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## ADJUSTABLE SEAL FOR PUMPS

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This invention relates generally to pumps. More specifically this invention relates to seals to reduce the amount of leakage along the shaft behind the impeller of a centrifugal pump.

It is common practice in the pump art to use a stuffing box that surrounds the shaft behind the impeller to prevent leakage of fluid that flows behind the impeller and along the driving shaft of the pump. Although this type of seal is generally adequate, it is not good enough in situations where a highly abrasive fluid is being pumped or in conditions where no leakage can be permitted. The life of the stuffing box type of seal is significantly shortened when a highly abrasive liquid is being pumped. The excessive wear on the stuffing box necessitates frequent shutdowns of the pump for replacement of the seal packing or the casing of the seal itself.

This invention overcomes the problems mentioned above by providing an axially adjustable member behind the impeller for varying the amount of clearance between the impeller and the adjustable member to thereby hold the amount of leakage behind the impeller to a minimum. Furthermore, the pump of this invention is provided with a bypass conduit that directs any fluid that flows past the adjustable clearance back to the low pressure or suction side of the pump. This has the effect of reducing the pressure on the stuffing box and thereby helps to prolong the life of the packing in the stuffing box and the stuffing box casing itself.

Therefore, it is the object of this invention to provide a new and improved pump.

Another object of this invention is to provide a new and improved seal for pumps.

Another object of this invention is to provide a new and improved centrifugal pump having less leakage.

Another object of this invention is to provide a new and improved seal for centrifugal pumps having a longer life.

Other objects and advantages of this invention will be apparent from the following description when read in connection with the accompanying drawing, in which:

FIG. 1 is a cross sectional view of a centrifugal pump of this invention; and

FIG. 2 is a cross sectional view of a portion of a modified pump of this invention.

Referring more specifically to the drawing, the centrifugal pump 10 has a casing 11 having an axial inlet 12 and a radially spaced discharge volute 13. The casing 11 is provided with a rear cover 14 which combines with the rest of the casing to define an impeller chamber 15. A suitable impeller 18 is mounted on one end of a drive shaft 19 and positioned within the impeller chamber 15 with the other end of the shaft extending through an opening 20 in the rear cover 14. The shaft is adapted to be driven by a suitable source of power such as an electric motor.

A stuffing box 23 having an annular cavity 24 surrounding the shaft 19 is connected to the rear cover 14. The cavity 24 in the stuffing box is filled with suitable packing material 25 and the outboard end of the stuffing box is closed off by an annular gland 26. Suitable means such as grease conduit 27 are provided for supplying lubricant to the packing material 25.

The impeller 18 has an intake 28 aligned with the inlet 12 and a set of blades 29 that throw liquid radially outward into the discharge volute 13. In the preferred embodiment the impeller has a hub 38 that is connected to the shaft 19. The rear end of the hub has a flat surface

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37 that also forms the rear surface of the impeller. In the alternate arrangement of FIG. 2, this surface 37 extends radially outward beyond the inboard end of the stuffing box.

The pump casing 11 is provided with an annular flange 30 for connecting it to the frame 31 of a driving mechanism which is normally an electric motor. The rear cover 14 of the pump is clamped between the flange 30 and the frame 31 so as to fix its position relative to the casing 11. The rear cover 14 may be provided with an annular wear plate 33 that is connected to the cover and positioned within the impeller chamber 15 adjacent the impeller 18 to absorb the wear of the fluid being pumped.

The inboard end 35 of the stuffing box 23 is positioned adjacent the rear surface 37 of the hub 38 of the impeller and they combine to define a clearance 39 therebetween. If this clearance is very small, there is a minimum amount of leakage behind the impeller and through the clearance. However, in operation there is a certain amount of wear on the parts that form the clearance and the space therebetween tends to increase as the pump is used and the leakage increases accordingly. When the leakage becomes too great, the stuffing box is moved forward axially to reduce the clearance.

An adjusting mechanism 40 is provided to vary the axial position of the stuffing box relative to the impeller 18. This adjusting mechanism 40 could be in any suitable form but as illustrated in the drawing, it comprises a series of arcuately spaced bolts 41 that extend through countersunk holes 42 in a flange 43 on the stuffing box 23 and threadedly engage aligned holes 44 in the rear cover 14 of the pump. With this mechanism, the clearance 39 between the inboard end 35 of the stuffing box and the rear surface 37 of the hub of the impeller can be reduced by merely tightening up the bolts 41.

In the alternate arrangement shown in FIG. 2, the wear plate 33 is adjustable axially relative to the impeller. The wear plate 33 forms a clearance 47 with the extended portion of the rear surface 37 of the hub 38 which forms a portion of the rear surface of the impeller. The means for varying the axial position of the wear plate 33 include a set of bolts 48 that extend through the arcuately spaced holes 49 in the rear cover 14 and threadedly engage aligned holes 50 in the wear plate 33 and a plurality of set screws 51 that operatively engage spaced apart threaded holes 52 in the rear cover and abut the wear plate 33. When it is desired to move the wear plate closer to the impeller the bolts 48 are loosened and the set screws 51 tightened to move the plate 33 closer to the rear surface 37 of the hub of the impeller and thereby reduce the size of clearance 47. Then the bolts 48 are tightened to lock the wear plate in position.

The rear cover 14 has a projection 53 that extends within an annular flange 54 on the wear plate 33. A suitable sealing material such as an O ring 55 is positioned between adjacent annular surfaces of the flange and the projection to provide a seal and still permit relative movement between the wear plate and the rear cover.

To further improve the seal of this invention and prolong the life of the stuffing box, a bypass conduit is provided that extends from an annular space 56 between the clearance 39 or 47 and the packing 25 in the stuffing box 23 to a low pressure area such as the inlet 12 or suction side of the pump. In the illustrated arrangement in FIG. 1 any liquid that flows past the clearance 39 into the space 56 is diverted through the bypass conduit 58 to the lower pressure area at the inlet 12 of the pump. In the embodiment shown in FIG. 2 any liquid that flows past the clearance 47 flows through the conduit 59 in the impeller to the lower pressure area near the intake of the impeller. Hence the liquid is not forced to flow past the packing in the stuffing box. Furthermore, since the pressure in the

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conduit is substantially the same as that at the inlet of the pump, it thereby reduces the amount of pressure to which the packing in the stuffing box would normally be subjected.

In operation, as the pump shown in FIG. 1 is started up the liquid is brought into the impeller chamber 15 through the inlet 12 and thrown radially outward by the impeller through the discharge volute 13. However, a small amount of liquid flows behind the impeller 18 and through the clearance 39 between the hub of the impeller and the inboard end 35 of the stuffing box 23. If the volume of liquid flowing through this clearance becomes excessive, the bolts 41 may be tightened down to move the stuffing box 23 axially toward the rear surface 37 of the hub 38 of the impeller and thereby reduce the size of the clearance therebetween. This in turn reduces the amount of liquid flowing through the clearance. Any liquid that passes through the clearance flows through the conduit 58 back to the inlet 12 of the pump and hence is again brought into the impeller and thrown radially outward.

The embodiment of FIG. 2 operates in substantially the same way as the embodiment of FIG. 1 as described above except that the liquid passing the clearance 47 is returned to the low pressure area through conduit 59 in the impeller.

Although but two embodiments of this invention have been illustrated and described, it will be apparent to those skilled in the art that various modifications and changes can be made therein without departing from the spirit of the invention or the scope of the appended claims.

Having now particularly described and ascertained the nature of my said invention and the manner in which it is to be performed, I declare that what I claim is:

1. A pump comprising a casing defining a pumping chamber having an inlet and an outlet, a shaft adapted to be connected to a source of power and extending through said casing into the said chamber, an impeller positioned in said chamber; said impeller having a hub connected to said shaft; a stuffing box surrounding said shaft and engaging said casing, the inboard end of said stuffing box being

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positionable adjacent the hub of said impeller to form a clearance therebetween; adjusting means for moving said stuffing box axially relative said hub to vary the size of said clearance; packing means positioned within said stuffing box and spaced from said hub, a recess area formed in said stuffing box between said inboard end and said packing means and a bypass conduit connecting said recess area to an area of lower pressure.

2. A centrifugal pump comprising a casing defining a pumping chamber having an axial inlet in a radially spaced discharge, a shaft adapted to be connected to a source of power and extending through said casing into the said chamber, an impeller positioned in said chamber; said impeller having an intake facing said inlet and a hub connected to said shaft; a stuffing box surrounding said shaft and engaging said casing, the inboard end of said stuffing box being positionable adjacent the hub of said impeller to form a clearance therebetween; adjusting means connected to said casing for moving said stuffing box axially toward said hub to vary the size of said clearance, packing means positioned within said stuffing box and spaced axially from said hub, a recess area formed in said stuffing box between said inboard end and said packing means for collecting fluid passing said clearance and a bypass conduit connecting said recess area to the inlet of said pump.

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