United States Patent

Rule

[15] **3,695,776**

[45] **Oct. 3, 1972**

[54] **SELF-PRIMING CENTRIFUGAL PUMP**

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[22] Filed: **Oct. 16, 1970**

[21] Appl. No.: **81,226**

[52] **U.S. Cl.** ....**415/206,** 417/199 A, 415/121

[51] **Int. Cl.** **F04d 1/00,** F04d 9/00

[58] **Field of Search**................415/53, 206, 204, 121; 417/199 A

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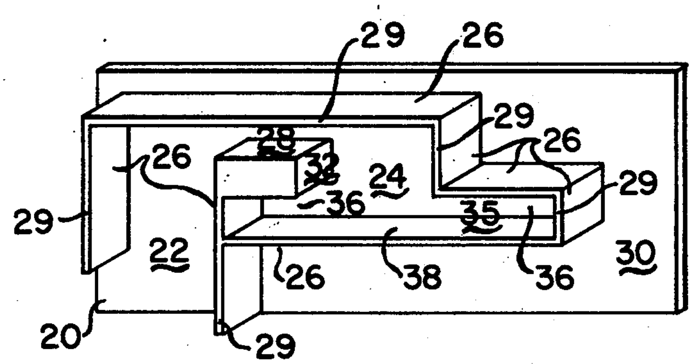
[57] **ABSTRACT**

A centrifugal pump is described wherein the pumping face of the impeller is disposed vertically and wherein integral self-priming means are provided.

4 Claims, 2 Drawing Figures



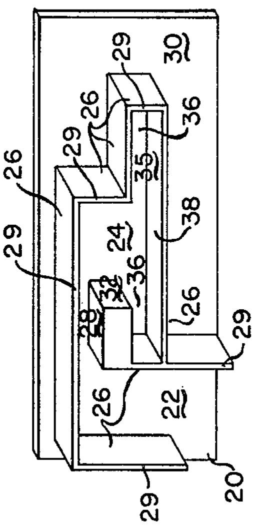


FIG. 2

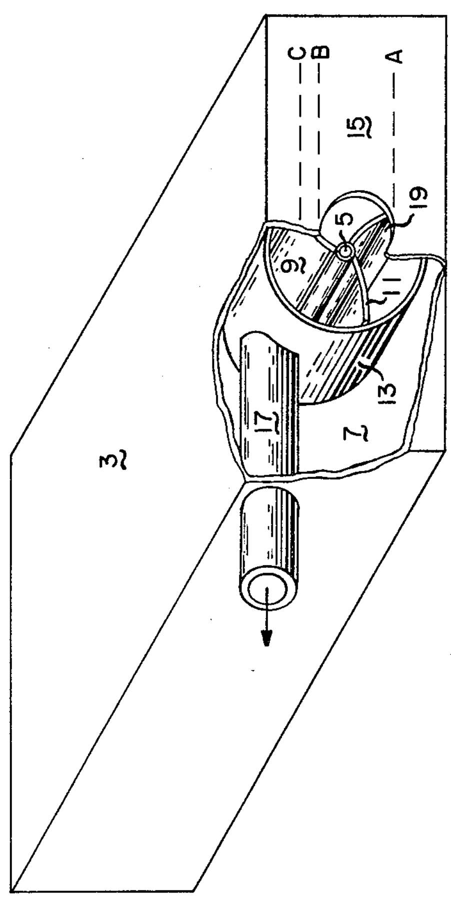


FIG. 1

SELF-PRIMING CENTRIFUGAL PUMP

Impeller pumps can generally be conveniently grouped into two broad design categories: Those in which the pumping face of the impeller is disposed horizontally and those in which the pumping face of the impeller is disposed vertically. The latter type, i.e., that type wherein the pumping face of the impeller is disposed vertically, shall be referred to hereinafter as "-side-impeller" pumps, and it is to said side-impeller pumps that the present invention principally relates.

In a side-impeller pump, the impeller rotates around a horizontal centerline within the impeller chamber. A major advantage generally enjoyed by pumps of this type resides in their generally lower profile or height for a given liquid pumping capacity. According, such side-impeller pumps are often especially adaptable for use in locations where vertical space is at a premium, such as, for example, under the floorboards of a small boat.

However, one of the major disadvantages of side-impeller pumps resides in their tendency to lose their prime subsequent to each operating cycle. This detrimental tendency is often an important concern which limits employment.

Methods and means for repriming and/or avoiding loss of prime from side-impeller pumps are of course known. For instance, one method comprises maintaining such pumps substantially completely submerged beneath the surface of the liquid to be pumped, thereby avoiding loss of prime. However, the use of this method requires that a substantial level of liquid be maintained in the area to be pumped, which level is frequently undesirably high.

Mechanical repriming and/or prime loss avoidance means are also known but are generally either complex and impractical and/or separate and distinct from the pump. These features tend to mitigate against their use. Moreover, those means which serve the sole function of repriming a pump after loss of prime are frequently not automatic, and thus require the manual attention of an operator prior to or during each operational cycle of the pump.

In accordance with the present invention, however, the above and other problems heretofore associated with prior art side-impeller pumps and/or auxiliary repriming means therefor have been substantially completely resolved.

It is a principal object of the invention to provide novel self-priming, side-impeller pumps.

It is yet another object of the invention to provide self-priming means for side-impeller pumps which means are characterized by their resistance to fouling.

It is another object of the invention to provide improved side-impeller pumps having integral self-priming means.

It is still another object of the invention to provide a self-priming, side-impeller bilge pump having substantial resistance to loss of prime due to rolling or listing of the hull in which said pump is mounted.

Other objects and advantages of the invention will in part be obvious and will in part appear hereinafter.

In accordance with the present invention, it has been discovered that self-priming of side-impeller pumps is achieved by providing a liquid reservoir in open communication with the impeller chamber, which reservoir is supplied by a circuitous ascending and descending conduit means interposed between said reservoir and the liquid intake.

FIG. 1 is a schematic isometric partly in section of the pump prior to the attachment of the priming reservoir of the present invention.

FIG. 2 is the priming reservoir of the present invention with interior exposed.

Referring now to the drawing, there is illustrated a side-impeller pump generally comprising a housing **3** which contains therein a prime mover such as a horizontally mounted, conventional, small, electric motor (not shown). In order to maintain the prime mover out of contact with the liquid to be pumped (which is frequently desirable), housing **3** is conventionally liquid-tight. Drive shaft **5**, in operative relationship with the prime mover, penetrates partition **7** of housing **3** into impeller chamber **9**. In order to maintain the liquid-tight integrity of housing **3**, an appropriate shaft seal or packing (not shown) is preferably provided in association with the penetration of shaft **5** through partition **7**. Impeller **11** is mounted on shaft **5** coaxially within impeller chamber **9**. The perimeter of impeller chamber **9** is defined by casing **13**, while the end closures of said chamber are constituted by partition **7** and endplate **15**.

Discharge of liquid from impeller chamber **9** is accomplished through tangential conduit **17** which is in open communication with the upper portions of said chamber. Liquid input into chamber **9** is achieved through inlet orifice **19** in endplate **15**, orifice **19** being preferably located at the eye of the impeller, i.e. substantially concentrically with respect to shaft **5**. Upon appropriate activation, therefore, impeller **11** is rotated by drive shaft **5** which, in turn, is rotated by the prime mover. Liquid is drawn into impeller chamber **9** through orifice **19** and is discharged through conduit **17**. Upon deactivation, and as is typical of side-impeller pumps, impeller chamber **9** tends to largely empty itself of liquid due to gravity or siphon backflow of liquid through orifice **19**. While liquid will ordinarily be retained in liquid tight impeller chamber **9** below the level of orifice **19**, designated as level A in the drawing, the loss of liquid experienced from the upper portions of chamber **9** often results in loss of prime. As a result, unless the ambient liquid level about the pump builds up prior to the succeeding operating cycle to at least the top of orifice **19** designated as level B in the drawing, and often to level C, said subsequent operating cycle frequently fails to pump liquid because of failure of the pump to be sufficiently primed.

Prior art methods for remedying the loss of liquid from the impeller chamber have conventionally involved the use of check valves, ball valves and the like which are installed at some point between the liquid intake port of the pump and orifice **19**. Such valves are intended to close upon deactivation of the pump thereby avoiding to a substantial degree the evacuation of impeller chamber **9**. Unfortunately, however, these valves often foul when the liquid to be pumped is not perfectly clean. For example, the bilge water in boats normally contains substantial quantities of particulate and other fouling matter, thus mitigating heavily against the use of check valves.

In the self-priming, side-impeller pumps of the present invention, however, such fouling problems are substantially circumvented. For purposes of clarity, the self-priming means of the invention is shown in the drawing disassembled from the major portion of the pump described hereinabove. Said means generally comprises liquid intake **20**, ascending conduit **22**, transverse conduit **28** and descending conduit **24**, the terminus of conduit **24** being a reservoir **35**, which reservoir is in open communication with orifice **19** when the unit is assembled. It should be understood that while the self-priming means of the invention is shown as a continuous open channel and reservoir, partitions **26** on endplate **30** defining said channel and reservoir when the entire unit is assembled, as indicated by the dotted lines, must abut endplate **15** in liquid tight relationship and so as to provide a closed reservoir and a circuitous, at least partially vertical, path from intake **20** to orifice **19**.

Transverse conduit **28** is, strictly speaking, necessary only to conduct liquid from ascending conduit **22** into descending conduit **24**. Accordingly, if desired, a suitable alternative to the presence of said transverse conduit **28** resides in a more direct connection of ascending conduit **22** to descending conduit **24** such as an inverted V or loop at the apex of said ascending conduit **22**. The presence of transverse conduit **28** together with a vertical partition **32** of some sort on conduit **28** is, however, preferred as will be explained in more detail hereinafter.

With regard to the design criteria of descending conduit **24** and reservoir **35**, it is all important that as a whole they retain sufficient liquid between operating cycles of the pump to ensure priming of the pump upon start up. The absolute minimum volume of said retained liquid should represent the difference between the full liquid volume of impeller chamber **9** and the normally retained liquid volume thereof when idle. As mentioned previously, the volume of liquid lost from chamber **9** in prior art pumps ordinarily brings the level in chamber **9** down to about level A in the drawing. However, in the present invention, reservoir **35** is designed so as to be in open communication with orifice **19** and to prevent the loss of liquid in chamber **9** below about level B.

Nevertheless, even with this minimum quantity of liquid in chamber **9**, loss of prime can result, and it is the further role of reservoir **35** to retain enough additional liquid to substantially ensure successful priming. The total quantity of liquid required as a minimum to substantially ensure successful priming is extremely difficult to predict due to the many variables at work. The volumes of conduits **22** and **28** are important factors, for example. Typically, the greater the volumes of conduits **22** and **28**, the greater will be the quantity of water that must be stored in reservoir **35** to ensure successful priming. In general, the minimum quantity of liquid stored in reservoir **35** should at least equal the volume, and most preferably should equal 1.5 times the volume, of conduits **22** and **28** expanded to a pressure which is less than atmospheric by at least the length of conduit **22** in inches of the fluid to be pumped. If this minimum quantity of water is present in reservoir **35** upon start up of the pump, atmospheric pressure will tend to force water up conduit **22**, through conduit **28** and thence into reservoir **35** thereby tending to substantially ensure successful priming. To this end, therefore, it is greatly preferred that reservoir **35** comprise lateral portions **36** which substantially increase the volume of liquid that can be retained. Moreover, the use of lateral chambers **36** to form an inverted T-shaped reservoir also serves to minimize the potential loss of availability of liquid to chamber **9** due to rolling and/or pitching of the boat as frequently occurs in bilge pump applications. While the volume of reservoir **35** can also be increased by increasing the front to back depth thereof, it should be borne in mind that the use of that design expedient will also tend to increase the overall length of the pump apparatus.

Also, the positioning of partition **32** (if there is one) is important. Said partition can serve to break a siphon action that may develop upon deactivation of the pump, which siphon action may empty or reduce the level of liquid in reservoir **35**.

Other considerations include the height of chamber **35**. Chamber **35** should be about as high as level B so that chamber **9** will always be full to at least that level. If the height of chamber **35** were greater than that, chamber **35** would contain air above about level B. If said height were lower, chamber **35** would not be capable of maximum capacity.

Bottom partition **38** of reservoir **35** can, of course, be positioned substantially below level A. However, it should be recognized that in such instances not all the liquid retained in reservoir **35** will ordinarily be available to flow into chamber **9**. Specifically, in such instances, only that liquid existing in reservoir **35** at above about level A can aid in priming the pump as only that liquid will normally be available to impeller chamber **9**. When the entire pump is positioned other than horizontally, however, some of the liquid normally "trapped" below level A may enter chamber **9**.

Attachment of endplate **30** bearing the self-priming system to the pump apparatus proper can be achieved in any suitable manner. Generally speaking, the particular manner of attachment will be dictated to a large extent by the materials of construction employed. We have found that polymeric materials, particularly the thermoplastics such as ABS, are generally admirably suited for use as materials of construction. In such instances, attachment of the self-priming means of the invention to the pump proper can be achieved by art recognized methods such as solvent welding, glueing, or the like, bearing in mind, of course, that the open channel means specifically illustrated in the drawing requires that edges **29** of partitions **26** be bonded in liquid-tight relationship to endplate **15**. However, when other suitable materials such as various metals are employed as materials of construction, attachment to the pump can be effected by soldering or welding, or by mechanical means such as gasketing or sealing coupled with screws, rivets, etc.

Obviously many changes can be made in the above description and/or drawing without departing from the scope of the present invention. Accordingly, it is intended not to limit the invention in any manner except as defined in the claims.

What is claimed is:

1. In a side-impeller, centrifugal liquid pump comprising a prime mover, a water-tight impeller chamber,

a shaft in operative relationship with said prime mover extending into said chamber, an impeller affixed to said shaft within said chamber, an inlet into said chamber positioned substantially concentrically with said impeller, and an outlet from said chamber, the improvement which comprises providing a liquid reservoir outside said chamber but in open communication by gravity flow with said inlet, and means connected to the top portion of said reservoir by a circuitous path comprising a vertical portion which in part projects downwardly from the top portion below the level of said reservoir, and said reservoir having a capacity available to flow into said chamber at least as great as the volume of said circuitous path.

2. The pump of claim 1 wherein said reservoir has a capacity available to flow into said chamber at least 1.5 times as great as the volume of said circuitous path.

3. The pump of claim 1 wherein said circuitous path is provided with a siphon breaking means.

4. The pump of claim 1 wherein said reservoir comprises lateral portions which increase the overall liquid capacity of said reservoir.

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