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Sully et al.

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[54] **SUBMERSIBLE PUMP**

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[73] Assignee: **Paddle Pumps Incorporated,** Minneapolis, Minn.

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[52] **U.S. Cl.** ..... **417/424,** 415/170 A

[51] **Int. Cl.** **F04b 17/00**

[58] **Field of Search** ..... 415/170 A; 417/424

[56] **References Cited**

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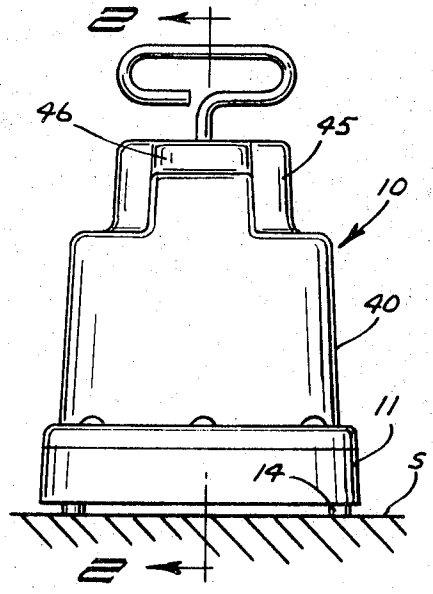
Attorney—Andrew E. Carlsen, Douglas L. Carlsen et al.

[57] **ABSTRACT**

A submersible pump driven by an electric motor and having the liquid inlet at the bottom and the outlet at the top, a sealed housing disposed above the inlet and enclosing the motor, a drive shaft extending downwardly from the motor and carrying an impeller between said housing and the inlet, a water jacket encircling the housing and having the outlet in its upper end and a passageway connecting the inlet with the lower portion of the jacket and said passageway and outlet located on diametrically opposite sides of the shaft axis so that water passing from the inlet to the outlet will move upwardly and around the housing through the jacket.

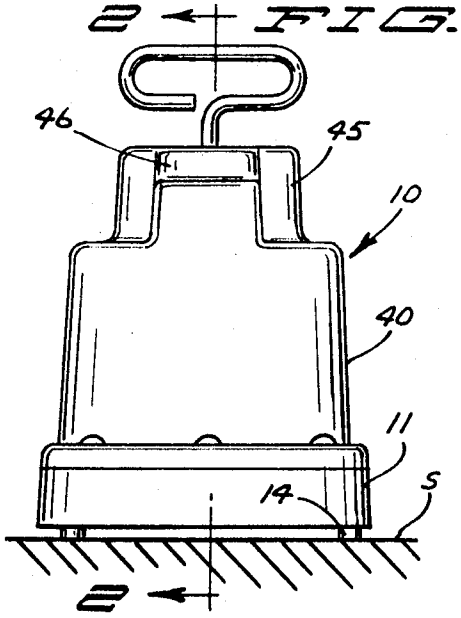
The invention is further characterized by extending the drive shaft upwardly from the motor into a bushing formed in the housing to securely position the motor within the housing and by providing a spacer means between the motor and impeller for proper positioning of a seal around the drive shaft.

4 Claims, 5 Drawing Figures



2 Sheets-Sheet 1

FIG. 1



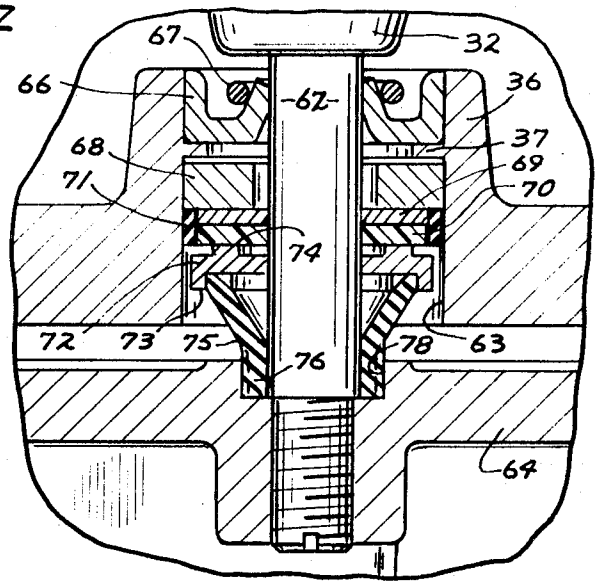


FIG. 3

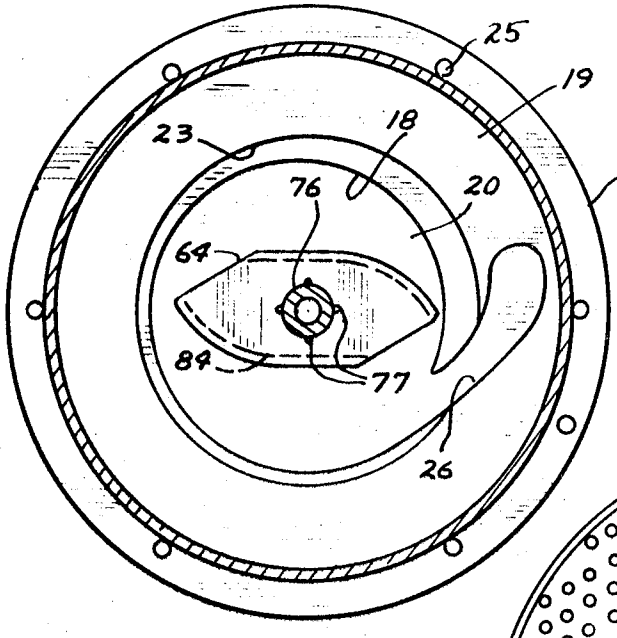


FIG. 4

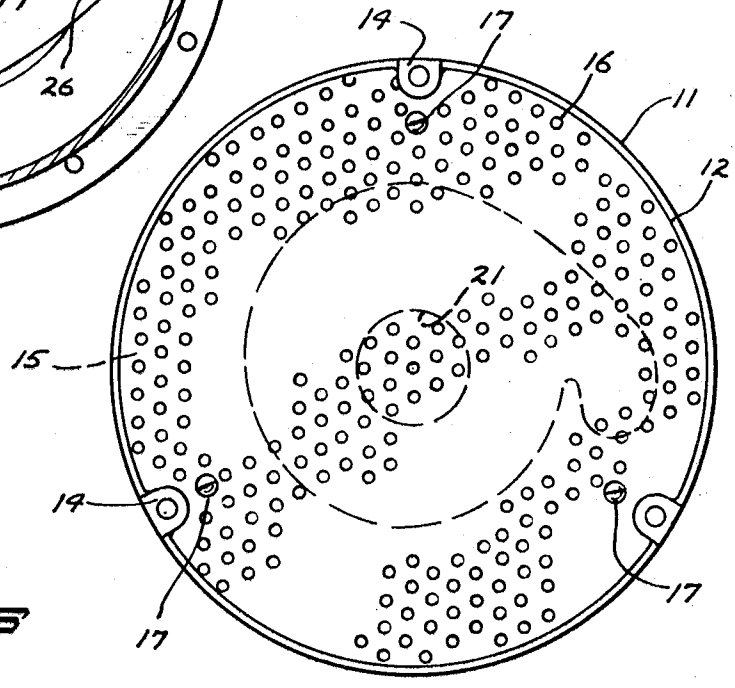
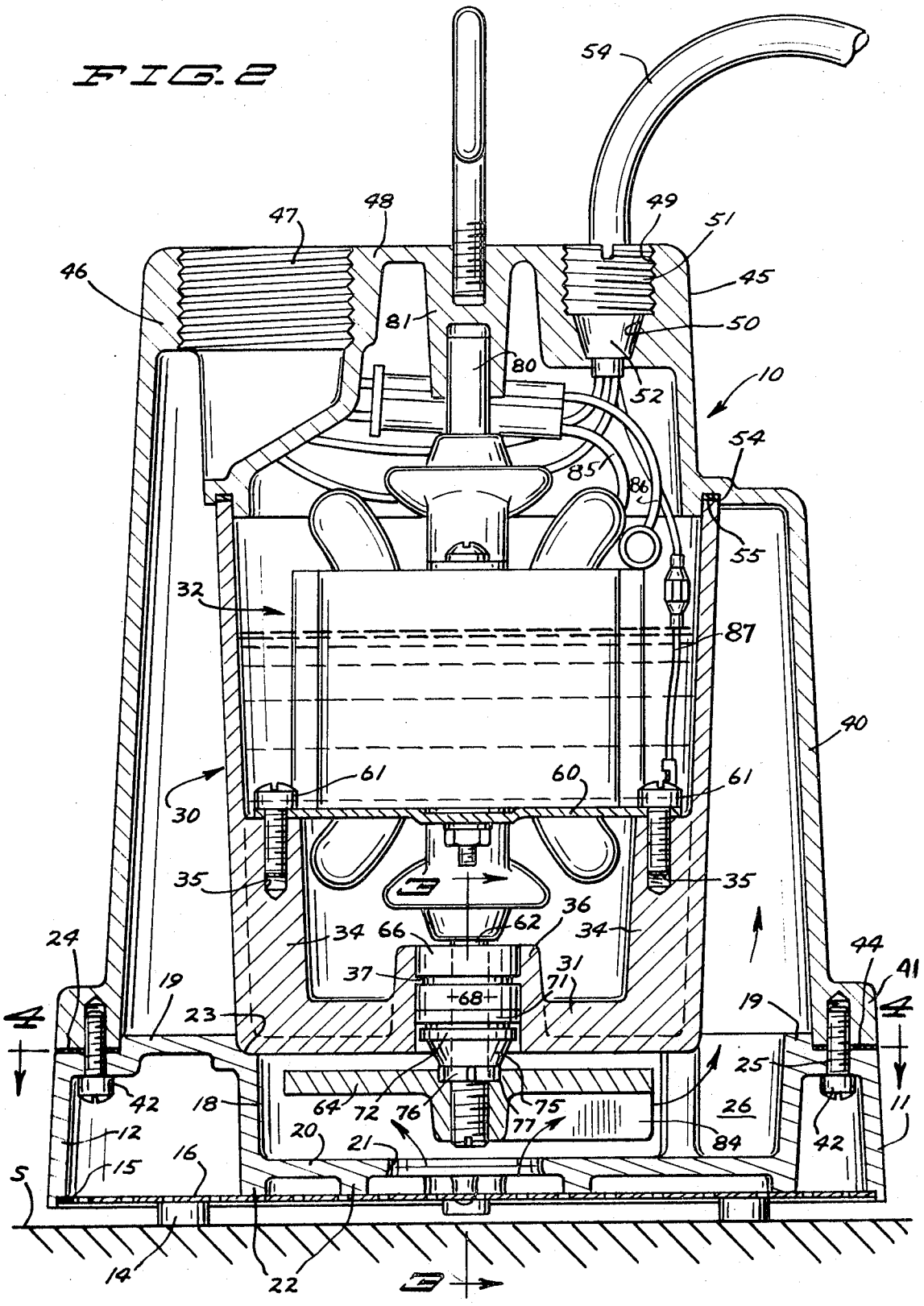


FIG. 5

2 Sheets-Sheet 2

FIG. 2



SUBMERSIBLE PUMP

BACKGROUND OF THE INVENTION

Submersible pumps are commonly used for evacuating or circulating water from a compartment, vessel or the like in which the water has been deposited. Generally such pumps are driven by an electric motor disposed within an oil bath in a sealed housing with heat from the motor being carried off through the housing to the surrounding body of water. However, this means of cooling becomes ineffective when the water level descends to a plane where it is surrounding only the lower portion of the housing.

Also many submersible pumps have their liquid inlet at such a height as to be ineffective in removing substantially all of the liquid from the vessel in which it has been deposited.

Moreover, it is desirable that a submersible pump impeller be driven by a low torque motor and inasmuch as there are an accumulation of variable tolerances between the impeller and motor, it is desirable that means be provided for properly positioning a water seal on the drive shaft extending from the motor to the impeller to enable performance of the low torque motor.

It is also desirable to provide a pump construction of such a design as to enable the pump housing members to readily be molded or die cast of inexpensive materials.

SUMMARY OF THE INVENTION

The principal object of the present invention is to provide an improved submersible pump adapted to withdraw liquid from a level down to the near bottom of a vessel or the like which utilizes the liquid to cool the pump motor even when the liquid level is well below the motor.

With these and other objects in view the invention broadly comprises a submersible pump having a liquid inlet spaced closely adjacent to the bottom of the pump, an impeller for drawing liquid through the inlet, an electric motor for driving the impeller, a liquid jacket surrounding the motor and having communication with the inlet, and a liquid outlet at the top of the jacket whereby liquid passing upwardly through the pump jacket will withdraw heat from the motor. The invention is further characterized by positioning said outlet and the communication between the inlet and jacket on diametrically opposing sides of the motor shaft axis. There is also provided a seal on the motor shaft with a positioning means to adjust for shaft tolerances enabling effective use of a low torque motor.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is an elevation view of the pump.

FIG. 2 is a vertical section taken diametrically through the pump housing on line 2—2 of FIG. 1 with the motor and certain other internal pump components shown in elevation.

FIG. 3 is an enlarged fragmentary section through the seal between the motor and impeller taken on line 3—3 of FIG. 2.

FIG. 4 is a horizontal section through the pump taken on line 4—4 of FIG. 2 and looking downwardly.

FIG. 5 is a bottom plan view of the pump.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now more particularly to the drawings reference characters will be used to denote like parts or structural features in the different views. The pump is denoted generally by the numeral **10** and is shown in FIG. **1** disposed upon a supporting surface S which may be the bottom of a liquid holding vessel or the like. A cavernous base member **11** has an annular outer wall **12** with depending feet **14** spaced circumferentially around the wall to support the bottom edge of the wall about one-sixteenth of an inch above the surface S. The lower edge of wall **12** is provided with an inwardly opening groove **15** which seats a circular perforated plate **16** which serves as a screen and is secured in place by machine screws **17.**

A circular inwardly opening impeller compartment **18** is formed in the central portion of base **11** and is connected to wall **12** by a top wall **19.** Compartment **18** is slightly offset from the center axis of base member **11,** as shown in FIG. **4,** and has a bottom wall **20** provided with a central inlet opening **21.** Feet **22** depend from wall **20** to rest against screen **16** and prevent inward collapse thereof. An upwardly opening circular seat **23** is provided around the upper edge of compartment **18** concentric with the axis of base member **11.** The upper outer portion of the base member **11** is also provided with an annular seat **24** in the top wall **19** and a plurality of circumferentially spaced screw openings **25** are provided in said wall.

A passageway **26** is formed in base **11** to extend in a generally tangential direction from and opening into the impeller compartment **18.** This passageway connects with compartment **18** adjacent to the side of the compartment closest to the center axis of the base and has a vertical depth equal to that of the compartment.

A generally cylindrical upwardly opening inner or motor housing **30** having a bottom wall **31** is seated in seat **23** formed in base **11.** This housing holds the electric motor denoted generally at **32** to be subsequently described in greater detail. The housing is provided with a pair of diametrically opposing solid portions **34** having upwardly opening internally threaded screw sockets **35** tapped therein. Bottom wall **31** is provided with an upwardly protruding center boss **36** which is coaxially aligned with base **11** when housing **30** is seated in the base. This boss serves as a sea housing and has an annular internally directed partition flange **37** formed integrally therewith.

A cylindrical outer jacket or housing is denoted generally by the number **40.** This housing has an open bottom with a peripheral rim **41** which rests in seat **24** and is secured to base **11** by machine screws **42** which pass upwardly through openings **25** and into threaded sockets in the rim. A sealing jacket **44** is disposed between the rim and the base. Housing **40** has a diametrically reduced dome **45** with an enlarged portion **46** at one side. Portion **46** has an outlet opening **47** extending through the top wall **48** of the housing **40** which opening is internally threaded for connection with a suitable outlet line having an externally threaded coupling.

Diametrically opposite from opening **47** the top wall **48** is provided with another internally threaded opening **49** leading to an internal cone **50** for reception of a pack nut **51** and sealing cone **52** on an electrical line **54.**

The dome 45 of housing 40 provides a closure cover for the inner housing 30 and is provided with a downwardly opening annular groove 54 for receiving a large O-ring seal 55 and the upper rim of housing 30. The tightening of screws 42 pulls housing 40 downwardly against base 11 to compress the ring 55 within groove 54 to provide a liquid-tight seal. Accordingly, dome 45 and inner housing 30 jointly provide a liquid-tight compartment for the electric motor 32. A port (not shown) in top wall 48 closed by suitable plug means is used to admit oil to or drain it from housing 30.

Motor 32 has a mounting plate 60 which rests upon the solid portions 34 of the housing 30 and is secured in place by screws 61 threaded into holes 35. The motor drives the shaft 62 which extends downwardly axially through the opening 63 in boss 36. An impeller 64 is threaded onto the lower end of shaft 62 for rotation within the compartment 18. An annular lip seal 66 encircles shaft 62 and rests upon flange 37 to prohibit downward oil leakage from the housing 30 into the impeller compartment 18. The inner lip of seal 66 is retained against the shaft 62 by means of a spring band 67.

A rotary water seal encircles shaft 62 between the flange 37 and impeller 64. This seal consists of several components positioned in abutting relationship along the shaft. Uppermost of these components is a metal washer 68 which is press fit upwardly into an opening 63 to the desired position. The purpose of washer 68 is to provide an inexpensive way of correcting any accumulation of manufacturing tolerances in the shaft or seal. A fixed seal is disposed within opening 63 in abutting relationship with the washer 68. This seat comprises integrally connected shaft encircling washers 69 and 70 respectively formed of metal and a low friction plastic or ceramic material having a ring 71 of resilient sealing material bonded to the periphery thereof to provide a waterproof seal with the wall of opening 63.

A rotary seal member 72 of low friction plastic material has a peripheral flange 73 and an annular upstanding portion 74 in continuous rotational sealing engagement with washer 70 around shaft 62. Member 72 is yieldably held in pressure engagement with washer 70 by means of a tubular bellows-type retainer 75 of resilient material having its upper portion fitting within flange 73 and a shank portion 76 having circumferentially spaced external protrusions 77. Shank 76 and its protrusions 77 fit into a mating socket 78 formed in the top of impeller 64 so member 75 is irrotatably united with the impeller 64. Member 75 is under slight axial compression so that its upper portion tends to distend within flange 73 into tight frictional engagement with seal member 72.

Accordingly, as shaft 62 and impeller 64 are driven by motor 32 a low friction rotational seal around the shaft is provided between seal seat washer 70 and seal member 72 to prohibit leakage of water from compartment 18 upwardly into the interior of motor housing 30.

Shaft 62 extends upwardly through the motor 32 and has its upper end portion 80 journaled in a bearing portion 81 formed to depend from the center of wall 48. This is to give the motor increased axial support.

Impeller 64 has a pair of diametrically opposing vanes 84 adapted to propel water from compartment 18 into passageway 26 as the impeller is rotated.

The electrical line 54 carries lead wires 85 and 86 connected to motor 32 and a ground wire 87.

It will now be understood that as the pump is operated in a water or other liquid retainer having a bottom S, the liquid will be drawn upwardly through the perforated plate 16 and through opening 21 into compartment 18, then forced by the impeller 64 through passageway 26 and into the outer housing 40 which forms a jacket around the inner housing 30. As the liquid moves upwardly in housing 40 to the outlet 47, it will withdraw heat from the housing 30 and thus prevent the motor 32 from overheating. The disposition of passageway 26 and outlet 47 on diametrically opposing sides of the motor axis assures circulation of the liquid around the housing 30 for uniform cooling.

Housing 30 is preferably formed of a light die cast metal or plastic for rapid heat transfer. The efficient cooling permits the use of a high output electric motor.

The journaling of the non-working portion 80 of the drive shaft 62 in the upper portion of the pump housing protects against misalignment of the motor in the event of accidental high impact shocks in handling of the pump.

The housing design permits assembly of the three housing components 11, 30 and 40 in correct alignment merely by installing screws 42, all of which are on a common plane to minimize assembly costs.

As hereinbefore brought out the washer 68 being press fit at any desired position within the opening 63 enables all pumps to have a uniform spacing between the washer 68 and impeller 64 for reception of the liquid seal in spite of a variance in the length of shaft 62.

Having now therefore fully illustrated and described our invention, what we claim to be new and desire to protect by Letters Patent is:

1. In a submersible pump
   a. a base adapted to be supported upon a horizontal surface and having an impeller compartment with an inlet in the bottom thereof spaced above the surface,
   b. a sealed inner housing mounted on the base and enclosing an electric motor having a rotary drive shaft extending downwardly into the compartment and carrying an impeller thereon,
   c. an outer housing mounted on the base and forming a hollow jacket around the sealed housing,
   d. the base having an internal passageway providing open communication between one side of the compartment and the jacket, and
   e. said outer housing having an outlet in the upper portion thereof located in a diametrically opposing position from said passageway relative to the drive shaft whereby as the impeller is driven by the motor liquid will be drawn upwardly through the inlet into the compartment and then forced through said passageway and upwardly through said jacket and around the inner housing to said outlet to withdraw heat from the inner housing.

2. The subject matter of claim 1 wherein said compartment is circular and said passageway extends in a tangential direction from the compartment to the jacket.

3. The subject matter of claim 1 wherein a rotary seal is provided around the drive shaft between the motor and said impeller compartment, and including means for selectively positioning the seal axially of the shaft.

4. In a submersible pump including a pump housing having a downwardly opening impeller compartment in the bottom portion thereof, an electric motor mounted within the housing above the compartment and having a drive shaft extending downwardly through an annular boss in the housing into the compartment and having a liquid impeller mounted on the shaft within the compartment, a rotary seal disposed within the boss and surrounding the shaft between the motor and the impeller, said seal comprising a positioning washer press fit into the boss at a selected position along the shaft, upper and lower seal members of low friction material encircling the shaft below the positioning washer with the upper seal member irrotatably fixed to the washer, a bellows type retainer of resilient material encircling the shaft and held under axial compression between and irrotatably fixed to the lower seal member and the impeller to retain the upper and lower seal members in rotational sealing engagement.

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