necessary to ensure that trapped solids between the rotating impeller and the wear plate are unable to rotate the wear plate and thereby alter the front running clearance. In addition, it is necessary to ensure that the slurry impeded is unable to attack and wear the means provided for adjusting the wear plate.

The adjusting means illustrated not only overcomes the problems associated with previous pro-

posals, but is also simple to manufacture and install.

The wear plate 16 is substantially in the shape of an annulus and has an axially extending, cylindrical peripheral surface 18 and an axially extending cylindrical internal surface 20. These surfaces 18 and 20, which extend coaxially relative to the longitudinal axis of the shaft 14, and of the impeller 8, give the wear plate 16 a substantially U-shaped radial cross-section. The cylindrical surfaces 18 and 20 are arranged to be slidable relative to respective axially extending cylindrical surfaces 22 and 24 defining an annular recess within the casing 2, which recess houses the wear plate 16. These mutually sliding surfaces 18, 22 and 20, 24 are sealed by respective O-rings 26 and 28. At the front of the pump the wear plate 16 is formed to have an annular flange 30 through which axially extending bores 32 extend. In the embodiment illustrated, four bores 32 are provided. It will be appreciated that the annular flange 30 together with the surfaces 18 and 20 defines a substantially C-shaped radial cross-section for the wear plate 16.

The annular flange 30 may be interrupted around its circumference. The circumferential extent of the flange to the circumferential extent of the gaps may be chosen as required. It will be appreciated that it is possible for the flange to be constituted by a number of spaced tabs each having a respective bore 32 extending therethrough.

Before the wear plate 16 is initially mounted in the annular recess of the casing 2, a respective T-bolt 34 is arranged to extend through each bore 32 of the wear plate 16. A respective internally threaded sleeve 40 is then screwed onto each bolt 34 until the annular flange 30 is gripped between the head 36 of the bolt 34 and corresponding sleeve 40. In this manner the four bolts 34 form fixed projections carried on the wear plate 16 which project axially of its front surface.

In the embodiment of the pump illustrated, the wear plate 16 is formed of Ni-hard, and this determines the manner in which the projecting bolts 34 are formed and fixed thereto. Other ways of providing the projections on the front surface of the wear plate are, of course, possible and any suitable construction can be used. For example, particularly where the wear plate 16 is made of a machinable cast iron, the bores 32 can be internally threaded for the receipt therein of stud bolts.

The wear plate 16 with its fixed projections 34 is positioned within the annular recess in the casing 2 such that the projections, namely the bolts 34 and their surrounding sleeves 40, extend through appropriately positioned bores 38 in the front surface of the casing 2 to prevent rotation of the wear plate 16. The bores 38 in the casing have smooth internal cylindrical surfaces and the peripheral sur-

faces of the sleeves 40 are similarly smooth. This facilitates the location of the wear plate 16 within the recess as no engagement between the projections and the bores in the casing has to be made.

When the wear plate 16 has been located in the recess in the casing 2 so that the bolts 34 extend through the bores 38, the bolts 34 will protrude forwardly of the casing 2. The forward end of each bolt 34 is provided with an external screw thread such that, if necessary, final assembly of the wear plate 16 within the recess can be achieved by screwing nuts onto the bolts 34 to cause forward movement of the wear plate.

With the wear plate correctly positioned within the recess in the casing, a retaining ring 44, provided with four appropriately positioned bores 46, is arranged to extend parallel to and coaxial of the flange 30 of the wear plate 16, and such that the projecting bolts 34 extend through the bores 46. Respective lock nuts 48 are then screwed onto the front ends of the bolts 34 to engage the front surface of the ring 44 and to ensure that the rear surface of the ring abuts the sleeves 40. In this position it will be appreciated that the wear plate 16, the bolts 34 and their associated sleeves 40, and the retaining ring 44 together form a single fixed unit which is slidable axially along the cylindrical surfaces 22, 24 of the casing 2, for example, by pushing or pulling the ring 44.

The retaining ring 44 is provided with further axial bores, indicated at 50, extending therethrough and arranged to receive respective stud bolts 52 which are fastened to the casing whereby the retaining ring can be secured to the casing by way of locking nuts 56. It will be appreciated that the stud bolts 52 do not extend through the wear plate 16.

Upon initial assembly of the pump, the locking nuts 56 are tightened to push the retaining ring 44 rearwardly with respect to the casing and to thereby move the wear plate 16 axially rearwardly until its rearwardly facing surface contacts the facing front surface of the impeller 8. In this position there is a gap between the ring 44 and the casing 2 which is filled by inserting a number of arcuate shims 62. In known manner, the shims 62 each have a small axial dimension, for example, of one millimeter, and extend in the circumferential direction over at least part of a circle. Clearly, the circumferential extent of each shim and the total circumferential extent of all of the shims provided can be chosen as required.

In the embodiment illustrated it is preferred that shims 62 have a circumferential extent which is less than a semi-circle and be provided in pairs located diametrically opposite to each other. The shims 62 are appropriately slotted so that they can be positioned as shown. It will be appreciated that by providing the shims in pairs, care can be taken

to ensure that the same number of shims are located between the ring 44 and the casing at the two diametrically opposed locations whereby it is ensured that the wear plate is accurately coaxial with the shaft and the casing and is not twisted.

When sufficient shims have been inserted between the ring 44 and the casing to completely fill the gap, the lock nuts 56 are loosened slightly and one additional pair of shims are inserted. The lock nuts 56 are then re-tightened such that the extra shims cause the retaining ring, and hence the wear plate, to be adjusted forwardly. This provides the required running clearance A between the facing surfaces of the wear plate and the impeller 8.

It will be appreciated from the above description of the construction and assembly of the slurry pump that adjustment of the position of the wear plate when wear has occurred is very simple and easy to attain. Thus, the lock nuts 56 are loosened to enable axial movement of the assembly of the wear plate and retaining ring. Shims 62 are removed from between the ring 44 and the casing in pairs to compensate for the wear that has occurred and then the lock nuts 56 are re-tightened. As the ring 44 moves rearwardly to take up the space vacated by the shims, the wear plate 16 is similarly moved rearwardly towards the impeller to reduce any increased running clearance. Of course, the exact position to be taken up by the wear plate 16 on adjustment can be determined as previously by bringing the wear plate into contact with the impeller and then inserting an additional pair of shims to draw back the wear plate from the impeller by the thickness of one shim.

It will be appreciated that the adjustment arrangement described has the advantage that all of the elements thereof are external to the casing 2. The movement of the retaining ring 44 is therefore visible, and it can be directly ensured that the ring 44 accurately extends in a radial plane at right angles to the longitudinal axis of the pump. Because the flange 30 of the wear plate extends parallel to the ring 44, it is thereby ensured that there has been no twisting of the wear plate, and this, in its turn, prevents jamming of the wear plate. Furthermore, the wear plate is bolted to the ring, and this is bolted to the casing, so that no rotation of the wear plate is possible.

As the pump is adjusted for wear, the number of shims between the retaining ring 44 and the casing 2 is decreased. The number of shims therefore provides immediate visible evidence of the internal condition of the pump. In addition, the retaining ring 44 moves more and more rearwardly until it contacts the casing, after which no further adjustment of the pump is possible. This is an advantage as it prevents over adjustment of the pump, with consequent risk of damage to the cas-

ing and the impeller, and leakage past the O-rings 26 and 28.

The embodiment of the pump illustrated also includes two diametrically opposed jacking bolts 70, only one of which is visible in Figure 1. Each bolt 70 is a rearwardly axially extending threaded bolt which passes through a corresponding internally threaded bore (not shown) provided in the ring 44 and through an appropriate hole or slot in the shims to contact the casing 2. It will be appreciated that rotation of these bolts 70 can be utilised to move the ring 44 axially forwardly when required.

In the embodiment illustrated, increasing wear is adjusted by decreasing the number of shims 62 provided. If it is preferred that increasing wear be compensated by an increased number of shims this can be achieved by way of a small modification, not illustrated. In the modified embodiment, a further ring is provided to extend parallel and coaxial with the retaining ring 44, but forwardly thereof. This further ring is rigidly fixed to the casing, for example by bolts or the like. Initially, the rearwardly facing surface of this further ring is arranged adjacent to, and even in abutment with, the forwardly facing surface of the retaining ring 44. The further ring is provided with appropriate bores for receipt of the projecting bolts. As adjustment through wear causes rearward axial movement of the ring 44 the spacing between this ring and the further ring will increase. It is this spacing that is filled by an increasing number of shims to determine the position of the ring 44 relative to the casing and hence the position of the wear plate 16 relative to the casing.

In the embodiment of Figure 1, the wear plate 16 is adjusted by manual adjustment of the retaining ring 44. Of course, it would be possible to provide adjusting means for moving the wear plate. An embodiment of a slurry pump including rotatable adjusting means for causing linear movement of the wear plate is illustrated in Figure 2.

In the embodiment of Figure 2, the wear plate 16 is provided with a screw thread on a substantially axially extending cylindrical surface 19 thereof which is spaced inwardly of its peripheral surface 18. The screw thread of the wear plate is in engagement with a corresponding screw thread on a substantially axially extending, cylindrical external surface of an adjusting ring 120. The cylindrical surface 19 extends coaxially to the axis of the impeller 8 and hence to the longitudinal axis of the shaft 14. The wear plate 16 is prevented from rotation relative to the casing 2, and so it will be appreciated that rotation of the adjusting ring 120 will cause the wear plate 16 to move axially of the pump, that is, in a direction parallel to the longitudinal axis of the drive shaft 14. As previously, the

cylindrical surfaces 18 and 20 of the wear plate are slidable relative to the respective cylindrical surfaces 22 and 24 defining the annular recess within the casing 2. The adjusting ring 120 is provided with two or more axially extending slots 122 accessible from the front of the pump into which a suitable tool may be inserted to rotate the ring 120 and hence adjust the wear plate 16.

Rotation of the wear plate 16 relative to the casing 2 is prevented by means of a retaining ring 124 which is rotationally fixed to the casing 2 by means of headed bolts 126. Interengaging means (not shown) prevent rotation of the wear plate 16 relative to the retaining ring 124. For example, these interengaging means can comprise lugs on the wear plate 16 with which the retaining ring 124 or the casing 2 engages. Where the engagement is between the wear plate 16 and the retaining ring 124, the lugs would be formed on the front surface of the wear plate 16 facing the casing and facing away from the impeller. The retaining ring 124 also has an increased diameter collar 130 on its external periphery which is arranged to engage an internal profile on the adjusting ring 120 for retaining the adjusting ring in position and preventing axial movement of the adjusting ring 120.

Releasable locking means are also provided to enable the adjusting means to be locked after adjustment. These locking means comprise two or more T-headed bolts 132 engaged in lugs 134 provided on the front surface of the wear plate. Each bolt 132 extends forwardly through bores provided in the retaining ring 124 and in the casing 2. It will be appreciated that these bolts 132 also prevent rotation of the wear plate 16 relative to the casing 2. A sleeve 136 and a plurality of spacing washers 138 are carried on each bolt 132 and retained in position by a first nut 140. A cover 142 is received on each bolt 132 and is held thereon by way of a second nut 144. To prevent rotation of the adjusting ring 120 during normal operation of the pump, each cover 142 carries a tang 146 arranged to engage in a respective one of the slots 122 provided in the adjusting ring 120.

If required, the lugs 134 on the facing surface of the wear plate 16 into which the heads of the T-headed bolts 132 engage may also form part of the interengaging means between the wear plate and the retaining ring 124.

The wear plate 16 and the adjusting means therefor are illustrated in Figure 2 in the locked position. To enable adjustment, the nuts 144 are removed together with the covers 142. The adjusting ring 120 is then rotated to cause axial movement of the wear plate 16 relative to the casing. It will be appreciated that as the wear plate 16 moves, the bolts 132 also move relative both to the casing 2 and to the retaining ring 124. It will also

be seen that although the washers 138 carried on each bolt 132 can move within the respective bore provided in the casing, the bore provided within the retaining ring 124 has an insufficient diameter to accommodate the washers 138. The bore in the ring 124 and the washers 138 therefore form stop means limiting the maximum adjustment of the wear plate 16.

Once the required adjustment has been made, the covers 142 and nuts 144 are replaced and the nuts 144 tightened. This effectively locks the adjusting means and retains the wear plate 16 in the adjusted position.

The embodiments illustrated and described above is given only as examples, and alterations to the construction may be made. In particular, the adjusting ring could be formed external to the casing.

Traditionally, the impeller 8 is fixed to the drive shaft 14 by way of co-operating screw threads on the end of the shaft 14 and within the central boss of the impeller. This arrangement has the disadvantage that the drive shaft must not be driven by its motor in the direction opposite to the specified direction of rotation or the coupling between the shaft and impeller is disengaged with disastrous results. In addition, normal operation of the pump tends to reinforce the connection between the impeller and the shaft and can make it virtually impossible to unscrew the impeller from the shaft when required.

It has been known to avoid these problems by bolting the impeller to the shaft by a bolt which extends from the surface of the impeller within the pumping chamber 6 into the drive shaft 14. Such a fixing arrangement cannot be used in the abrasive and corrosive environment within the pumping chamber of a slurry pump.

In the pump shown in Figure 1 the impeller 8 is screwed by way of threads 150 within its central boss onto the threaded forward end of a headed bolt or rod 152. This bolt 152 extends within a bore 154 formed to extend longitudinally of the shaft 14. The bolt 152 is also rotationally fixed to the shaft 14 and is located by way of its head 156. In the embodiment illustrated, this rotational fixing is by means of a locking tab 158 carried by the bolt 152 which has projections 160 engaged in slots provided in the shaft 14.

In the embodiment shown the shaft 14 is formed to have a drive surface 162 with either a square profile or with flats which is in engagement with a corresponding driven surface formed in the boss of the impeller 8. Of course, any suitable means to enable the shaft 14 to impart torque to the impeller 8 can be employed. For example, the shaft 14 could be keyed to the impeller.

It will be appreciated that when the pump is

assembled, the drive surface 162 of the shaft 14 is engaged with the driven surface of the impeller 8. The shaft 14 is then held so that it cannot rotate and the bolt 152, which has been positioned to extend through the shaft 14, is rotated to screw its threaded end 152 into tight engagement with the threads 150 of the impeller 8. Once the bolt 152 cannot be screwed any further, the bolt 152 is tightly fastened to the shaft 14. The application of drive to the shaft 14, for example, by a suitable motor, will then rotate both the shaft 14 and the bolt 152 as well as the impeller 8.

The locking tab 158 ensures that relative rotation between the bolt 152 and the shaft 14 cannot take place and thus that vibration and other problems cannot cause the bolt 152 to become unscrewed. It will also be appreciated that whilst the impeller is located and subjected to driving torque by the shaft 14, it is axially retained in its correct position by the bolt 152. This means that the bolt locks the impeller on the end of the shaft preventing uncoupling and forward movement of the impeller during driven rotation thereof in either direction.

The pumps described above are shown to have volute casings. Of course, other casing designs, for example, bowl casings may be provided. Furthermore the casing, the impeller and both the front and back wear plates may be made of any suitable material, for example, of Ni-hard, high chrome iron, cast iron, stainless steel or high silicon iron. Of course, some alteration to the methods by which the components of the pump are fastened together may be necessary depending upon the hardness of the material used.

The embodiments of the pump described and illustrated are centrifugal slurry pumps. However, the invention is not restricted to such pumps. For example, the invention may also be utilised with sump pumps.

In the embodiments illustrated, the wear plate is sealed with respect to the casing by O-rings 26 and 28. Of course, these O-rings can be replaced by any other suitable sealing means. Furthermore, if required, more than two jacking bolts 70 may be provided.

It will also be appreciated that other variations and modifications to the embodiments illustrated and described may be made within the scope of the appended claims.

Claims

1. A pump comprising a casing (2) in which a pumping chamber (6) is defined, and an impeller (8) arranged for rotation about its axis within said pumping chamber (6), the pump further comprising

a wear plate (16) supported by said casing (2) to define a surface of said pumping chamber (6), and means (34,44;120) for adjusting the position of said wear plate relative to said casing, characterised in that said adjusting means are arranged to permit movement of the wear plate (16) linearly with respect to the casing but to prevent rotation of the wear plate.

2. A pump as claimed in Claim 1, wherein said wear plate (16) is positioned at the front of the pumping chamber (6) such that facing surfaces of the impeller and the wear plate define a front running clearance (A) of the pump.

3. A pump as claimed in Claim 1 or 2, wherein the adjusting means (34,44;120) are arranged to permit movement of the wear plate (16) evenly in a direction parallel to the axis of the impeller (8).

4. A pump as claimed in any preceding claim, wherein the adjusting means (34,44) are mounted externally of the casing (2).

5. A pump as claimed in any preceding claim, wherein movement of only one component (120) of the adjusting means is arranged to cause movement of the wear plate (16) linearly with respect to said casing (2).

6. A pump as claimed in any preceding claim, wherein the wear plate (16) has an annular flange (30) arranged coaxially relative to the impeller (8), and wherein the adjusting means comprises a retaining ring (44) arranged to be releasably secured to an external surface of the casing (2) coaxially with respect to said flange, and releasable means (34) for securing the wear plate (16) to said retaining ring (44).

7. A pump as claimed in Claim 6, wherein the spacing of the retaining ring (44) from said external surface of the casing can be determined by the interposition of one or more shims (62).

8. A pump comprising a casing (2) in which a pumping chamber (6) is defined, and an impeller (8) arranged for rotation about its axis within said pumping chamber (6), wherein said casing has a substantially cylindrical surface (22,24) extending coaxially relative to said impeller (8) and defining a recess within said casing (2), wherein a wear plate (16) is received within said recess in said casing, said wear plate (16) defining a surface of said pumping chamber (6), and wherein said wear plate (16) has a substantially cylindrical surface (18,20) arranged coaxial with, and to be slidable with respect to, the substantially cylindrical surface (22,24) of said casing, and further comprising means (34,44; 124, 126) for releasably securing said surface of said wear plate in a predetermined axial position relative to the corresponding surface of said casing (2), and for preventing rotation of the wear plate relative to said casing.

9. A pump as claimed in Claim 8, wherein said releasable securing means comprise a retaining member (44;124) arranged to be fixed relative to the casing, and means (34,126) for securing said retaining member to said wear plate (16).

10. A pump as claimed in Claim 9, wherein said retaining member is a ring (44;124) arranged to be releasably secured to a surface of the casing adjacent to said recess coaxially relative to the impeller, and wherein releasable means are provided for securing the wear plate to said retaining ring.

11. A pump as claimed in Claim 10, wherein said wear plate (16) is provided with a substantially cylindrical threaded surface (19) extending coaxially with said first cylindrical surface (18,20), and further comprising a rotatable adjusting ring (120) having a corresponding thread or threads in engagement with said threaded surface (19), and wherein said retaining ring (124) is arranged to prevent axial movement of the adjusting ring (120) relative to said casing, and said adjusting ring is arranged such that rotation thereof moves the wear plate axially relative to said substantially cylindrical surface (22,24) of the casing.

12. A pump as claimed in Claim 10, wherein said retaining ring (44) is releasably secured to an external surface of the casing, and the spacing of said retaining ring from said external surface is arranged to be determined by the interposition of one or more shims (62).

13. A pump as claimed in Claim 10 or 12, wherein the wear plate (16) has an annular flange (3) arranged coaxially relative to the impeller (8) and to extend within said recess, and wherein said releasable means for securing the wear plate to said retaining ring comprise three or more bolts (34) carried by the annular flange of the wear plate and extending through bores (38,32) in the casing (2) and in the retaining ring (44), and respective locking nuts (48) for engagement on said bolts.

14. A pump as claimed in Claim 13, further comprising three or more further bolts (52) carried by the casing and extending through bores (50) in the retaining ring (44), and respective locking nuts (56) for engagement on these further bolts to secure the retaining ring against rotation.

15. A pump as claimed in Claim 13 or 14, wherein the bolts (34) carried by the annular flange (30) of the wear plate are locked in position thereon by corresponding internally threaded sleeves (40) to form fixed projections carried by the wear plate.

16. A pump as claimed in any of Claims 8 to 15, wherein the wear plate (16) has a second substantially cylindrical surface (20,18) arranged coaxially with the first cylindrical surface (18,20), the surface of the wear plate (16) defining the surface of the pumping chamber (6) being fixed to

and substantially at right angles to each of said cylindrical surfaces (18,20) whereby the wear plate (16) is substantially in the shape of an annulus having a substantially U-shaped radial cross-section.

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17. A pump as claimed in Claim 16, wherein the second cylindrical surface of the wear plate is arranged to be slidable along a corresponding second substantially cylindrical surface of the casing.

18. A pump comprising a casing (2) in which a pumping chamber (6) is defined, and an impeller (8) arranged for rotation about its axis within said pumping chamber (6), the pump further comprising means (152) for retaining the impeller within the pumping chamber and separate means (14) for imparting rotation to the impeller.

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19. A pump as claimed in Claim 18, wherein said means for imparting rotation to the impeller (8) comprises a drive shaft (14) rotationally fixed to said impeller, and wherein said impeller retaining means comprises a bolt (152) extending through the drive shaft and releasably secured to said impeller.

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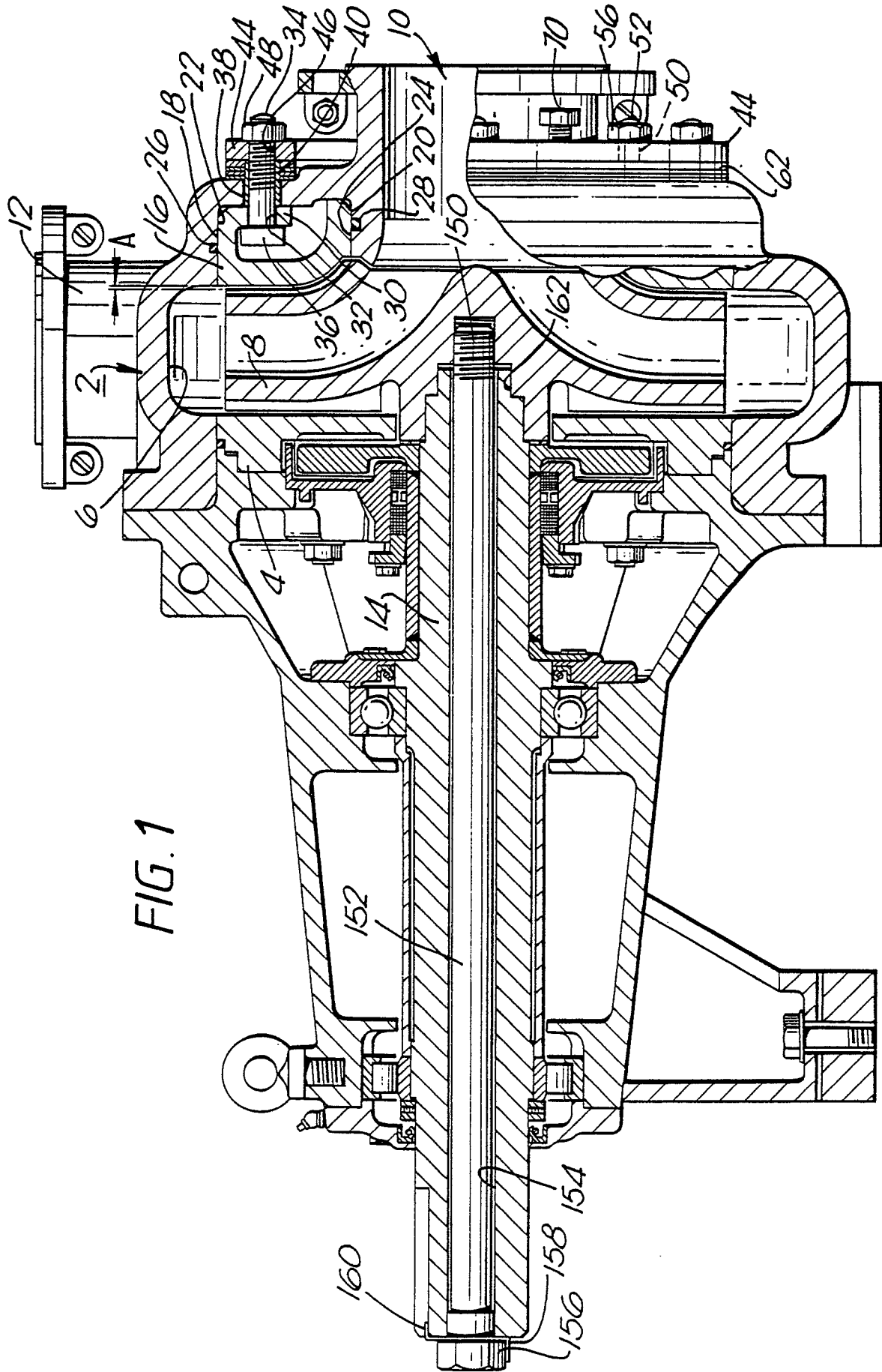


FIG. 2

