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ADJUSTABLE SEAL FOR PUMPS

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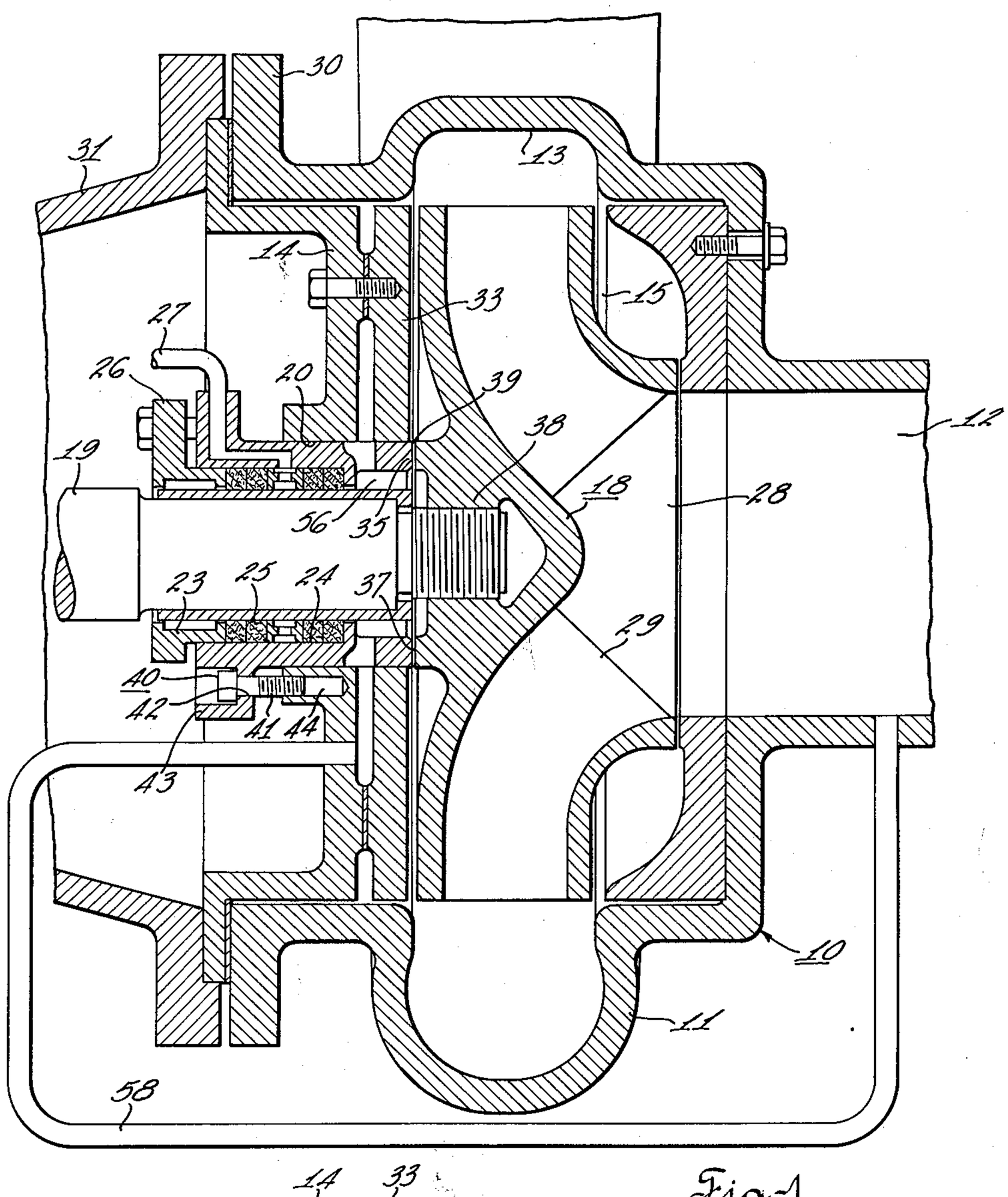

Fig. 1

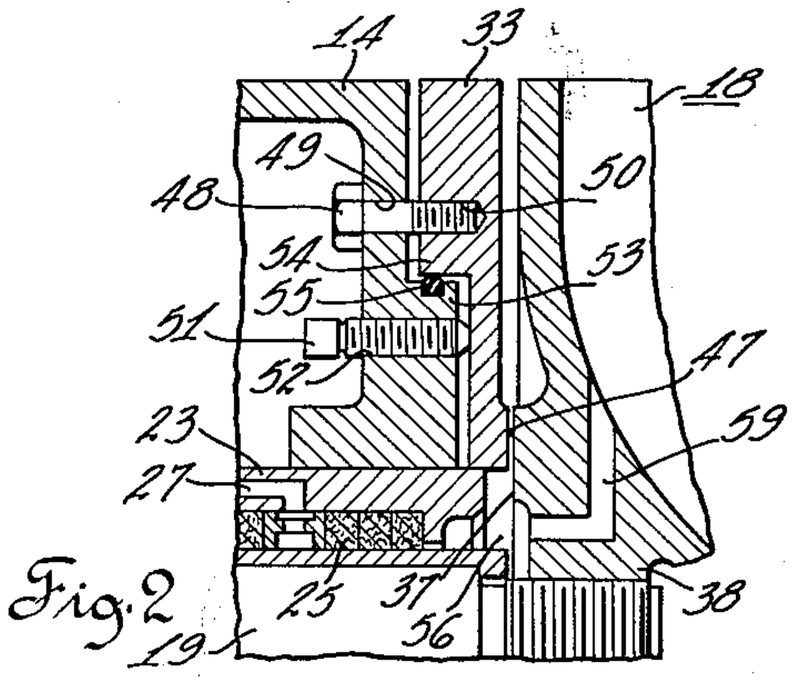

Fig. 2

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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

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

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 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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