

PATENT SPECIFICATION

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(54) IMPROVEMENTS RELATING TO THE MOUNTING OF ROTATABLE IMPELLER SHAFTS

(71) I, KENNETH DUNDONALD REID, a British subject and New Zealand citizen, of 44, Hohaia Street, Matamata, New Zealand, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the mounting of rotatable impeller shafts and is more particularly concerned with the mounting of impeller shafts for centrifugal or other rotary pumps.

An object of this invention is to provide an improved manner of mounting a shaft for an impeller in bearings and whereby maintenance of the support means and bearing is substantially eliminated and whereby there is provided a sealing means to prevent the passing of extraneous matter or unwanted or undesirable fluids from externally of the mounting means to or along the impeller shaft or vice versa, particularly at the support means and impeller shaft bearings.

Another object of this invention is to provide a mounting and bearing means for an impeller shaft whereby the impeller shaft may extend beyond the support and bearing means so that an impeller mounted on the free end of such impeller shaft is spaced from the support means and bearings and in a manner permitting a limited amount of trans-axial movement of the impeller in its body or housing to facilitate and/or permit the passage of solids or semi-solids without jamming occurring between the impeller and body or housing therefor.

Other objects and advantages of the present invention will become apparent from the ensuing description.

According to this invention there is provided a bearing support and sealing means for an impeller shaft of a rotary pump comprising a support with two spaced plates

provided with co-axial bearings through which a portion of the impeller shaft spaced from the impeller is rotatably located, the support plate nearer the impeller being secured to an elongate tubular housing extension which extends from the pump impeller housing and encloses a free unsupported length of impeller shaft between the impeller and said nearer support plate in a manner permitting some flexing of said unsupported length of and thus some trans-axial movement of the impeller thereon, the housing and impeller dimensions permitting such impeller movement, and there being a flexible or floating liquid seal located about the impeller shaft and interposed between the impeller and the bearing provided on the said nearer support plate at a point close to such nearer support plate to prevent extraneous liquid reaching the bearings without restricting said shaft trans-axial movement.

The support and sealing means of this invention is particularly applicable to the mounting of the impeller of a centrifugal or other rotary pump and the invention will now be described by way of example and with reference to the accompanying drawings, in which:—

Figure 1 is a diagrammatic and part sectional view illustrating one form of the invention,

Figure 2 is a fragmentary diagrammatic and part sectional view illustrating a second form of the invention,

Figure 3 is a fragmentary diagrammatic and sectional view illustrating a preferred bearing arrangement,

Figure 4 is a fragmentary diagrammatic sectional view illustrating a further form of the invention, and

Figure 5 is a fragmentary diagrammatic sectional view illustrating a still further variation of the invention.

In one application of the invention, a rotary pump is provided with a vertical

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impeller shaft 1 having the impeller 2 located at the lower end thereof, the impeller 2 being enclosed by the pump body or housing 3 and there being an elongate tubular extension 4 of such housing extending upwardly therefrom and wherein the lower unsupported free end portion of the driven or impeller shaft 1 is freely located to permit some trans-axial movement of the impeller when the pump is passing solids, and thus minimising risk of the pump jamming, the housing 3 and impeller 2 dimensions permitting such impeller movement.

The bearing support 5 may also be of tubular formation and may be circular in cross-section with a diameter greater than that of the tubular housing extension 4 and such support 5 is provided with upper and lower end plates, 6 and 7 respectively, through which the impeller shaft 1 can pass, and the lower end plate 7 of the support 5 is secured such as by welding to the upper end of the tubular housing extension 4.

The upper and lower plates 6 and 7 of the support 5 are each provided with bearings 8 and 9, respectively, through which the upper portion of the impeller shaft 1 is rotatably located. The bearings 8 and 9 can be such as ball, needle, roller or bush bearings, the bush bearings where provided being of alloy or synthetic materials, and a liquid seal 10 is provided at the lower plate 7 of the support 5 and about the portion of impeller shaft 1 passing therethrough and between the lower bearing 9, i.e. the bearing nearer the impeller 2, and the impeller 2 itself so that any liquid or extraneous matter that might find its way into the tubular housing extension 4 cannot reach the bearings 8 and 9 or pass into or through and beyond the tubular bearing support 5. The arrangement also provides that the seal 10 is spaced from the lower bearing 9 and a lubricant reservoir 11 may thus be provided between the lower bearing 9 and seal 10.

In the preferred arrangement and as illustrated in the accompanying drawings, the upper and lower bearings 8 and 9 are of the ball race self aligning and normally sealed type enclosed by bearing housings 12 and 13, respectively. The bearing housings 12 and 13 may thus be secured such as by bolting to the end plates 6 and 7 of the tubular support 5. In these known type of self aligning sealed bearings, the bearing cup is offset from the face of the bearing housing flange so that the lower lubricant reservoir 11 may be formed between the lower bearing race 9 and lower support end plate 7 with which it is associated and a similar upper lubricant reservoir 14 may be provided at the upper bearing 8 and end plate 6. Referring particularly now to figure 3 of the drawings, the bearing housings 12 or

13 are usually also provided with an annular lubricant channel 15 at the bearing cup for the bearing race 8 or 9 and a lubricant passage 16 extends to the lubricant ring 15 from an external lubricant nipple 17; by providing a further passage 18 intercepting the aforesaid lubricant passage 16 and leading to the lubricant reservoir 11 or 14, the reservoir 11 or 14 may be filled as required from outside the bearing housing 12 or 13. The upper bearing housing 12 is preferably located above the upper end plate 6 of the tubular support 5 and the lubricant nipple 17 is thus readily accessible; the lower bearing 9 and housing 13 therefor are located within the tubular support 5 and in this arrangement the lubricant nipple can be omitted from the lower bearing housing 13 and the tubular support 5 filled or partly filled with oil or grease from outside so that such oil or grease may pass through the lower bearing housing 13 to the bearing 9 and reservoir 11 thereof to provide lubrication and further liquid seal means at the liquid seal 10 between the impeller 2 and lower bearing 9. It is envisaged that the support upper end plate 6 may be apertured to permit lubricant fed to the upper reservoir 14 to pass therethrough to the interior of the support 5 and thence the lower bearing 9 and reservoir 11 in providing a single lubrication point.

The liquid seal 10 may take various forms and in the arrangement illustrated in figure 1 of the drawings, a flexible "bucket" seal of synthetic material, rubber or leather, is located about the impeller shaft 1 and within an enlarged aperture 19 in the lower plate 7 of the tubular support 5. In the alternative arrangement illustrated in figure 2 of the drawings, the lower end plate 7 of the tubular support 5 is provided merely with a clearance aperture 20 for the impeller shaft 1 and a rigid annular or ring-like seal member 10a of carbon or synthetic such as a plastics material is slidably located on the impeller shaft 1 below the support lower plate 7 and in frictional sealing engagement therewith. The carbon or synthetic seal ring 10a is self lubricating and is normally urged into contact with the underside of the lower support plate 7 by a resilient flexible member 21 which may preferably be in the form of a tubular bellows of rubber or synthetic materials and which has its upper end part clamped and sealed onto the carbon or synthetic seal member 10a and its lower end part clamped and sealed onto the impeller shaft 1 so that the bellows 21 and seal 10a are rotatable with the shaft 1. The provision of such a resilient bellows member 21 provides a further seal preventing extraneous matter passing to the interior thereof and to the bearings, 8 and 9, and support 5 and also maintains pressure on

the carbon or synthetic seal ring 10a to compensate for wear of such ring 10a.

In a further modification of the invention and to avoid an undue pressure build-up within the housing extension 4 for the impeller shaft 1, and thus further reduce the risk of any liquid or extraneous matter being forced past the bearings (8 and 9) and liquid seal (10 or 10a), as shown in figure 1 of the drawings, a pressure relief aperture 22 may be provided below the impeller housing 3 at a point diametrically opposite the pump outlet aperture 23. The pressure relief aperture 22 is in communication, such as by way of an external conduit or duct 24, with a further aperture 25 in the housing extension 4 at a point just above the impeller housing 3. By this arrangement any pressure build-up within the housing extension 4 will be released by way of the duct 24; air cannot be admitted through the duct 24 from the extension 4 to the impeller housing 3, or vice versa, whilst the pump is submerged in the medium being pumped. Also, where a high delivery discharge is required and/or in case of blockage at the pump main inlet 3a, the relief aperture 22 can be utilised as a second inlet to the pump.

In still further modifications of the invention, and referring now to figure 4 of the drawings, the liquid seal for the impeller shaft 1 can be provided by a floating gland assembly provided within a cavity or chamber 26 formed between the support 5 and housing extension 4, a portion 5a of the support 5 extending downwardly beyond the lower bearing support plate 7 and a housing extension flange plate or further end plate 7a secured to the housing extension 4 being secured to the lower end of the support extension 5a in forming the chamber 26. The floating gland assembly may include a flanged cup 27 through which the impeller shaft 1 passes to provide an annular space about the shaft 1 and in which a suitable gland material 28 can be placed, the cup 27 extending downwardly into the upper part of the housing extension 4 from its flange 27a which is supported by the further end plate 7a, and a flanged thrust ring 29 which is a close fit within the cup 27 and is normally urged downwardly into the cup 27 to compress the gland material 28 under the influence of a compression spring 30 located about the shaft 1 and interposed between the lower bearing plate 7 and thrust ring 29. A slinger washer or ring 31 can be located about the portion of impeller shaft 1 between the sealing gland assembly and lower bearing plate 7 to centrifugally disperse any liquid that may leak through the gland assembly to prevent such liquid reaching the lower bearing 9. Similarly a "slinger" washer or ring 32 can be located on the impeller shaft 1 above the upper bearing 8 and end

plate 6 to throw liquid outwardly away from the upper bearing 8, in the illustrated form in figure 4 the upper bearing 8 is mounted within the support 5 below the upper end plate 6 and the upper end plate 6 is provided with an upwardly extending spigot portion 6a through which the shaft 1 extends, and the upper "slinger" 32 is in the form of an inverted cup washer extending over the spigot 6a.

Referring now to figure 5 of the drawings, in a further modification of the invention the arrangement can include upper and lower sealed bearing assemblies, 33 and 34 respectively, (each comprising a flanged housing and shaft bearing) for the upper part of the shaft 1 and separated by the support tube 5, the housing extension 4 being spaced from the support tube 5 and lower bearing assembly 34 but the assembly being jointed by long retaining bolts 35 passing through aligned apertures in peripheral flange parts of the bearings 33 and 34 and in an upper plate or flange 36 from which the housing extension 4 depends, the bolts 35 being located externally of the support tube 5. The bolt arrangement also secures the assembly to such as a support plate 37, which can also form an upper wall for the support tube 5, located and clamped between the support tube 5 and the upper bearing assembly 33 the plate or bracket 37 being apertured for the shaft 1 and bolts 35. The flanged housing of the lower bearing assembly forms the lower wall for the support tube 5. This arrangement employs the spring influenced floating gland assembly afore-described with reference to figure 4 of the drawings, and provides for ease of final adjustment to alignment and location of the impeller 2, shaft 1, housing 3 and housing extension 4 relative to the bearing assemblies 33 and 34, and support 5.

Thus, by this invention, there is provided a simple and effective means for supporting a rotatable impeller shaft in a centrifugal or other rotary pump and in a manner substantially eliminating or at least reducing the maintenance required for such pump and permitting the pump to run "dry" for any length of time; and when used in installations where they could be switched on before any liquid is available, or left running after the liquid has been emptied from the desired area or container, little or no damage to the pump is suffered. In addition costly and unreliable automatic switching mechanisms usually provided in such installations for conventional pumping apparatus, is no longer required. Pumps with impeller shafts mounted in accordance with the invention lend themselves to direct drive from either flange mounted or foot mounted electric motors, or to direct or belt drive

from diesel or petrol engines, or to any form of belt or gear drive.

Particular forms of the invention have been described by way of example but it will be appreciated that other variations of and modifications to the invention can take place without departing from the scope of the appended claims.

WHAT I CLAIM IS:—

1. Bearing support and sealing means for an impeller shaft of a rotary pump comprising a support with two spaced plates provided with co-axial bearings through which a portion of the impeller shaft spaced from the impeller is rotatably located, the support plate nearer the impeller being secured to an elongate tubular housing extension which extends from the pump impeller housing and encloses a free unsupported length of impeller shaft between the impeller and the said nearer support plate in a manner permitting some flexing of said unsupported length of shaft and thus some trans-axial movement of the impeller thereon, the housing and impeller dimensions permitting such impeller movement, and there being a flexible or floating liquid seal located about the impeller shaft and interposed between the impeller and bearing provided on the said nearer support plate at a point close to such nearer support plate to prevent extraneous liquid reaching the bearings without restricting said shaft trans-axial movement.

2. Bearing support and sealing means as claimed in claim 1 wherein the bearings are of the ball race self aligning and normally sealed type enclosed by bearing housings, the bearing housings each including a bearing cup portion offset from a securing flange of the housing which is secured to a respective support plate in providing a grease reservoir between the bearing race and respective support plate with which it is associated.

3. Bearing support and sealing means as claimed in claim 2 wherein each bearing housing has an annular lubricant channel at its bearing cup for the bearing race and a lubricant passage extends to the lubricant channel from an external lubricant nipple, and there being a further passage intercepting the aforesaid lubricant passage and leading to the lubricant reservoir, whereby the reservoir may be filled as required from outside the bearing housing.

4. Bearing support and sealing means as claimed in claim 1, claim 2 or claim 3, wherein the liquid seal for the impeller shaft comprises a flexible "bucket" seal of synthetic material, rubber or leather, located about the impeller shaft and within an enlarged aperture in the support plate nearer the impeller.

5. Bearing support and sealing means as

claimed in claim 1, claim 2 or claim 3, wherein the support plate nearer the impeller is provided with a clearance aperture for the impeller shaft and a rigid annular seal member of carbon or synthetic self lubricating material is slidably located on the impeller shaft below the said nearer support plate and in frictional sealing engagement therewith, the seal member being normally urged into contact with the side of the support plate nearer the impeller by means of a resilient flexible member.

6. Bearing support and sealing means as claimed in claim 5 wherein the resilient flexible member for the annular seal member is in the form of a tubular bellows of rubber or synthetic material and which is located about the impeller shaft, said bellows having its end part remote from the impeller clamped and sealed onto the seal member and its end part nearer the impeller clamped and sealed onto the impeller shaft so that the bellows and seal are rotatable with the shaft.

7. Bearing support and sealing means as claimed in claim 1 or claim 2 wherein the liquid seal for the impeller shaft is provided by a floating gland assembly provided within a cavity or chamber formed between the support and housing extension, the support being of tubular form and extending in the direction of the impeller beyond the support plate or wall nearer the impeller and the housing extension having a flange plate secured thereto and secured to the end of the support extension nearer the impeller.

8. Bearing support and sealing means as claimed in claim 7 wherein the floating gland assembly includes a flanged cup through which the impeller shaft passes to provide an annular space about the shaft and in which a suitable gland material can be placed, the cup extending into the end part of the housing extension remote from the impeller, the flange of the cup being supported by the housing extension flange plate, and a flanged thrust ring which is a close fit within the cup being normally urged into the cup to compress the gland material by the influence of a compression spring located about the shaft and interposed in the chamber between the thrust ring and nearer bearing support plate.

9. Bearing support and sealing means as claimed in any one of the preceding claims wherein the impeller shaft is provided with a "slinger" washer or ring between the impeller shaft and the bearing nearer the impeller, the "slinger" being rotatable with the shaft and arranged to centrifugally disperse any liquid on the shaft away from the nearer bearing.

10. Bearing support and sealing means as claimed in any one of the preceding claims wherein the impeller shaft is provided with a

from diesel or petrol engines, or to any form of belt or gear drive.

Particular forms of the invention have been described by way of example but it will be appreciated that other variations of and modifications to the invention can take place without departing from the scope of the appended claims.

WHAT I CLAIM IS:—

10 1. Bearing support and sealing means for an impeller shaft of a rotary pump comprising a support with two spaced plates provided with co-axial bearings through which a portion of the impeller shaft spaced from the impeller is rotatably located, the support plate nearer the impeller being secured to an elongate tubular housing extension which extends from the pump impeller housing and encloses a free unsupported length of impeller shaft between the impeller and the said nearer support plate in a manner permitting some flexing of said unsupported length of shaft and thus some trans-axial movement of the impeller thereon, the housing and impeller dimensions permitting such impeller movement, and there being a flexible or floating liquid seal located about the impeller shaft and interposed between the impeller and bearing provided on the said nearer support plate at a point close to such nearer support plate to prevent extraneous liquid reaching the bearings without restricting said shaft trans-axial movement.

35 2. Bearing support and sealing means as claimed in claim 1 wherein the bearings are of the ball race self aligning and normally sealed type enclosed by bearing housings, the bearing housings each including a bearing cup portion offset from a securing flange of the housing which is secured to a respective support plate in providing a grease reservoir between the bearing race and respective support plate with which it is associated.

50 3. Bearing support and sealing means as claimed in claim 2 wherein each bearing housing has an annular lubricant channel at its bearing cup for the bearing race and a lubricant passage extends to the lubricant channel from an external lubricant nipple, and there being a further passage intercepting the aforesaid lubricant passage and leading to the lubricant reservoir, whereby the reservoir may be filled as required from outside the bearing housing.

60 4. Bearing support and sealing means as claimed in claim 1, claim 2 or claim 3, wherein the liquid seal for the impeller shaft comprises a flexible "bucket" seal of synthetic material, rubber or leather, located about the impeller shaft and within an enlarged aperture in the support plate nearer the impeller.

65 5. Bearing support and sealing means as

claimed in claim 1, claim 2 or claim 3, wherein the support plate nearer the impeller is provided with a clearance aperture for the impeller shaft and a rigid annular seal member of carbon or synthetic self lubricating material is slidably located on the impeller shaft below the said nearer support plate and in frictional sealing engagement therewith, the seal member being normally urged into contact with the side of the support plate nearer the impeller by means of a resilient flexible member.

6. Bearing support and sealing means as claimed in claim 5 wherein the resilient flexible member for the annular seal member is in the form of a tubular bellows of rubber or synthetic material and which is located about the impeller shaft, said bellows having its end part remote from the impeller clamped and sealed onto the seal member and its end part nearer the impeller clamped and sealed onto the impeller shaft so that the bellows and seal are rotatable with the shaft.

7. Bearing support and sealing means as claimed in claim 1 or claim 2 wherein the liquid seal for the impeller shaft is provided by a floating gland assembly provided within a cavity or chamber formed between the support and housing extension, the support being of tubular form and extending in the direction of the impeller beyond the support plate or wall nearer the impeller and the housing extension having a flange plate secured thereto and secured to the end of the support extension nearer the impeller.

8. Bearing support and sealing means as claimed in claim 7 wherein the floating gland assembly includes a flanged cup through which the impeller shaft passes to provide an annular space about the shaft and in which a suitable gland material can be placed, the cup extending into the end part of the housing extension remote from the impeller, the flange of the cup being supported by the housing extension flange plate, and a flanged thrust ring which is a close fit within the cup being normally urged into the cup to compress the gland material by the influence of a compression spring located about the shaft and interposed in the chamber between the thrust ring and nearer bearing support plate.

9. Bearing support and sealing means as claimed in any one of the preceding claims wherein the impeller shaft is provided with a "slinger" washer or ring between the impeller shaft and the bearing nearer the impeller, the "slinger" being rotatable with the shaft and arranged to centrifugally disperse any liquid on the shaft away from the nearer bearing.

10. Bearing support and sealing means as claimed in any one of the preceding claims wherein the impeller shaft is provided with a

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"slinger" washer or ring located on the impeller shaft near the bearing further from the impeller and on the side of the bearing remote from the impeller, the "slinger" being rotatable with the shaft and arranged to centrifugally disperse any liquid on the shaft away from the further bearing.

11. Bearing support and sealing means as claimed in any one of the preceding claims wherein a pressure relief aperture is provided at a point beyond or below the impeller housing and such pressure relief aperture is in communication, such as by way of an external conduit or duct, with a further aperture in the housing extension at a point close to the impeller housing.

12. Bearing support and sealing means as claimed in any one of the preceding claims wherein the spaced plates carrying the shaft bearings are clamped together at either end

of a tubular support by means of external bolts located in and through aligned apertures in outer peripheral parts of flanges of the plates, and the housing extension is mounted in spaced relationship with its nearer support plate by extensions of said bolts being engaged with a flange or plate secured to the housing extension at its end remote from the impeller.

13. Bearing support and sealing means for an impeller shaft for a rotary pump, arranged and constructed substantially as hereinbefore described with reference to the accompanying drawings.

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