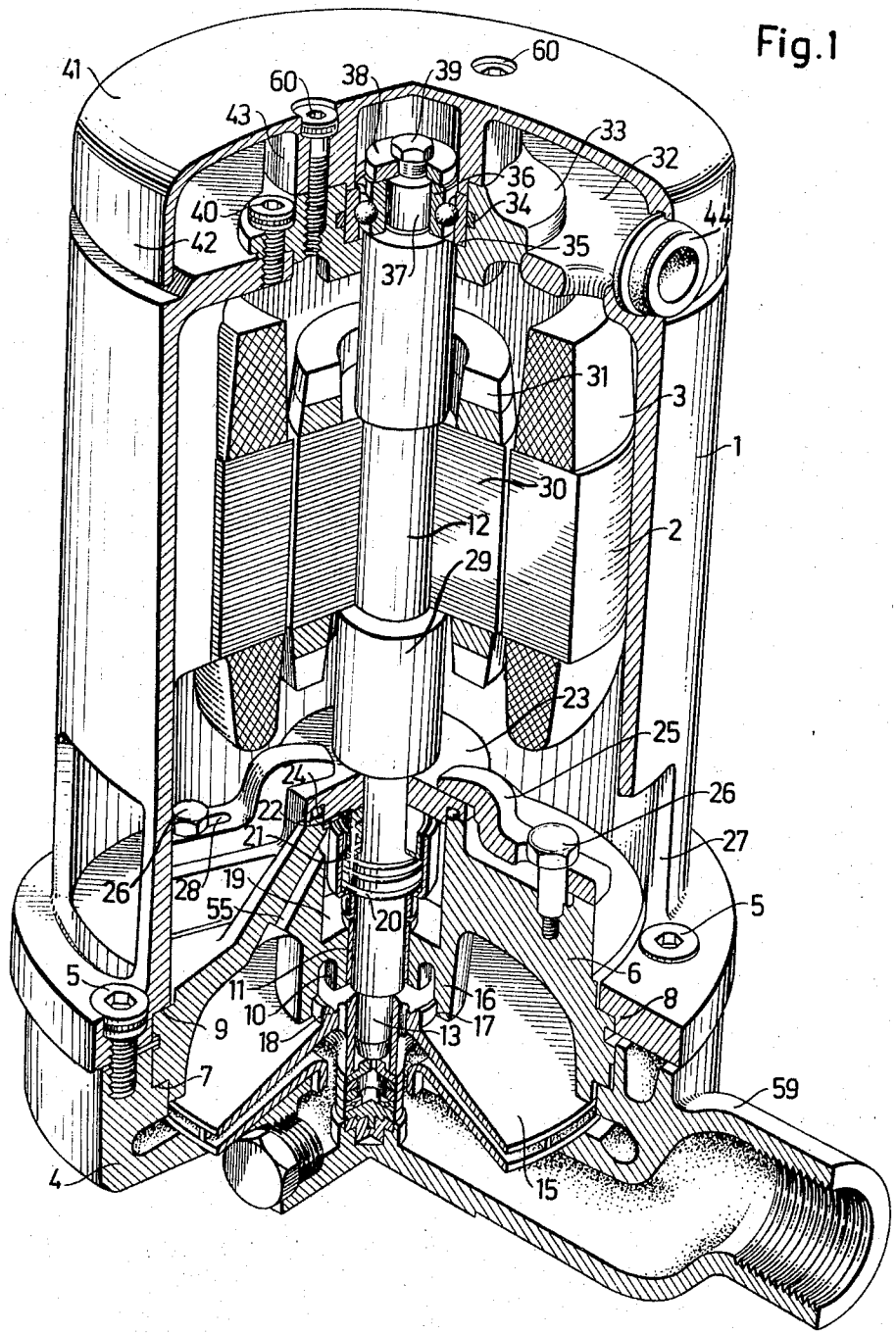
Feb. 28, 1967 J. K. A. DAHLGREN ETAL 3,306,220

CENTRIFUGAL PUMP, PARTICULARLY A HOT WATER PUMP

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Fig.1



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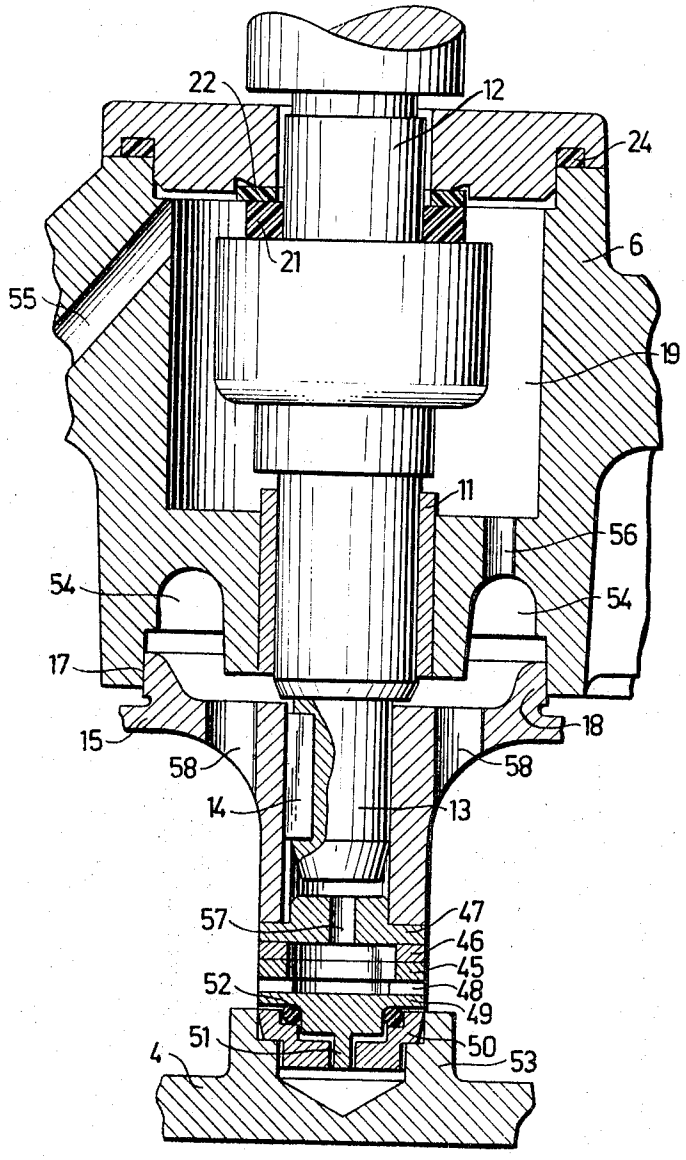
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Fig. 2



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CENTRIFUGAL PUMP, PARTICULARLY A HOT WATER PUMP

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The invention relates to centrifugal pumps, particularly hot water pumps having a substantially vertical through-going driving shaft for the impeller and with a drive-motor stator mounted on the pump-housing, and a shaft bearing and sealing arrangement positioned in the pump-housing cover between the pump chamber and motor chamber, and an upper bearing bracket attached to the upper stator end wall. Such motors are very space saving and reliable, as well as easy to mount but present the inconvenience that if a fault should occur with respect to the seal arrangement or any of the bearings, the pump must be dismantled completely and the fluid connections as well as electrical connections must be disconnected, because otherwise the bearings and seal arrangements in question could not be reached. Other inspections of the motor and pump also require a similar, inconvenient procedure which, especially where pumps pumping hot water are concerned, can be very troublesome in wintertime.

The present invention is intended to avoid such inconveniences and exists mainly in that the driving shaft of the pump is withdrawably connected with the impeller and, together with the rotor of the driving motor and possibly also said seal arrangement and bearing bracket—subsequent to removing the securing means of the latter and possibly the securing means for the seal arrangement—are capable of being axially withdrawn as a unit (shaft unit) through the upper stator gable.

According to one embodiment of the invention, an axial bearing connected with the bottom of the pump-housing is arranged thereby for fixing the impeller in an axial direction, said axial bearing being self adjustable so that it can be adapted to the position of the impeller so that its plane of rotation can be completely determined by the shaft-neck. The impeller driver suitably consists of a key piece forced into a groove extending longitudinally along the shaft, which key fits into a key way extending axially in the shaft neck when this is passed through the impeller hole. It is possible for the neck of the shaft to be made rectangular in cross section and for the impeller hole to present a similar shape so that the impeller is driven by the plane surfaces of the shaft neck.

According to a further development of the invention the pump-housing cover, so that it can guide the impeller when the neck of the shaft is lifted out of the same, and for creating a chamber having a certain subpressure, is provided with a concentrical muff passed with the shaft down towards the impeller, said muff being given a cylindrical guide surface on its lower inner surface for an upwardly fitted collar-like ring arranged on said impeller and facing the guide surface.

Thus, due to the invention, the substantial advantage is gained of being able to remove the motor from the pump and lift out the shaft unit, consisting of at least the shaft, rotor and possibly also the seal arrangement and upper bearing as well as the bearing bracket, from the pump housing and stator of the motor without disconnecting the electrical wiring connections, or the fluid conduit connections of the pump. Due to the fact that the impeller thereby rests on the axial bearing and is sufficiently centered by the above mentioned guide surface on the collar cooperating with the muff of the pump

cover, a centering of the impeller is obtained which is sufficient enough to allow the neck of the shaft to be easily refitted into the impeller hole.

The axial bearing of the impeller includes two metal rings which slide against each other and which are suitably made of hard metal; the upper metal ring is secured to a flange ring which has been force fitted into the hole for the shaft of the impeller, whereas the lower ring is fixed to a distance ring which in turn is mounted on a plate which, by means of a pin and with the assistance of an elastic seal, is mounted in a bowl connected to the bottom portion of the pump housing so that said plate can carry out a circular tilting movement, thereby adjusting the lower slide ring so that its position matches that of the upper slide ring connected to the impeller. To faciltate cooling of the axial bearing, the above mentioned distance ring is supplied with openings through which the pumped fluid is fed into the space inside the rings, and thereafter is passed through a hole in the above mentioned flange ring and the hole for the impeller shaft, along the shaft-neck disposed in said hole, up to the suction side of the pump.

The driving shaft is provided with a flange shape abutment surface to enable the impeller to be fitted against the axial bearing when the neck of the shaft is inserted into said impeller.

Remaining characteristics of the invention will be clear from the following description which is made in connection with an embodiment of said invention shown on the attached drawings.

FIGURE 1 shows a perspective view of a hot water pump according to the present invention, whereas

FIGURE 2 shows a detail of the axial bearing and the sealing chamber of the pump cover as well as the assembly of the shaft-neck with the impeller.

In the hot water pump illustrated by FIGURE 1 the stator portion of the driving motor is indicated by **1**, with the laminated core of the stator arranged inside said pump by the reference numeral **2**, and the stator winding **3** mounted on the pump housing **4** with the assistance of bolts having counter sunk heads **5**, the pump and driving motor are shown cut away in FIGURE 1 so that the mutual position of all parts of the pump can be clearly seen. The pump-housing cover **6** rests upon a flange **7** in the pump-housing and is secured in position by means of a flange forming abutment surface **8** on the stator housing which rests against a corresponding flange surface **9** on the pump-housing cover **6**.

The pump-housing cover **6** guides the shaft, by means of a bearing holder **10** which is provided with a bronze shaft bushing **11** lubricated by the pumped fluid. The driving shaft **12** of the motor is provided with a neck **13** which together with a key **14** forced into said neck, is passed into the shaft opening of the impeller **15**.

The pump-housing cover **6** acts as a guide for the impeller **15** when the neck **13** of the shaft is lifted out of the same, and creates a chamber having a certain sub pressure, said cover **6** is also supplied with a muff **16**, facing downwards towards the impeller **15** and concentrical to the shaft **12**, which muff **16** is provided with a cylindrical guiding surface on its inner edge **17** for guiding a collar like ring **18** arranged upwardly on the impeller and facing said guiding surface.

A sealing chamber **19** (also see FIGURE 2) is also arranged in the upper portion of the pump-housing cover, in which chamber is arranged a plane seal **21** acting under spring pressure and rotating with the driving shaft in an axial direction, said seal **21** pressing against a stationary sealing ring **22** attached to the undersurface of a cover plate **23** fitted over the shaft **12** and closing the sealing chamber. The cover plate **23** is sealed against

the upper edge of the sealing chamber by means of a sealing ring **24** and is pressed down against said upper edge by means of claw forming members **25** which are drawn downwards towards the cover plate by means of bolts **26** screwed into the pump-housing cover **6**. The bolts can be loosened easily through openings **27** in the stator housing, whereafter the members **25**, which are fitted on said bolts prior to being assembled with the assistance of elongated holes **28**, can be rotated sidewards and thereby release the sealing cover plate **23**.

The driving shaft is also provided with a shaft enlarging member **29** which at the bottom forms an abutment shoulder for the sealing cover plate **23** against the upper edge of the sealing chamber **19** when the shaft unit is fitted into the pump-housing cover **6** said shaft enlarging member also has an upper abutment shoulder against which the laminated core **30** of the rotor rests. The embodiment shown in the drawing is imagined to be provided with a squirrel cage winding **31**. The stator housing **1** is curved at the top so that an annular end wall **32** is formed, against the surface of which rests the upper bearing holder or bracket **33**. The ball bearing **36**, held by means of a seal **34** and a flange forming abutment shoulder **35**, is fitted over a neck **37** on the driving shaft and is held on the same by means of a washer **38** which is secured to the end of the shaft by a bolt **39**. The bearing bracket is secured to the stator housing end wall **32** by means of bolts which have been given counter sunk heads **40**. The bearing bracket thus builds a closed unit secured to the driving shaft, which unit, on removal of the bolts **40** connected to the stator end wall, can be withdrawn together with the shaft unit.

The stator housing end wall and bearing bracket are closed outwardly by means of an upper cover **41**. The cover is passed over an annular sealing abutment surface **42**, cut out of the upper edge of the stator housing, and is provided with a cup shaped member **43** on the inside of its centre portion, which member **43** is brought into engagement with an annular abutment surface on the bearing bracket **33** thereby closing the bearing against the coupling space formed under the upper cover **41**. The cover **41** is provided with a bushing **44**, for facilitating fitting of electrical connections.

The sealing space **19** of the pump-housing cover **6**, the guiding of the driving shaft **12** in the bushing **11** and the cooperation of the shaft neck **13** with the impeller **15** by means of the key **14**, are more evident from FIGURE 2. This FIGURE 2 also shows an axial bearing which rests against the bottom of the pump housing **4** and which consists of the slide rings **45**, **46**, the flange ring **47** supporting said ring **46** and the supporting plate **49** supporting ring **45** by means of a distance plate **48**, said supporting plate **49** being arranged in a bowl **50**. The axial bearing is therefore designed in such a way that the plate **49** is guided, by means of a pin **51**, into a hole in the bottom of the bowl **50** and thereby, whilst lying in abutment with an elastic seal **52**, can carry out a circular tilting movement so that the slide ring **45**, secured for example by means of brazing to the distance ring **48**, which in turn is attached to plate **49**, can adapt itself to the rotation plane of the impeller **15** by abutting the slide ring **46** attached to the flange ring **47** which in turn is press fitted into the opening for the shaft of the impeller **15**. Due to the fact that the bowl **50** is similarly force fitted into an annular groove cut in a sleeve forming abutment surface **52** on the bottom of the pump-housing **4**, a fully defined journalling of the impeller in a vertical direction is obtained which impeller is free, at the same time, to adapt itself completely to the direction of the shaft neck fitted into the same, as was previously mentioned, the impeller is provided with a collar like ring **18** on its upper surface, which ring **18** cooperates with a guide surface **17** on the downwardly directed muff, concentric with the driving shaft, in the pump-housing cover.

Thereby a space **54** having a certain sub pressure is formed at the same time inside said muff, which space is utilized for cooling the axial bearing as well as the bearing bushing, by means of the pumped fluid. A channel **55** is aranged from the upper surface of the impeller **15** (see also FIGURE 1) for cooling said bearing bushing **11**, which channel supplies fluid to the sealing chamber **19**, A channel **56** is arranged from this chamber which extends parallel with the shaft bushing between the sealing chamber and space **54**, which channel **56** is somewhat smaller than channel **55** so that when the fluid under pressure is fed through channel **55** into the sealing channel **19** and a portion of said fluid is led away through channel **56**, the remainder of the fluid passes between the driving shaft **12** and the bushing **11** thus cooling and lubricating said bushing.

A similar flow of the pumped fluid is obtained through the axial bearing, which fluid is passed through openings in the distance ring **48** into a chamber inside the slide rings **45** and **46** and thus cools and lubricates the same. The fluid then continues through an opening **57** in the flange ring **47** and thereafter through the shaft opening in the impeller, past the neck of the shaft **13** up into the chamber **54** and through openings **58** down to the inlet side of the impeller.

As is obvious from the above description, the shaft unit can be easily lifted up out of the hot water pump without necessitating the uncoupling of electrical or water connections attached to the pump. The removal of said unit is carried out thus: subsequent to the removal of bolts **60** the cover plate **41** is lifted off, whereafter the bearing bracket **33** is released by removing bolts **40**. Then the bolts **26** have been loosened through the openings **27** and the claw like members have been moved to one side so that the sealing cover **23** is released, the whole shaft unit is freed which merely needs to be lifted up in order to give access to the motor chamber and sealing chamber. Thus, if faults should occur with the bearing or sealing arrangement, it is simple to change the bearing bracket together with associating bearings for a new bearing or sealing arrangement, by simply withdrawing the same from the driving shaft by hand and fitting a new such arrangement, whereafter the shaft unit can be returned to its position in the pump and secured by means of the bolts **40**, the claw like members **25** and bolts **26** respectively.

Although the invention has been described in connection with an embodiment of the same, it can, however, be varied in any way within the scope of the following claims.

What we claim is:

1. A centrifugal pump, particularly a hot water pump, having a pump housing including a cover defining with said housing pump and motor chambers, an impeller, a substantially vertical throughgoing driving shaft for the impeller having an axis, a drive motor stator including an upper end wall and being mounted on the pump-housing, a shaft bearing and sealing arrangement having securing means and being positioned in the pump-housing cover between the pump chamber and motor chamber, an upper bearing bracket having securing means and being attached to the upper stator end wall, the driving shaft being withdrawably connected to the impeller, and being adapted to be withdrawn axially together with the rotor of the driving motor and said sealing arrangement and bearing bracket, subsequent to removing the securing means of the latter, and the securing means of the sealing arrangement, as a unit through said end wall.

2. A centrifugal pump as claimed in claim **1**, said shaft having a neck, an axial bearing journalling the impeller, said axial bearing being connected to the bottom of the pump-housing and being self-adjustable so that it can adapt itself to the position of the impeller, whereby the rotation plane of said impeller can be completely determined by the neck of the shaft of the shaft unit.

3. A centrifugal pump as claimed in claim 2, characterized in that the axial bearing includes two hard metal slide rings which slide against each other, to a flange ring inserted into the hole for the impeller shaft by means of a pressfit, the upper of said two hard metal rings being secured to said flange ring, a plate, a distance ring mounted on said plate, the lower of said two hard metal rings being secured to said plate, a pin, a bowl connected to the bottom section of the pump-housing and including an elastic seal, said plate being mounted with said pin and said elastic seal in said bowl in such a manner that said plate can effect a circular tilting movement and thereby position the lower guide slide ring so that it adapts itself to the upper slide ring attached to the impeller.

4. A centrifugal pump as claimed in claim 3, said distance ring defining openings, the bearing including a lower axial bearing, said impeller having a shaft hole, the cooling of the lower axial bearing occurring through the circulation of the fluid pumped through openings in the distance ring and up through the hole intended for the shaft of the impeller, along the neck of the shaft inserted into said hole, to the suction side of the impeller.

5. A centrifugal pump as claimed in claim 1, said impeller defining a shaft hole having an axial key slot, said shaft including a neck having a longitudinal key way, and a key, the impeller being arranged to be driven by said key forced into the longitudinal key way in the neck of the shaft, which upon insertion of the neck into the impeller hole is fitted into the axial key way in said impeller hole.

6. A centrifugal pump as claimed in claim 1, said shaft having a neck of rectangular cross-section, the impeller being driven by the neck of said shaft of rectangular cross section.

7. A centrifugal pump as claimed in claim 1, the pump-housing cover for guiding the shaft being provided with a bearing holder, which in turn is provided with a brass shaft bushing lubricated by the pump fluid.

8. A centrifugal pump as claimed in claim 1, said impeller including a collar like ring, the pump-housing cover for guiding the impeller when the neck of the shaft is lifted out of the same forming a muff concentric with the shaft and facing downwards towards the impeller, said muff having at its lower inner surface a cylindrical guiding surface for said collar like ring arranged on said impeller, said collar like ring facing the guide surface.

9. A centrifugal pump as claimed in claim 7, said cover establishing a delivery channel and an outlet channel, a sealing chamber defined above said bushing in the cover, the pumped fluid for cooling the bushing being passed through said delivery channel to said sealing chamber above the bushing in the pump-housing cover and through said outlet channel, said outlet channel extending parallel to the bearing bushing from said sealing chamber to said chamber, existing under sub pressure, of the impeller.

10. A centrifugal pump as claimed in claim 1, the driving shaft being provided with a neck and an abutment shoulder, which upon insertion of the shaft neck into the impeller displaces said neck downwards toward the axial bearing.

11. A centrifugal pump as claimed in claim 9, a shaft cover, a stationary sealing ring, a plane seal prevailing under spring pressure being arranged in the sealing chamber of the pump-housing cover, which seal rotates in an axial direction with the driving shaft and which presses against said stationary sealing ring, said sealing ring being attached to the undersurface of said shaft cover, said shaft cover being fitted over the shaft and closing the sealing chamber.

12. A centrifugal pump as claimed in claim 11, said shaft having a shoulder, said cover upon insertion of the driving shaft into the bearing bushing being driven by said shoulder on the shaft, and in the closed position is arranged to be tightly pressed against the upper edge of the sealing chamber, a pressure member which is accessible from without pressing said shoulder against said upper edge and including tightenable claws.

13. A centrifugal pump as claimed in claim 1, the bearing bracket being formed as a closed unit secured to the driving shaft, and which subsequent to loosening of the screws connecting said bracket to the stator portion is removable together with the shaft unit.

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ROBERT M. WALKER, *Primary Examiner.*