

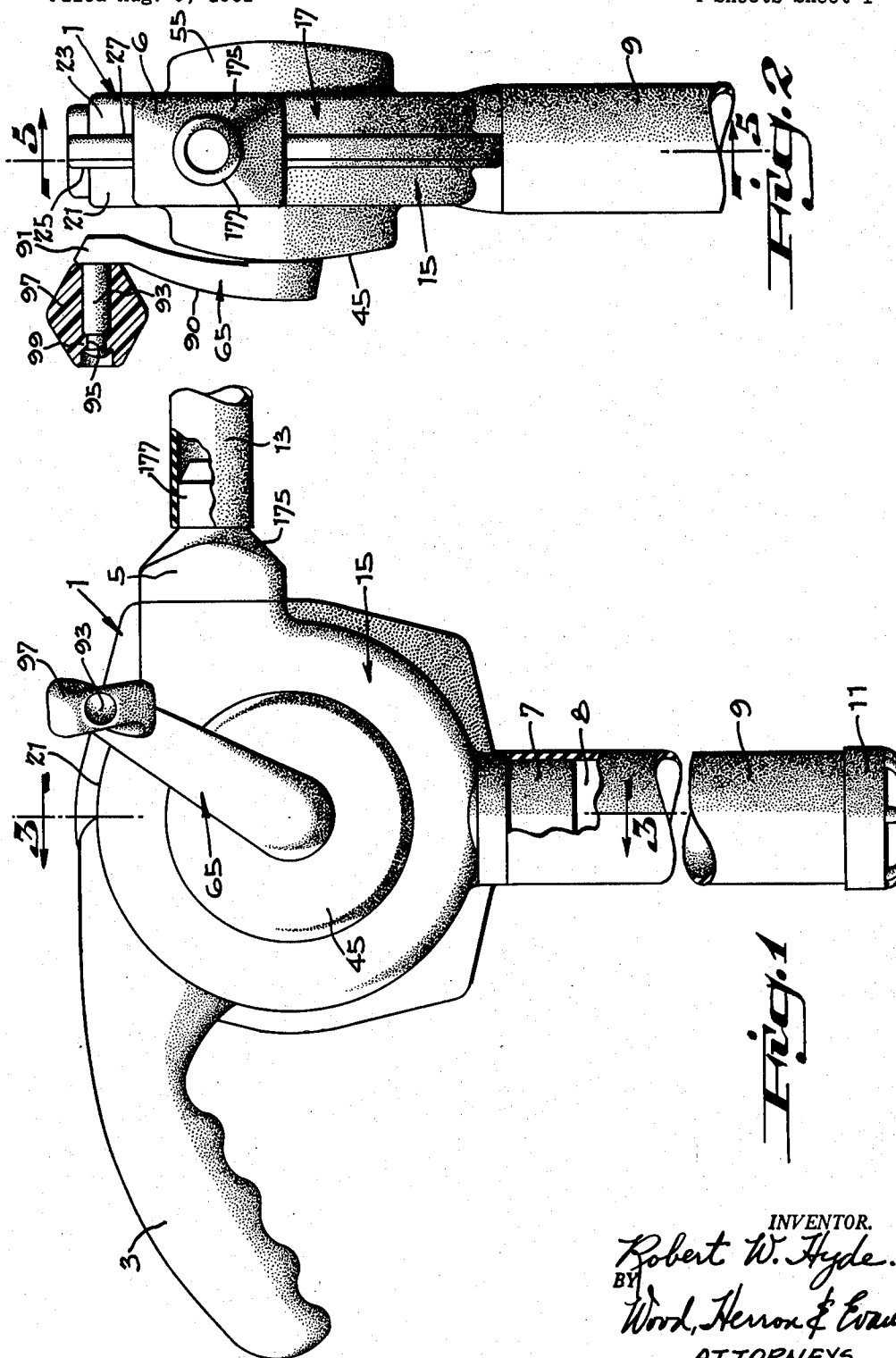
June 18, 1963

R. W. HYDE
PUMP ASSEMBLY

3,094,076

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4 Sheets-Sheet 1



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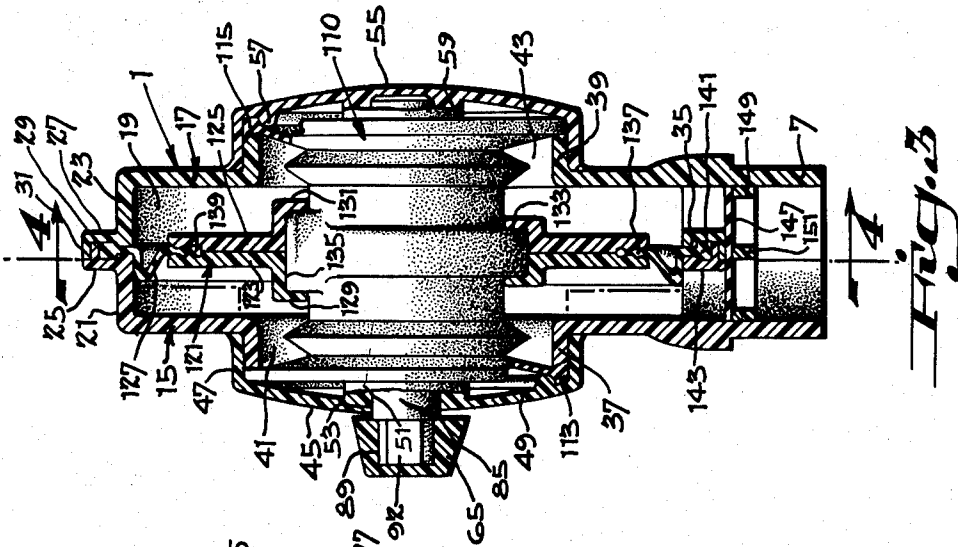


Fig. 3

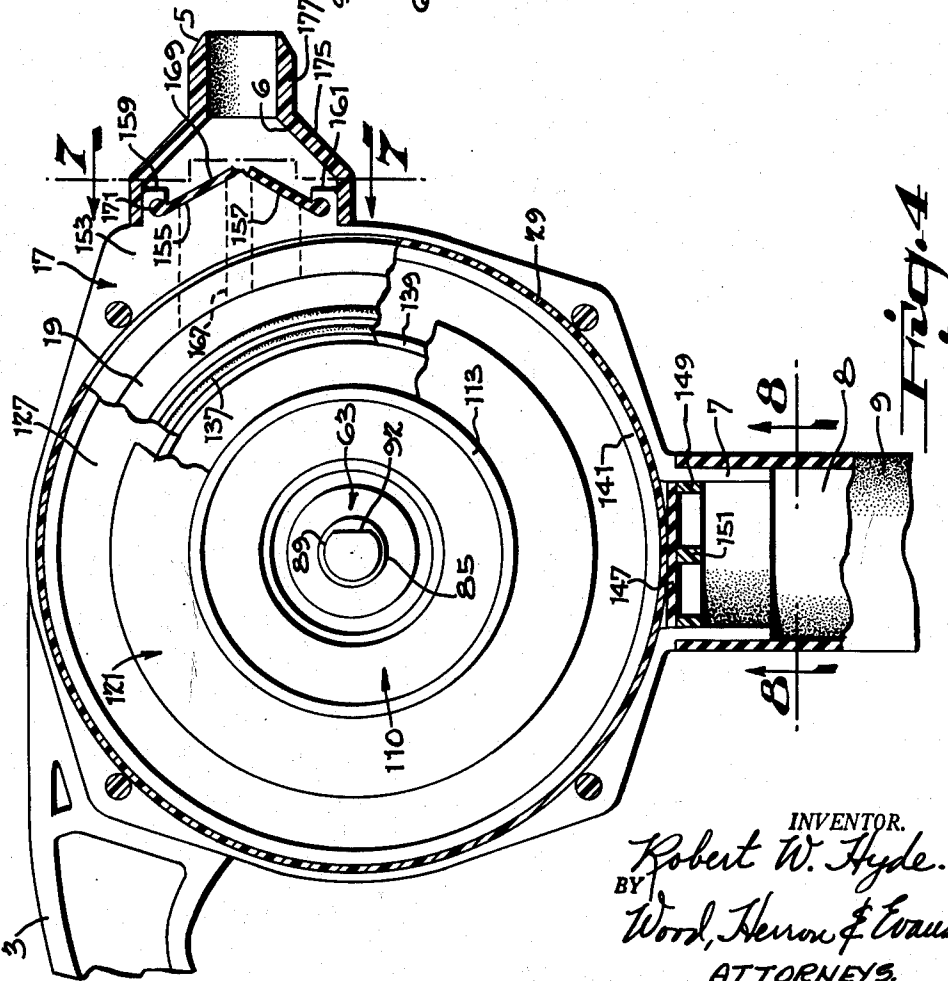


Fig. 4

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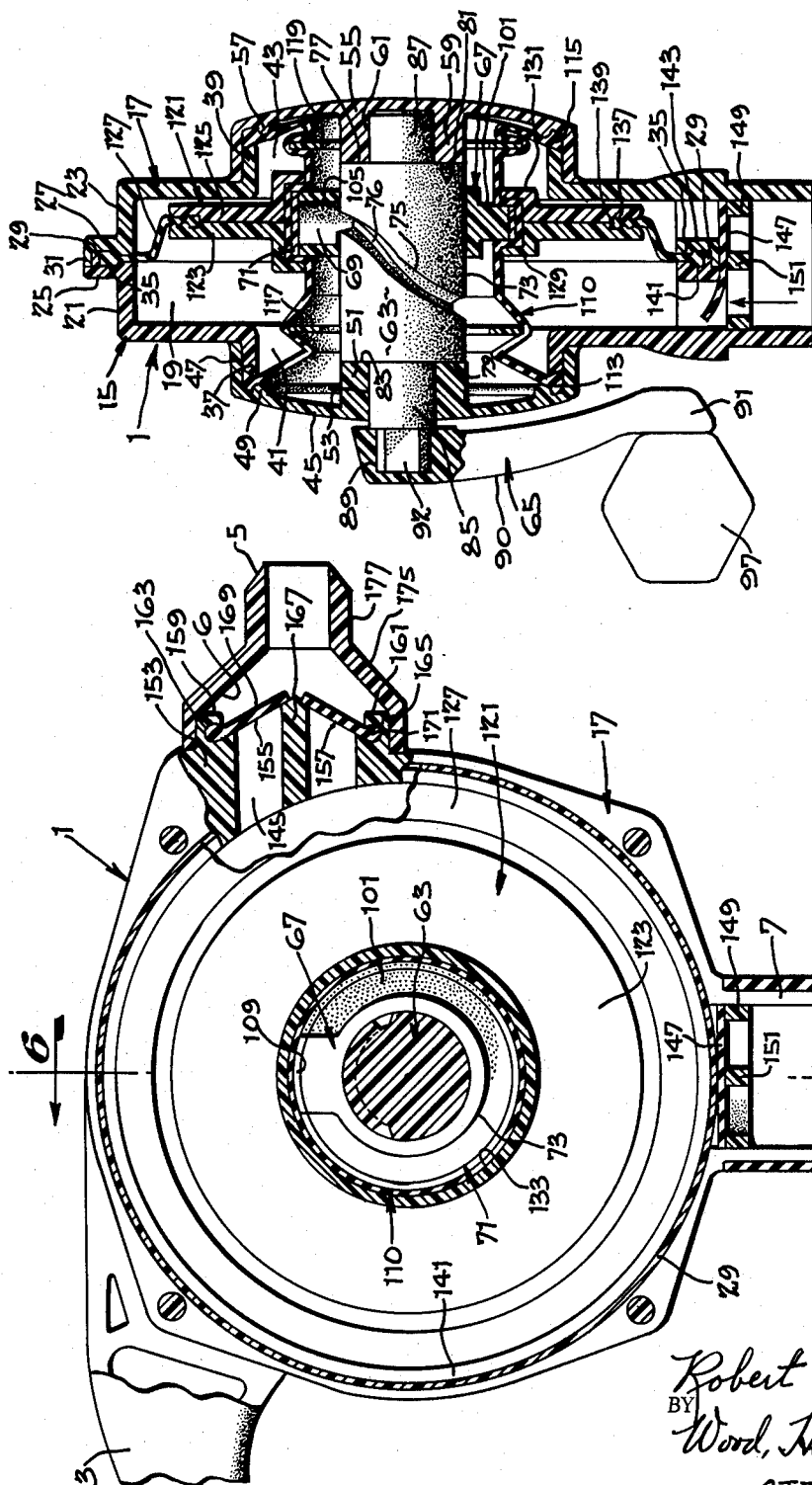


Fig. 5

Fig. 6

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PUMP ASSEMBLY

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11 Claims. (Cl. 103—150)

This invention relates to pumps, and it is directed particularly to an improved diaphragm pump.

One of the objectives of the invention has been to provide an inexpensive, compact, lightweight, trouble-free pump for use by the owners of small boats for such jobs as pumping bilge water, transferring fuel, aerating live boxes, pumping water to and from storage tanks, bailing and others. For this reason, the invention is disclosed in relation to a pump for small boats, but it will be apparent that the principles of the invention are applicable to pumps designed for other uses. Additionally, the invention is disclosed in relation to a hand cranked, portable pump, but it will be apparent that it may be power driven and that it may be mounted in a fixed location if desired.

A typical diaphragm pump requires some sort of push-pull mechanism to move the central part of the diaphragm back and forth within the pump chamber. Such a pump may be double acting. That is, movement of the diaphragm in one direction pulls fluid into the chamber at one side of the diaphragm while simultaneously forcing fluid from the chamber at the other side of the diaphragm. An action of this type is preferred in the pump of this invention. However, with slight modification it is capable of single action operation; that is, an operation in which fluid is moved through the chamber at one side only of the diaphragm.

One of the main features of the pump of this invention is the provision of a unique actuating mechanism which converts simple rotary motion into the push-pull motion required in a diaphragm pump. Thus, the pump is readily adapted to be driven by an electric motor, or, as in the embodiment disclosed here, it may be driven by means of a simple hand crank. The mechanism provided consists essentially of a rotatable cam shaft which extends axially through the center of the pump. The cam shaft has an endless helical groove in it. A cam follower, which includes a pin engaged in the groove, is caused to reciprocate lengthwise of the cam shaft as the cam shaft rotates. The diaphragm surrounds the cam shaft with its central portion secured to the cam follower, so that it is moved back and forth within the chamber as the cam shaft is rotated. This arrangement has the advantage that it is exceedingly compact. The pump of the embodiment disclosed here may be only approximately four inches wide, which includes the hand crank, and the other two dimensions may be approximately six inches by ten inches, the latter dimension including a handle which projects from the body of the pump. The pump, therefore, requires little space for storage or mounting.

Another objective has been to provide a pump of the type set forth which is not subject to corrosion or fouling. In the fulfillment of this objective, the pump, in the preferred embodiment is constructed of corrosion resistance plastic materials which have the added advantage of being lightweight and shockproof. Additionally, all working parts, with the exception of the diaphragm are sealed with respect to the fluid being pumped. Thus, the pump may be used for salt water or other corrosive fluids. Sand and grit have no effect upon it, and the sealed construction permits the use of a permanent lubricant for all moving parts, insuring that the lubricant is not washed or dissolved away from these parts during operation of the pump.

Other objectives and advantages of the invention will be

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apparent to those skilled in the art from the following description and drawings in which:

FIGURE 1 is a front elevation of the boat bailing pump of the invention.

FIGURE 2 is an end elevation of the pump as seen from the outlet end.

FIGURE 3 is a cross sectional view taken along the line 3—3 of FIGURE 1.

FIGURE 4 is a cross sectional view taken along the lines 4—4 of FIGURE 3.

FIGURE 5 is a cross sectional view taken along the lines 5—5 of FIGURE 2.

FIGURE 6 is a cross sectional view taken along the lines 6—6 of FIGURE 5.

FIGURE 7 is a cross sectional view of the outlet orifice of the pump taken along lines 7—7 of FIGURE 4.

FIGURE 8 is a cross sectional view of the intake orifice of the pump taken along the lines 8—8 of FIGURE 4.

FIGURE 9 is an exploded perspective view of the cam actuator and follower mechanism of the pump.

Referring to the drawings in more detail, it will be seen that the pump of this invention comprises a substantially flat, generally circular, housing 1 having a handle 3 extending from one side thereof. The housing is made from two mating shells which are substantially identical in shape. Extending from the side of the housing which is opposite the handle 3 is an outlet extension 5 having a rectangular outlet orifice 6 therein which opens into the hollow interior or cavity 19 of the housing. A hose 13 may be attached to the outlet extension 5. Depending from the bottom of the housing is an intake extension 7 over which is fitted one end of a rigid plastic tube 9. The intake extension has a circular intake orifice 8 therethrough which opens into the housing cavity 19. Mounted over the opposite end of the hose is a plastic guard 11 which serves to prevent the intake of foreign objects into the pump and which spaces the end of the hose from the bottom of the boat in use. Referring to FIGURE 3, it will be seen that the housing 1 comprises a front plate 15 and rear plate 17 between which is formed the cavity 19. The cavity 19 is closed at the periphery thereof by an inwardly extending flange 21 on the front plate 15 and an inwardly extending flange 23 on the back plate 17. Each of these flanges in turn has peripheral members 25 and 27 extending radially outwardly at the inside edge thereof around the edge of the housing and across the intake and outlet extensions. Extending inwardly from the extending peripheral member 25 is a lip 29 which is engaged by an overlying lip 31 on the peripheral member 27. The peripheral member 25 of the front plate has four equally spaced locating lugs 28 thereon which are received in four locating recesses (not shown) on the rear plate peripheral member when the plates are assembled. Defined between the peripheral members 25 and 27 is a substantially annular T slot 35 which extends completely around the housing. Extending outwardly from the front plate 15 is an annular flange 37 and similarly, extending outwardly from the rear plate 17 is an annular flange 39. Each of the annular flanges 37 and 39 defines therewithin opposed open annular apertures 41 and 43 respectively.

Fitted over the front plate annular flange 37 is an annular cap 45 having an inwardly extending flange 47 at the periphery thereof, which flange overlays the annular flange 37 and abuts against the front plate 15. Extending inwardly from the inside surface near the edge thereof, the cap has an annular rib 49. Near the central portion of the cap and extending inwardly therefrom is a hub 51. At the center of the cap 45 is an aperture 53 which passes through the center of the hub 51.

Fitted over the annular flange 39 of the rear plate is

a cap 55 similar to the cap 45. Extending inwardly from the inside of the cap is an annular rib 57 and an annular hub 59. Referring to FIGURE 6, it will be seen that the hub 59 has a closed annular recess or bearing surface 61 therein.

Referring to FIGURES 3, 5, 6 and 9, it will be seen that the reciprocating mechanism of the invention comprises a stepped cam shaft 63, a crank 65, a cam follower sleeve 67, a cam follower pin 69 and a cam follower closure ring 71.

The cam shaft comprises four stepped portions. The largest portion 73 carries a reverse, endless, helical cam groove 75. The walls of the cam groove 75 taper inwardly to a flat bottom surface 76. The cam carrying portion 73 of the cam shaft is received between the hub 51 of the front cap 45 and the hub 59 of the rear cap 55 with the radially extending sides 77 and 79 of the cam carrying portion abutting against the flat sides 83 and 81 of the respective hub portions. Extending axially from the front side of the cam carrying portion 73 of the cam shaft 63, is the front bearing portion 85 of the cam shaft which is received within the bearing aperture 53 of the front cap. A rear bearing portion 87 of the cam shaft is received in the bearing recess 61 of the rear cap. A crank receiving portion 89 of the cam shaft extends axially from the front bearing portion 85 of the cam shaft and has a flat surface 92 thereon.

The crank 65 is fixed to the handle receiving portion 89 of the cam shaft 63 and extends radially therefrom. Referring to FIGURES 2 and 6, it will be seen that the crank 65 has a curved, radially inwardly extending portion 90, and a straight portion 91. Fixed to the portion 91 of the handle and extending outwardly therefrom, is a shaft 93 having an annular groove 95 therein. The gripping portion 97 of the handle is rotatably journaled on the shaft 93 and has an annular rib 99 extending into the annular groove of the shaft portion of the handle.

The cam follower assembly consists of annular cam follower sleeve 67, cam follower pin 69, and cam follower closure ring 71.

The cam follower sleeve 67 is loosely journaled upon the cam shaft 63. As will be clearly seen in FIGURE 9, the axial length of the sleeve 67 is approximately one-third the length of the cam carrying portion of the cam shaft. Extending radially from the periphery of the sleeve is an annular flange 101. At one side of the sleeve and on the periphery thereof, the flange 101 has axial protrusions 103 and 104 thereon which extend from both sides of the flange the length of the sleeve and the sides of which are parallel to the axis of the sleeve. Rotatably journaled in an aperture 105, which passes through the sleeve at the center of the flange at the point where the flange is enlarged by the protrusions 103, 104, is the cam follower pin 69. A truncated inwardly extending tapered portion 107 depends from the bottom surface of the cam follower pin 69. The tapered sides of portion 107 are flat and are received within the cam slot 75 of the cam shaft. Press fitted over the flange 101 of the cam follower sleeve 67 is the closure ring 71. The closure ring has axial extending protrusions 109, 111 thereon which mate with and cover the protrusions 103, 105 of the sleeve flange 101 to hold the cam follower pin 69 within the cam follower sleeve.

Because the cam follower pin is made of plastic material, the cam surface engaging walls of the cam follower pin 69 are made flat in order to provide a large area of bearing contact. Additionally, these flat surfaces spread the load on the pin over a larger area in order to prevent deformation of the pin.

A rubber bellows sleeve 110 is received over the reciprocating mechanism and extends between the front and rear plates. The bellows sleeve serves to prevent the water or medium being pumped from entering the reciprocating mechanism.

At the ends of the bellows sleeve are rims 113, 115 of

increased cross sectional area. The bellows sleeve rims are sealed between the ends of the annular flanges 37, 39 of the front and rear plates, the sides of the caps 44, 55, and the annular ribs 49, 57. Two annular rings 117 and 119 are fitted within the bellows and serve to prevent the collapse of the thin side walls of the bellows.

Referring to FIGURE 6, it will be seen that between the ends, the bellows sleeve is received over and tightly fitted against the walls of the flange 101 of the cam follower sleeve and the closure ring 71. The bellows sleeve is held in position over the reciprocating mechanism by the diaphragm assembly 121, which prevents rotation of the cam follower while permitting reciprocation thereof.

The diaphragm assembly 121 consists of a front annular plate 123, a rear annular plate 125 and a rubber diaphragm 127. At the inside edge, the front and rear plates 123, 125 have outwardly and inwardly extending annular flanges 129 and 131 which, in each instance, define a circular recess 133. The circular recess 133 has an enlarged recess area 135 which fits over the protrusions 103, 105 of the cam follower sleeve. The plates thus fit over the flange of the cam follower sleeve to seal the bellows thereto and also connect the plates to the reciprocable cam follower mechanism. At the peripheral edge, the plates form an annular radially extending T slot 137.

The rubber diaphragm 127 extends between the peripheral edges of the plates 123, 125 and the inside edge of the housing. Since the diaphragm 127 extends completely around the plates, it divides the annular cavity 19 into front and rear sections. As may be seen in FIGURES 5 and 6, the diaphragm 127 has an inside rim 139 and an outside rim 141 of increased cross sectional thicknesses which are received in the T slot 137 between the plates and the T slot 35 of the housing, respectively.

Referring to FIGURES 5, 6, 7 and 8, it will be seen that the intake orifice 8 is bisected by an extension 143 of the peripheral members 25, 27 which extends diametrically across the intake orifice. Seated upon the extension 143 is an annular rubber flapper 147, the diameter of which is equal to or slightly smaller than the diameter of the intake orifice 8. The flapper 147 is held in position against the extension 143 by a washer 149 glued or otherwise secured in the orifice. Two cross bars 151 extend diametrically across the washer and are so located that one of the cross bars is seated immediately under and parallel to the extension 147 while the other cross bar is normal to the first. This arrangement permits the flapper 147 to bend inwardly on either side of the extension 147 while prohibiting it to bend outwardly so that it acts as a one way valve.

The outlet orifice 6 is rectangular in cross section and passes through the rectangular projection 153 on the housing 1. As may be clearly seen in FIGURE 5, the front walls 155 and 157 of the rectangular projection 153 taper outwardly from the top and bottom thereof. The tapered walls are overhung by lips 159 and 161 which form open, arcuate recesses 163 and 165 respectively. The outlet orifice in the housing is bisected in the vertical plane by an extension 145 of the peripheral members 25, 27 which extends across the orifice and, in addition, is bisected in the horizontal plane by a cross member 167. The vertical extension 145 and horizontal cross member 167 thus divide the outlet orifice into four separate openings, each of which opens into the housing cavity 19. Located over each of these four outlet orifice openings are four rectangular elastomeric flapper members 169. An enlarged edge portion 171 on one side of the two upper flapper members is received in the recess 163 while the lower edges of these two flapper members abut against the cross member 167. In a similar manner, the two lower flapper members have an enlarged edge portion 171 received in the recess 165 and an opposite edge portion abutting against the cross member 167. The flapper members thus operate as one way valves to permit the outlet of the medium being pumped but to prohibit the inflow of air.

A hollow nozzle 175 having a rectangular end portion fits over and is glued or otherwise secured to the rectangular outlet projection 153 of the housing. The sides of the rectangular portion of the nozzle are tapered inwardly to a circular front portion 177 having an outlet orifice 179 therein. The circular portion 177 of the nozzle may be fitted with a hose 13 if so desired.

The operation of the pump should be readily apparent from the above detailed description. Upon rotation of the crank 65, the cam shaft 63 having the endless reverse helical cam groove 75 therein is caused to rotate. This rotary movement is translated into reciprocating movement of the cam follower via the cam follower pin 69 which is engaged in the cam groove 75. Reciprocation of the cam follower, in turn, causes reciprocation of the impeller 121 which is mounted thereon. As the diaphragm moves to the rear or right side as viewed in FIGURE 6, a vacuum will be created on the front or left side which will tend to pull the water or medium being pumped into the left side through the one way valve in the inlet orifice. As the impeller moves to the front or left side, the water which has been pulled into this side will be forced out through the outlet orifice 6 via the two outlet openings on the left side of the pump. The same type of pumping action takes place on the right or rear side of the pump.

An important consideration in the construction of the pump disclosed is that all operating parts are permanently sealed within the housing. The two diaphragm plates 123, 125, the two shells 21, 23 of the housing, the two caps 45, 55, the crank 65, nozzle 5 and the parts of handle 3 are made of that type of lightweight, shock resistant plastic material, which is adapted to be solvent welded to itself. Thus, the two plates 123, 125 are adapted to be solvent welded to one another interfacially, which locks the inner marginal edge of the diaphragm 127 to the assembled plates. This also locks the bellows and the cam follower assembly to the plates. The rim portions of the two shells are also solvent welded to each other and the outer marginal edge of the diaphragm permanently locked between them. The caps are similarly solvent welded onto the shells, which locks the two ends of bellows 110 in place and which completely seals off the cam and follower assembly from the pump chamber. Thus permanent lubricant, placed within the bellows on the cam and follower parts at the time of assembly, is isolated from the fluids being pumped and remains on these parts for the life of the pump.

The handle 3, as is apparent from FIGURE 4, preferably is made of two mating halves which are hollow and which are solvent welded to one another and to the housing. It is found that the hollow handle, plus the lightweight nature of the plastic materials utilized, makes the assembled pump buoyant, thereby avoiding the danger of loss of the pump should it be dropped overboard.

It will be seen, therefore, that I have provided a pump which is ideally suited for use in light boats, and one which, due to the use of molded plastic parts, is adapted to be manufactured and sold at a lower cost than the pumps heretofore available for use by boating enthusiasts.

It will be understood that the above detailed description is made by way of illustration and not limitation, it being contemplated that modifications in the details of the invention may be made without departing from the scope of the appended claims.

Having described my invention, I claim:

1. A pump comprising, a housing having inlet and outlet means therein, impeller means mounted within said housing, shaft means journaled within said housing, a reverse endless cam groove in said shaft means, a follower sleeve mounted on said shaft means and connected to said impeller means, a follower pin depending from said follower sleeve and engaged with said cam groove whereby upon rotation of said shaft said impeller is caused to reciprocate within said housing, and an impervious sleeve between the impeller means and the follower sleeve, the

ends of said impervious sleeve being sealed to opposing walls of said housing, whereby a medium being pumped is prevented from contacting the follower sleeve and pin.

2. A pump comprising a housing having inlet and outlet means therein, reciprocating means including means to translate rotary movement into reciprocating movement mounted within the housing, impeller means mounted within said housing and connected to the reciprocating means, and an impervious bellows sleeve mounted between said reciprocating means and said impeller means and having the ends thereof sealed to opposing walls of said housing, whereby a medium being pumped will not come into contact with said reciprocating means.

3. A pump comprising a housing having inlet and outlet means therein, shaft means journaled in said housing and having cam means thereon, cam follower means mounted on said shaft means, impeller means mounted within said housing and connected to said follower means, and an impervious sleeve mounted between said follower means and said impeller means and having the opposite ends thereof sealed to opposing walls of the housing, whereby a medium being pumped will not come into contact with said cam means and cam follower means.

4. A pump assembly comprising a housing having an inlet and an outlet opening therein, a check valve in operative association with each of said openings, a shaft rotatably journaled in said housing and having an endless reversing cam groove therein, a cam follower sleeve slidably mounted on said shaft, a cam follower pin slidable in the groove and in operable engagement with said sleeve to reciprocate said sleeve upon rotation of said shaft, a flexible impervious sleeve surrounding said shaft and cam follower, the ends of said sleeve being sealed to opposing walls of said housing, a piston mounted over said flexible sleeve and operatively connected to said cam follower sleeve so as to reciprocate therewith, and a diaphragm connected to said piston and having its peripheral edge portion sealed to said housing.

5. The pump assembly defined in claim 4 wherein a handle extends outwardly from said housing.

6. The pump assembly defined in claim 4 wherein the cam follower pin is rotatably journaled in the cam follower sleeve and has flat side walls in engagement with said cam groove.

7. The pump assembly defined in claim 4 wherein said check valves comprise flexible flapper valves.

8. A pump assembly comprising a housing having inlet and outlet means therein, check valve means in operative association with said inlet and outlet means, a shaft rotatably journaled in said housing and having an endless reversing cam groove therein, a cam follower sleeve slidably mounted on said shaft, a cam follower pin slidable in the groove and in operable engagement with said sleeve to reciprocate said sleeve upon rotation of said shaft, a flexible impervious bellows sleeve surrounding said shaft and cam follower, the ends of said sleeve being sealed to opposing walls of said housing, rigid annular rings within said bellows sleeve to prevent the collapse thereof, a piston mounted over said flexible sleeve and operatively connected to said cam follower sleeve so as to reciprocate therewith, and a diaphragm connected to said piston and having its peripheral edge portion sealed to said housing.

9. A pump assembly comprising a housing having inlet and outlet means therein, check valve means in operative association with said inlet and outlet means, a shaft rotatably journaled in said housing and having an endless reversing cam groove therein, a cam follower sleeve slidably mounted on said shaft, a cam follower pin slidable in the groove and in operable engagement with said sleeve to reciprocate said sleeve upon rotation of said shaft, a flexible impervious sleeve surrounding said shaft and cam follower, the ends of said impervious sleeve being sealed to opposing walls of said housing, a piston mounted over said flexible sleeve and operatively connected to said cam

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follower sleeve so as to reciprocate therewith, and a diaphragm connected to said piston and having its peripheral edge portion sealed to said housing.

10. A pump assembly comprising a housing having an inlet and an outlet opening therein, a check valve in operative association with each of said openings, a shaft rotatably journaled in said housing, a sleeve slidably mounted on said shaft, cam means in operative association with said shaft and said sleeve whereby said sleeve is caused to reciprocate upon rotation of said shaft, an impervious sleeve surrounding said shaft and said first mentioned sleeve, said impervious sleeve having the ends thereof sealed to opposing walls of said housing, a piston mounted over said flexible sleeve and operatively connected to said first mentioned sleeve so as to reciprocate therewith, and a diaphragm connected to said piston and having its peripheral edge portion sealed to said housing.

11. A pump assembly comprising a housing, a shaft rotatably journaled in opposing walls of said housing, a sleeve slidably mounted on said shaft, cam means in operative association with said cam and said sleeve, whereby said sleeve is caused to reciprocate upon rotation of said shaft, a flexible impervious sleeve surrounding said shaft and said first mentioned sleeve and having the opposite ends thereof sealed to said opposing walls, a piston mount-

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ed over said flexilbe sleeve and operatively connected to said first mentioned sleeve to reciprocate therewith, a diaphragm connected to said piston and having its peripheral edge sealed to said housing in a plane normal to the axis of said shaft to divide the interior of said housing into two chambers, two inlet openings having check valves associated therewith, said inlet openings disposed in paired relationship at opposite sides of said diaphragm in the lower part of the housing, two outlet openings having check valves associated therewith, and said outlet openings disposed in paired relationship at opposite sides of the diaphragm in the housing and in spaced relationship to said inlet openings.

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