ADAPTOR AND FRAME FOR A CENTRIFUGAL PUMP

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ABSTRACT

Centrifugal Pump Means to provide selectively close coupled centrifugal pump means and separately coupled centrifugal pump means from a wide variety of interchangeable modular components including respectively pluralities of different, interchangeable pump casings, pump impellers, pump drive shafts, adaptors, pump drive means and shaft seals each of which may be readily and conveniently operatively connected to each of the other stated pump components to thereby enable the provision of a very wide variety of different centrifugal pump means taking either close or separately coupled form, each of which is particularly suitable for a group of different pumping applications, without requiring the manufacture and inventory of a wide variety of completed pumps.

6 Claims, 20 Drawing Figures
ADAPTOR AND FRAME FOR A CENTRIFUGAL PUMP

BACKGROUND OF THE INVENTION

Although centrifugal pump means having some interchangeable components are known, the provision for a wide variety of different centrifugal pump means, each particularly suitable for a different pumping application, will require the manufacture and inventory of a corresponding wide variety of completed pumps a significant competitive disadvantage from a financial viewpoint because of the money tied up in inventory.

In those prior art centrifugal pumps wherein major pump components are interchangeable, it has been found that replacement of one or more of such major pump components by other and different components to adapt the same centrifugal pump means to a materially different pumping application will generally involve relatively involved and time consuming procedures and require the use of specialized fittings and the like to effect the desired modification.

The present invention overcomes this problem by providing a wide variety of close coupled and separately coupled centrifugal pump means for a group of different pump applications which utilizes separate, different and independent forms of casings, impellers, driving means for the impeller including, driven shafts connectable to the impellers, adapters, and seal means for the driven shafts; each readily and conveniently interchangeable with other of the same elements without requiring the manufacture and inventory of large numbers of completed pumps.

The close coupled centrifugal pump means and separately coupled centrifugal pump means of the present invention requires only readily available relatively simple components of proven dependability in the fabrication thereof so that any given pump means which is formed from such interchangeable elements will provide long periods of satisfactory maintenance-free pumping operation and will be competitive in the commercial market place with centrifugal pumps manufactured for the same application.

SUMMARY OF THE INVENTION

Thus the present invention covers apparatus to provide selectively, close coupled and separately coupled centrifugal pump means, from interchangeable modular components including a plurality of different, interchangeable casings each having an identical back opening, a plurality of different interchangeable impellers each of which may be disposed in each of said casings, a plurality of different interchangeable drive shafts each of which may be extended onto each of said casings and operatively connected therein to each of said impellers, a plurality of different, interchangeable adapters each having an identical connecting means at one end to permit any given adapter to be connected to the back end of each of said casings, different, interchangeable drive means, each of which may be connected to each of said adapters and each of said pump drive shafts to drive the pump, and different interchangeable seal means operable with a selected adapter means to close said back opening of the selected casing configuration, at least one adapter and an associated seal means connectable between a selected casing and a selected drive means to form the desired close coupled centrifugal pump means, and at least one other adapter and an associated seal means selectively and alternatively connectable in place of said first mentioned one adapter and associated seal means for mounting between a selected casing and a selected drive means to form the separately coupled centrifugal pump means.

DESCRIPTION OF THE DRAWINGS

The above and other objects and advantages of this invention are believed made clear by the following detailed description thereof taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a side elevational view of a close coupled pump constructed and operative in accordance with the teachings of the invention,

FIG. 2 is an end elevational view of the pump of FIG. 1.

FIG. 3 is a vertical cross sectional view taken through the pump to FIG. 1.

FIG. 4 is an exploded view of the pump of FIGS. 1 to 3 with parts cut away and parts in cross section.

FIG. 5 is a vertical cross sectional view taken through the inlet of the pump of FIGS. 1 – 4 illustrating an optional inducer.

FIG. 6 is a side elevational view of a separately coupled pump constructed and operative in accordance with the teachings of the invention and which comprises an open bearing frame or cartridge.

FIG. 7 is an end elevational view of the pump of FIG. 6.

FIG. 8 is a side elevational view of an enclosed bearing frame or cartridge for alternative use in the pump of FIG. 6.

FIG. 9 is a vertical cross sectional view taken through the pump of FIG. 6 but incorporating the enclosed bearing cartridge of FIG. 8 therein.

FIG. 10 is a side elevational view with parts broken away and parts in cross section of a modified form of the enclosed bearing frame or cartridge of FIG. 8.

FIG. 11 is an exploded view with parts cut away and parts in cross section of the pump of FIG. 9.

FIG. 12 is a vertical section taken at line 12—12 of FIG. 9 to show the support means operatively associated with the adapter.

FIG. 13 is a vertical cross sectional view of a portion of the pump casing of FIG. 9 illustrating the use of a shrouded impeller and adjustable shroud therein.

FIG. 14 is a side elevational view of another form of closely coupled pump of the invention which includes a one piece adaptor.

FIG. 15 is a side elevational view of another form of pump casing.

FIG. 16 is a side elevational view of a vertically oriented, separately coupled pump in accordance with the invention partly broken away to show the back portion of the casing.

FIG. 17 is a side elevational view of a two-piece adapter pump casing combination of the invention partly in vertical section.

FIGS. 18 and 19 are respectively side elevational views of the two pieces of the adapter of FIG. 16.

FIG. 20 is another form of vertically oriented separately coupled pump in vertical section to show the arrangement in accordance with the present invention.
CLOSE COUPLED CENTRIFUGAL PUMP MEANS

Referring now to FIGS. 1-4, a close coupled centrifugal pump constructed and operative in accordance with the teachings of this invention is indicated at 30 and comprises a pump end or pump casing 31.

Pump casing 31 is generally cylindrical in shape and has the usual suction inlet 32 internally threaded as at 33 and a discharge outlet 34. The side remote from the suction inlet forms a back opening 35 having a counterbore 36 forming a shoulder as at 37. The form of this back opening though relatively simple is important because it serves as one of the techniques to enable interchangeability of the casings with any of the desired forms of adaptors at 38.

Adaptor 38 is a one piece adaptor and the pump is driven therethrough, as described in detail hereinafter, from an electric drive motor 40. Support lugs 39a and 39b are respectively formed as shown on the pump casing 31 and the housing of electric drive motor 40 to permit this form of pump to be maintained in alignment on suitable mounting means or a baseplate, not shown.

The one piece adaptor 38 has a cup-like configuration as shown in FIGS. 3 and 4 and comprises a front wall portion 42, having a casing wearing ring 44 disposed therein which in assembled position will form the back cover plate of the pump casing. The adaptor 38 is attached to the pump casing 31 by attachment bolts 46 extending through an attachment flange 48 on the adaptor and into threaded bores 47 on said pump casing. In like manner, the adaptor 38 is attached to the housing of drive motor 40 by attachment bolts 50 which pass as shown through adaptor attachment flange 52 into suitable threaded bores 51 in said motor housing. Drain and gauge connection plugs 53 and 55 are provided as shown in pump casing 32.

The motor drive shaft is indicated at 54 and extends as shown through the adaptor 38 into the pump casing 31. The centrifugal pump impeller is indicated at 56 and is of the shrouded type. The impeller includes balancing ports 57 and is attached as shown directly to the motor drive shaft by an attachment bolt 58 and a key 59. A casing wearing ring 60 is disposed as shown in the pump casing 31 adjacent the forward edge of the impeller 56.

A flexible mechanical seal is indicated generally at 62 and is disposed in a seal housing 63 formed as an integral part of the one piece adaptor 38. The seal 62 is carried from a rotatable shaft sleeve 64 and includes a spring assembly 66 and a seal ring 68 which is pressed into sealing contact with a non-rotatable seal member 70 carried by the adaptor 38.

Referring now to FIG. 5, an optional inducer of the depicted helical form is indicated at 72 and is attached as shown to the end of drive shaft 54 just ahead of impeller 56 by an integral attachment bolt 74. Bolt 74 acts in place of the attachment bolt 58 and will hold the inducer 72 and the impeller 56 on shaft 54 as is shown in FIG. 3 of the drawings.

SEPARATELY COUPLED CENTRIFUGAL PUMP MEANS

A separately coupled or bearing supported pump constructed and operative in accordance with the teachings of this invention is indicated at 80 in FIGS.
shaft 120 by a key 126, an attachment nut 128 which screws over a threaded shaft extension 129, and a lock washer 130, respectively.

A packing assembly is indicated generally at 132 and is disposed as shown in the adaptor section 112. The packing assembly 132 cooperates in obvious manner with a rotatable shaft sleeve 134 to prevent leakage of the pumped fluid, and said packing assembly comprises packing members 136, 138 and 140 which are pressed tightly together and maintained in position as shown by a packing nut 142 and a locking bolt 144 which extends through a threaded aperture 146 provided therefor in said packing nut. The packing member 138 comprises spaced apertures 148 formed therein for the supply of the pumped fluid as a lubricant to the packing assembly, and partially threaded fluid supply ports 150 are formed as shown in adaptor section 112 to mate with each aperture 148 and enable the supply of fluid thereto.

An enclosed bearing cartridge is indicated generally at 152 and comprises a generally cylindrical housing 154 having ball bearing assemblies 156 and 158 mounted as shown at opposite extremities thereof by retaining rings 157 and 159. The housing 154 is attached to the adaptor housing 106 by attachment bolts 160 which extend through attachment flanges 161 and 162 as are respectively formed on said bearing cartridge and adaptor housings.

End caps 164 and 166 are provided as shown at opposite extremities of the bearing cartridge housing 152 to seal the interior thereof, and are attached to said housing by attachment bolts 168 and 170. Seals 172 and 174 are provided as shown in the driven shaft apertures through the end caps. In use, the bearing cartridge 154 is partially filled with a suitable lubricating oil, and spaced slingers 176 and 178 are attached to the driven shaft 120 to promote circulation of said lubricating oil through the bearing assemblies 156 and 158. The remote extremity of the driven shaft 120 has a keyway 180 formed therein for attachment of the shaft to the coupling 92 as shown in FIG. 61.

For particularly heavy duty applications, or use in a particularly hot environment, an annular water jacket casing 181 illustrated in phantomized form in FIG. 9 will provide a water cooling passage as at 181f about the bearing cartridge to permit cooling water to be passed therethrough for cooling the bearing cartridge 84.

MODIFIED BEARING CARTRIDGE

A modified or heavier duty form of the enclosed bearing cartridge is indicated generally at 182 in FIG. 10. The construction is substantially similar to bearing cartridge 152 and like parts therefor have been given the same numbers.

Bearing cartridge 182 differs from bearing cartridge 152 in that dual ball bearing assemblies are provided at each end of the cartridge housing 154 and the end cover 164' is modified to mount this dual arrangement.

Only one of the dual ball bearing assemblies is illustrated in FIG. 10 which shows ball bearing assemblies 183 and 184 as held in the cup shaped end cover 164' by an end flange 186 about the open end of end cover 164'.

The end cover is provided with a circumferential flange 187 through which bolts 188 are passed to hold

the end cover 164' in assembled position on the housing 154 to properly provide bearing support for the driven shaft 120.

The modified combination of the end cover 164' facilitates assembly and replacement and provides better support for the ball bearing assemblies 183 and 184.

REPLACEABLE SHROUD FOR IMPELLER

The utilization of an open impeller with a replaceable shroud in a selected pump casing such as pump casing 82 is illustrated in FIG. 13. The open impeller is indicated at 192 and the replaceable shroud at 194. Replaceable shroud is supported in casing 82 by bolt means 196.

The versatility of the present invention is indicated in this arrangement because it permits the same casing to be used with a shrouded or closed impeller or a non-shrouded or open impeller.

The replaceable shroud element is subject to wear and can be replaced cheaply while the pump is being used with an open impeller. However, the pump is readily convertible to a shrouded impeller or back to an open impeller as the user thereof may elect or require.

This is a significant departure from conventional commercial practice wherein two casings are designed, one for an open impeller and one for a shrouded or closed impeller. The replaceable shroud arrangement of the present invention permits a single casing design interchangeably adaptable to either impeller arrangement.

ALTERNATE PUMP CASING

Another form of closely coupled pump constructed and operative in accordance with the teachings of this invention is indicated generally at 197 in FIG. 14 and comprises a pump casing 198 which is closely coupled through a one-piece adaptor 200 to an electric drive motor 202. In this form, the entire pump assembly is supported from a support stand 204 which is a part of the adaptor 200.

ANOTHER ALTERNATE PUMP CASING

A somewhat different form of pump casing is indicated at 206 in FIG. 15 and comprises integral support legs formed to each side thereof and only one of which is visible as indicated at 208 in FIG. 15.

IN-LINE CENTRIFUGAL PUMP MEANS VERTICALLY DISPOSED

A vertically oriented, separately coupled pump constructed and operative in accordance with the teachings of this invention is indicated generally at 210 in FIG. 16 and comprises an in-line pump casing 211 having a flanged, volute-like inlet 212 and a flanged, centerline discharge outlet 213.

In-line pump casing 211 similar to pump casing 31 and pump casing 81 is provided with a substantially similar back opening at 214 having a counterclockwise 215 and a shoulder at 216 to receive an adaptor such as the two-piece adaptor as indicated at 218. Two-piece adaptor 218 is mounted about the pump drive shaft 220.

An electric drive motor is indicated at 222 and is disposed as shown atop the adaptor 218. The motor 222 includes a drive shaft 224 which in the illustrated form of adaptor utilized will be coupled to the pump drive
ALTERNATE TWO-PIECE ADAPTOR

The two-piece adaptor 218 of FIG. 16 is illustrated in more detail in FIGS. 17, 18 and 19 in conjunction with a different form of pump casing as indicated at 236 and which comprises a flanged inlet 238 and a flanged, radially disposed outlet 240.

Adaptor 218 may be seen in these figures as having a cylindrical housing 242. A core-like member 244 fitted into the cylindrical housing 242 serves also as the back plate 246 of the pump casing 236 and provides a shaft packing mounting section 248.

The adaptor 218 is attached to the pump casing 236 by attachment bolts 250 which extend through an attachment flange 252 formed on the adaptor housing 242.

ANOTHER VERTICALLY DISPOSED CENTRIFUGAL PUMP ARRANGEMENT

FIG. 20 shows still another arrangement utilizing the versatility of the present invention wherein a vertically oriented pump is operatively associated with a remote drive means.

Thus the pump casing designated 270 includes a suction inlet 271 and a pump chamber 272 and a radially extending discharge outlet 273.

Casing 270 is open at the back end and is provided with a flange 274 inwardly of the open end which forms the counterebore 275 and a stop shoulder 276 identical in design to the back openings of all of the casing designs of the present invention previously illustrated and described.

Support legs as at 277 and 278 in engagement with the casing 270 may be used to support the pumping arrangement.

A two-piece adaptor generally designated 280 acts to close the back of the pump casing 270 by connection thereto as hereinafter described and at the end of the adaptor remote from the end connected to the pump casing 270 connects with one end of an elongated pipe 281 which in turn connects to the base of the coupling support 282 for a driving means, not shown.

The adaptor 280 includes an outer generally cylindrical housing 283 which is provided with attachment flanges as at 284 and 285 at the respective ends. Attachment flange 284 is a predetermined speed distance back from the end so that the adaptor can hold an inner core member 286 in engagement with the shoulder 276 of the casing 270 when connecting bolts extending through the attachment flange 284 connects the adaptor to the back end of pump casing 270.

The core 286 is shown to include the end cover or back plate as at 287 for the pumping chamber and provides a suitable lubricated bearing arrangement 288 for the driven shaft 289 which is disposed to extend vertically from suitable bearing means 290 in the coupling support 282.

The driven shaft 289 extends the length of the elongated pipe 281 through bearing 288 and the core 286 into pump chamber 272 where the impeller 291 is connected to the end thereof as by a threaded nut 292.

A very wide variety of combinations of the disclosed pump casings, impellers, adaptors and/or bearing cartridges other and different than those described directly hereinabove by way of example, are of course, possible.

More specifically, should a particular application require, for example, a close coupled, vertically oriented pump, it may readily be seen that the one-piece adaptor 38 of FIG. 3 may be interchanged with the two-piece adaptor 218 of FIG. 15, for use with the pump casing 212 of the latter figure.

Alternatively, should a separately coupled pump having threaded inlets and outlets be required, it may readily be seen that the two-piece adaptor 84 of FIG. 9 could be interchanged with the one-piece adaptor 38 of FIG. 3 for use with the pump casing 34 of the latter figure. As another example, if a separately coupled pump including a bearing cartridge and utilizing the pump casing 32 and impeller 56 of FIG. 3 were required, as for a heavy duty application, it is believed clear that the two-piece adaptor 84 and the bearing cartridge 182 of FIG. 10 could be interchanged with the adaptor 38 of FIG. 3.

A major advantage of the centrifugal pumps of the invention is the fact that the different forms of pump casings, pump drive shafts, pump drive means, pump impellers and adaptors are interchangeable, each with the others, to thereby enable the ready assembly of pumps for a variety or a group of different pumping applications without requiring the manufacture and maintenance of a large stock of different completed pumps.

While there has been shown and described the preferred embodiment of the invention, it will be understood that the invention may be embodied otherwise than as herein specifically illustrated or described, and that certain changes in the form and arrangement of parts and in the specific manner of practicing the invention may be made without departing from the underlying idea or principles of this invention within the scope of the appended claims.

What is claimed is:
1. A two piece adaptor in combination with a frame including a bearing cartridge for the driven shaft of a separately coupled centrifugal pump having, a pump casing with an impeller therein connected to and rotatable with the driven shaft, said two piece adaptor includes:
   a. an end cover and seal assembly about the driven shaft,
   b. a connecting bracket independent of said end cover and seal assembly and said frame dispose about the shaft and spaced therefrom having a first connecting means at one end for connecting the adaptor to the back end of the casing, and at the end remote therefrom a second connecting means for connecting the connecting bracket to the frame,
   c. means forming a seal between said connecting means and said end cover and seal assembly, and
   d. the frame includes, support means for said connecting bracket at the end remote from the connecting means to support one end of said bearing cartridge in assembled position.
2. A two piece adaptor as claimed in claim 1 including a cooling jacket about the bearing cartridge, and
means for continuously supplying a cooling medium to said cooling jacket.

3. In a two piece adaptor as claimed in claim 1 wherein the bearing cartridge has spaced double rows of roller bearings, and means on said bearing cartridge for lubricating the roller bearings.

4. A two piece adaptor as claimed in claim 1 wherein the end cover and seal assembly has means therein operatively connectable to a mechanical seal, and said means adaptable to convert to a stuffing box inter-changeable and selective.

5. A two piece adaptor as claimed in claim 1 wherein the end cover and seal assembly has means thereon to form a stuffing box, and said means adaptable to be operatively connectible to a mechanical seal inter-changeably and selectively.

6. A two piece adaptor as claimed in claim 1 wherein the support means for said connecting bracket comprises,

a. a body member having means for connecting the body member to the connecting bracket,
b. leg means on said body member at the end remote from the connecting bracket,
c. and said body member having means to dispose said body member in snug engagement with the connecting bracket and to fix said body member at an angle to the longitudinal line of the connecting bracket in assembled position.

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