July 29, 1969 R. W. JANETZ 3,457,869

CENTRIFUGAL PUMPS

Filed Feb. 13, 1967 3 Sheets-Sheet 1

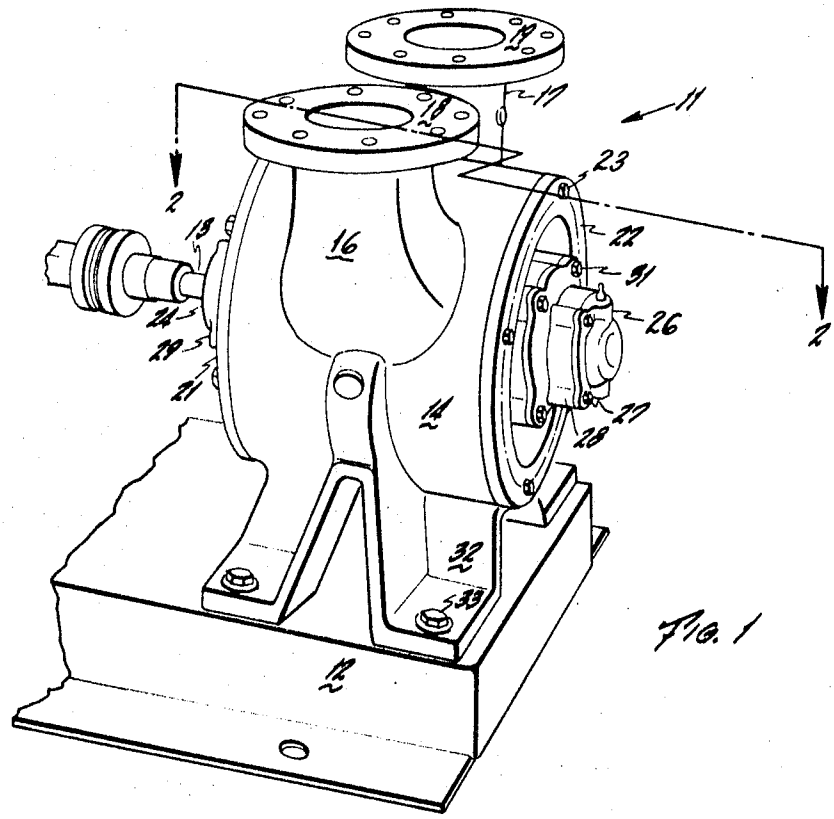


FIG. 1

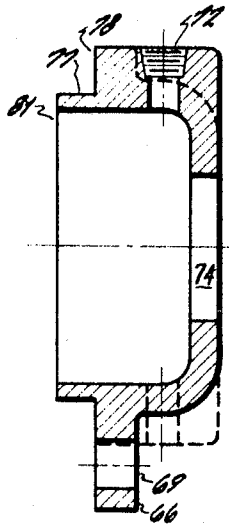


FIG. 6

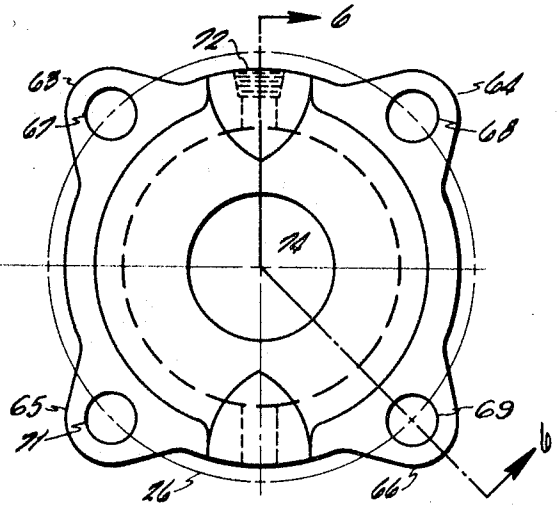


FIG. 5

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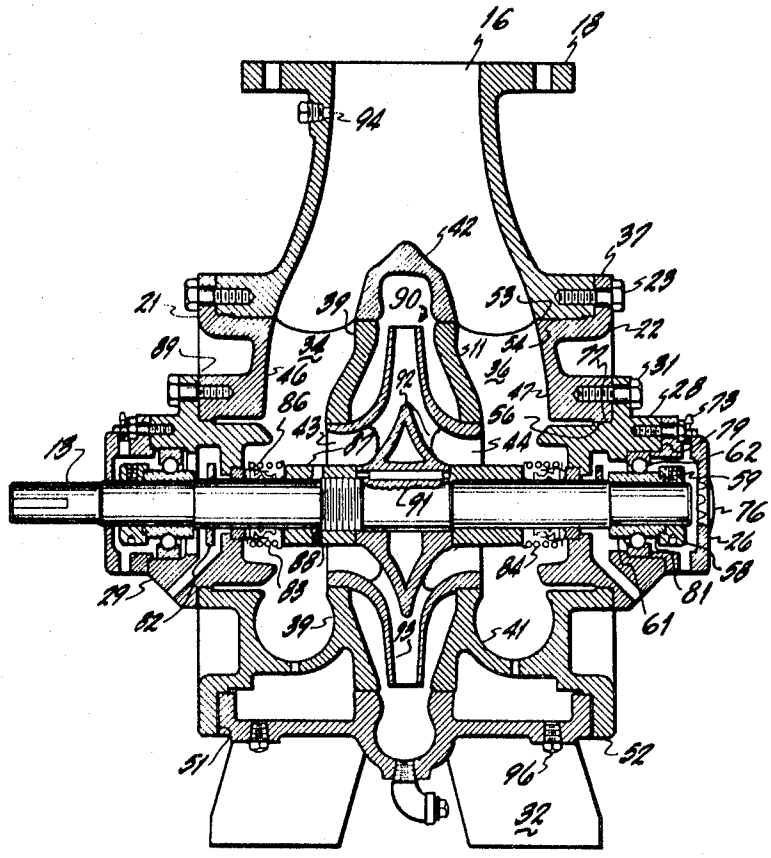


FIG. 2

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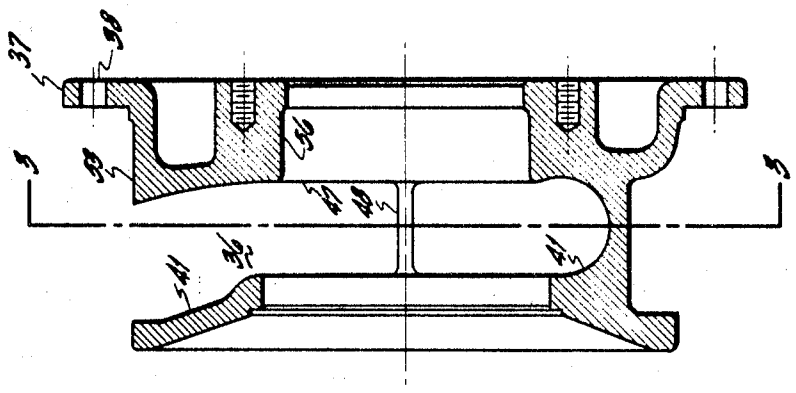


FIG. 4

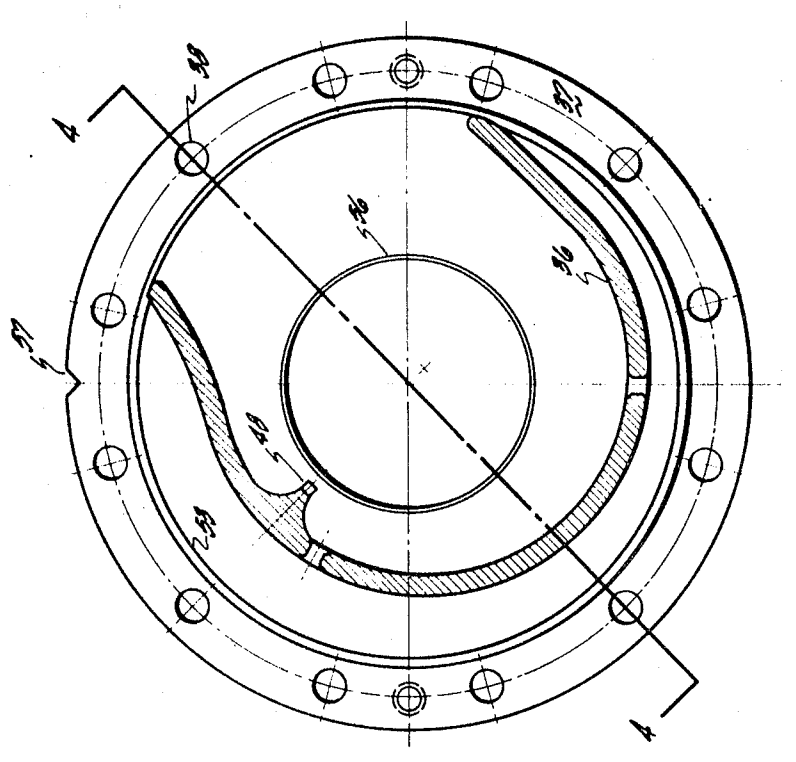


FIG. 3

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CENTRIFUGAL PUMPS

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Int. Cl. F04d 1/00, 29/22, 29/42
U.S. Cl. 103—104 9 Claims

ABSTRACT OF THE DISCLOSURE

Compact centrifugal double suction pumps having vertical split cases and vertical nozzles. Inlet passageways integrally included in dual cover plates along with bearing cavities in each of the cover plates combine to provide a high capacity compact pump.

This invention relates to centrifugal pumps and more particularly to vertical split case centrifugal double suction pumps having vertically displaced inlet and outlet ports.

The use of hydronic temperature control systems in large apartment and industrial buildings has increased the need for system pumps having larger capacities. Larger capacities can be provided by using a plurality of stages of pumps. Such a solution is costly in both money and space. A more efficient solution is the use of double suction pumps. In addition to providing greater capacity, double suction pumps eliminate the problem of "end thrust" resulting from the unequal axial forces created by the single eye impeller of single suction pumps.

While double suction pumps take less space than a plurality of single stage pumps nonetheless since space is at a premium in commercial buildings an ubiquitous problem in pump design is to make pumps more compact.

A companion problem associated with pumps is that most pumps have at least one of the nozzles normal to the other nozzle. Thus, space consuming elbows are required to connect the pumps into the system.

The necessity for using space consuming elbows can be overcome by arranging to have both the inlet and the outlet pump nozzles parallel to each other and to have both nozzles protruding from the pumps case in the same direction. The most efficient type of centrifugal pump for this type of nozzle arrangement is the double suction pump. In the past, space gained by using pumps having parallel nozzles have been lost, at least in part, by the larger size of the double suction pump.

Previous attempts at providing compact double suction pumps have only raised other problems, such as maintenance problems, leakage problems and axis support problems. For example, cantilevered shafts have been used to reduce the size capacity ratio of the pumps. However, such pumps have not matched the durability, or reliability of pumps using "straddle the impeller" bearings; that is wherein the shafts are supported on bearings at both sides of the impeller.

When such dual bearings were used in the past, the size of the pumps increased disproportionately because the bearings were placed outside of the packing glands in order to assure accessibility of the bearings for maintenance purposes.

If the bearing were within the actual pump casing then problems of inadequately sealing the shaft ends of the pumps were encountered.

Accordingly, it is an object of this invention to provide a compact dual suction centrifugal pump which can be installed into a system without using space consuming elbow fittings.

A related object of the invention is to provide such

pumps wherein the bearings are readily accessible for maintenance and the mechanical seals are durable and reliable.

A further object is to provide vertical nozzles for the pump.

Yet another object of the invention is to provide pumps having vertically split cases with interchangeable parts and straddle the impeller bearing arrangements.

In accordance with one preferred embodiment of the invention a vertical split case centrifugal pump is provided with bearings at both ends of the pump shaft. The bearings are enclosed within dual end plates fastened to the pump body. The end plates are provided with complete fluid intake passages to conserve space and thereby assure a more compact pump. Removable bearing housings and covers attached to the end plates make the bearings and seals readily accessible for inspection and maintenance purposes. Further, the bearings are provided with an extra wide sleeve or inner ring to facilitate the removal of the bearings.

These and other objects of this invention and the manner of obtaining them will become more apparent, and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a pictorial representation of the inventive pump;

FIG. 2 is a cross sectional side view of the pump taken along line 2—2 of FIG. 1;

FIG. 3 is a side view of the outboard cover plate taken along line 3—3 of FIG. 4;

FIG. 4 is a sectional view of the outboard cover plate taken along line 4—4 of FIG. 3;

FIG. 5 is a front view of the bearing cover plate; and

FIG. 6 is a sectional view of the bearing cover plate taken along line 6—6 of FIG. 5.

In the FIG. 1 pictorial representation of a preferred embodiment of the invention, the pump **11** is shown mounted on a base plate **12**. Also mounted on the base is a motor, not shown, which acts as a prime mover.

The pump shaft **13** is coupled to the shaft of the motor (not shown) with any well known flexible coupling.

The pump assembly **11** as shown is a vertical split case pump comprising a solid volute body **14** terminating in two vertically disposed nozzles **16, 17**. While the nozzles **16, 17** are shown vertically disposed, it should be understood that within the scope of this invention they could also be horizontally disposed. The advantageous feature is that both nozzles, inlet and outlet protrude from the same side of the pump so that elbows are not necessary for connecting the pump into the fluid system.

The nozzles are equipped with means for coupling the pump into the system. As shown in FIG. 1 the nozzles **16, 17** each terminate in flanges **18, 19** respectively.

End covers or volute cover plates **21, 22** are provided at each end of the solid volute body **14**. The end covers are fastened to the body by means such as volute cover plate screws, peripherally placed around the end cover, such as cap screw **23**, for example.

Means, such as bearing covers **24, 26** assure that the bearings are accessible for inspection purposes. The covers are held in place with screws, such as bearing cover cap screw **27**.

Means, such as bearing housings **28, 29** actually contain the bearings. The bearing housings are held in place with screws, such as cap screw **31**. The removal of the bearing housing uncovers the seal and the internal intake system making them readily accessible for maintenance purposes just as the removal of the bearing cover makes the bearing available for repair maintenance or replace

ment without the necessity of disassembling either the pump or the piping connected to the pump.

The pump body **14** rests on feet, such as foot **32**, which is mounted on base **12** and firmly coupled thereto with threaded fasteners such as cap screw **33**. The feet are cast integral to volute body **14**.

FIG. 2 is a cross sectional view of the pump taken along vertical planes including line **2—2**. FIG. 2 best shows the double suction, straddle the impeller bearing construction of the pump and the intake passageways which are complete and form an integral part of the volute covers.

More specifically, means, such as inlet passageways **34, 36** are provided in covers **21, 22** respectively. The use of passageways within the volute covers contributes to the compactness of the pump. The cross sectional of FIG. 2 view shows port or nozzle **16** as the intake nozzle or inlet which connects directly to the inlet passageways **34, 36** of the end covers **21, 22**, respectively.

The end cover **21** is designated the inboard cover since it is on the motor side. Similarly, the cover **22** is designated the outboard cover.

Since the pump is substantially symmetrical the inboard and the outboard covers are very similar. Therefore, only the outboard cover is shown in FIGS. 3 and 4. The same designation symbols and numbers are used wherever possible on all of the figures to enhance the explanation of the invention.

FIG. 3 shows the outboard end cover **22** as viewed from the line **3—3** of FIG. 4. It can be seen in FIGURES 1, 2, 3 and 4 that the cover has a flange **37** with holes, such as hole **38** peripherally disposed to accommodate the volute cover cap screws.

Inlet passageway inner walls **39, 41** (FIGS. 2, 3 and 4) in volute cover **22** form continuous projections extending from the bifurcating ridges **42** of the central volute fluid channel to form one side of the inlet passageways **34, 36** of the cover respectively. The inner walls **39, 41** circumscribe circular openings matching the eyes **43, 44** of the impeller. The other side of the inlet passageways **34, 36** are defined by outer walls **46, 47**, respectively. The spiral-like configuration of the passageway in the cover is best seen in the cross section of FIG. 3.

Means are provided in each of the inlet passageways for inhibiting prerotation. More specifically, rib **48**, best seen in FIGS. 3 and 4 projects into passageway **36** to establish a turbulence therein and thereby prevent the formation of prerotation of the fluid being pumped.

Means such as volute gaskets **51, 52** are provided for preventing leakage of the pumped fluid past the volute covers **21, 22**, respectively. It should be noted that the gaskets are perfectly placed for sealing. That is, the sealing process is aided by the flush fit of shoulder **53** for example, against the inner shoulder **54** of the body. Also, there is no shaft, for example, extending through the gasket sealed section of the pump as is the case in the horizontal split case pumps.

Inner diameter **56** forms an opening in the volute cover **22** for example, for receiving bearing housing **28**.

A notch **57** is provided in the flange **37** to enable the end cover to be properly aligned. This notch emphasizes the fact that with the inventive pump it is not necessary to "marry" the split portions of the case to one another, instead the design enables the interchangeable use of common parts.

Means are provided for adequately bearing the shaft in the inventive pump. More specifically, the pump utilizes a straddle ball bearing construction, that is best seen in FIG. 2. Therein is shown a bearing housing at each end of the shaft **13**. The outboard housing **28** contains the bearing designed to take thrust. The inboard bearing housing **29** contains the bearing designed to take radial forces. Both bearings are similar in constructive parts. Therefore, only the outboard bearing parts will be described herein. The bearing assembly comprises (see FIG. 2) a locking collar **58** held in place on the shaft **13** by any well known means such as set screw **59**. The locking collar holds the inner bearing ring or sleeve **61** in place. Note that the inner sleeve **61** of the bearing raceway is relatively wide. This facilitates easy removal of the bearing assembly if such removal is required.

To remove the bearing the four bearing cover cap screws **27** are first removed. This allows the bearing cover **26** to be removed. The bearing is then accessible for inspection. Set screw **59** is then loosened and the four bearing housing cap screws are removed. The bearing assembly comprising raceway **61** and ball bearings **62** can then be slipped off the shaft with the bearing housing.

The bearing cover is shown in detail in FIGS. 5 and 6. Incidentally, the bearing covers on the inboard and outboard sides of the pump are substantially identical hence only the outboard side bearing cover is described in detail.

FIG. 5 shows the cover **26** as viewed from the outboard side of the pump. It has a basically circular shape with four corner ears having holes **67, 68, 69, 71** to allow the bearing cover cap screws to pass therethrough into threaded holes, such as hole **27A**, in the bearing housing. A tapped hole is provided to receive a grease fitting, such as fitting **73** shown in FIG. 2. An opening **74** is left in the center of the body of the cover. On the outboard side this opening receives a bearing cover plug **76** as best shown in FIG. 2. On the inboard side the opening is left unplugged and the pump shaft fits through opening **74**.

The cover **26** is designed to slip fit into the bearing housing **28** with outer shoulder **77** of cover **26** contiguous to surface **56** when the cover cap screws are tightened to hold surface **78** juxtaposed with surface **79** of the bearing housing. The inner surface **81** of cover **26** presses against the outer face of the bearing raceway to help lock the cover **26** in place. The inside of the cover **26** is normally filled with grease injected through the grease fitting **73**.

As explained above, the removal of the cover allows inspection of the bearings and is a first step in the removal of the bearing housing, bearings and seals. It should be noted that the bearing housing depicted in the drawings (FIG. 2) includes a water slinger **82**.

A mechanical seal assembly **83, 84** is used at both ends of the shafts to insure a reliable seal. The assembly comprises a ring of packing material which is pressed by spring **86** into a cavity designed to receive the ring. The spring is pressed between collar **87** which is threaded onto shaft **13** and is held in place by set screw **88**. It is readily apparent that the removal of the bearing housing enables the removal of the seal making the volute interior accessible.

A gasket **89** is pressed between the bearing housing and the volute cover to prevent any fluid leakage at this point. The gaskets used in the pump embodied in the figures form complete closed figures and thus are relatively simple in construction and operation.

The impeller **90** is attached to the shaft by any well known means, such as key **91**. In addition to the key, an impeller nut such as the threaded collar **87** may be used to assure a stable impeller operation. The collar **87*a*** on the other side of the impeller need not be threaded.

Since the pump operates on the dual suction principle to provide the required capacity per unit weight, the impeller has two eyes. The impeller blades **92** are shown enclosed by shrouds **93**. The volute is provided with a plug **94** for removal if a test gauge is desired and various drain plugs such as plug **96**.

Thus, in construction the pump ports are not "married"; instead the volute covers, for example, are interchangeable as are the other separate parts of the pump. Once assembled the pump is easily maintained because of the removable bearing housings and bearing covers. These

parts of the pump can be removed while the pump remains connected to the piping of the system. Hence, notwithstanding the pump compactness it is easily serviced.

The vertically disposed suction and pressure nozzles enable the pumps to be connected to the system without the use of elbow fittings. Thus, a minimum of space is required for connecting the pump into a system.

In operation, the fluid such as heated water, is drawn into inlet port **16**. Bifurcating ridge **42** separates the fluid into inboard and outboard inlet channels **34**, **36**, respectively. From the channels the fluid is sucked into the impeller eyes **43**, **44** and carried by the impeller into the pressure volute and finally into the outlet port **17** where it is under pressure.

While the above principles of the invention have been described in connection with a specific embodiment it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention.

What is claimed is:

1. A dual suction centrifugal pump for handling liquids, the assembled pump being adapted as a unit for attachment to or removal from a pair of fixed conduits, said conduits providing the intake and discharge passages to and from the pump, said pump being constructed of a heavy metal assembly of parts, said pump assembly comprising: a vertically split casing including a unitary volute body terminating in two nozzles generally parallel and extending in the same direction from the unitary volute body, one forming an intake nozzle for connection with the fixed intake conduit, the other forming the discharge nozzle for connection with the fixed discharge conduit and an inboard cover means and an outboard cover means abutting opposite ends of the unitary volute body, each of said cover means having an intake channel communicating with the intake nozzle in the volute body, a dual intake impeller in said unitary volute body communicating with the intake channel in the inboard and outboard cover means, said inboard cover means and said outboard cover means being of sufficient size whereby on the removal of either of said cover means, said impeller may be removed as a unit or inspected without the separation of the pump from the fixed conduits, bearing means in each cover means removable as a unit from said cover means without disturbing the connection between the volute body and the respective cover means whereby each of said bearing means may be inspected or replaced.

2. The centrifugal pump of claim **1** wherein fluid bifurcating ridge means are located in said inlet nozzle for separating said supply fluid to flow into the inlet channels of both inboard and outboard cover, said inlet channel formed to cooperate with said bifurcating ridge.

3. The centrifugal pump of claim **2** wherein said bearing means comprise bearing housing means, means for removably connecting said housing means to said volute case cover means.

4. The centrifugal pump of claim **3** wherein said bearing housing means comprises bearing raceway means, bearing cover means for removably connecting said bearing cover to said bearing housing means whereby when said bearing cover means are available for inspection.

5. The centrifugal pump of claim **4** wherein said bearing raceway means have wide inner rings to facilitate removal of said bearing housing.

6. The centrifugal pump of claim **5** wherein said gasket means are fitted between said bearing housing and said volute case means and wherein mechanical seal means cooperate with the pump shaft where said shaft extends into said housing to prevent fluid leakage.

7. The centrifugal pump of claim **6** wherein said nozzles are both vertically disposed.

8. The centrifugal pump of claim **7** wherein said volute case cover means and unitary volute body are interchangeable.

9. The centrifugal pump of claim **1** wherein means are provided in said inlet channels for preventing prerotation.

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