June 26, 1962 D. S. CUSHING 3,040,663

TWO-WAY VALVELESS PUMP

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FIG. 1

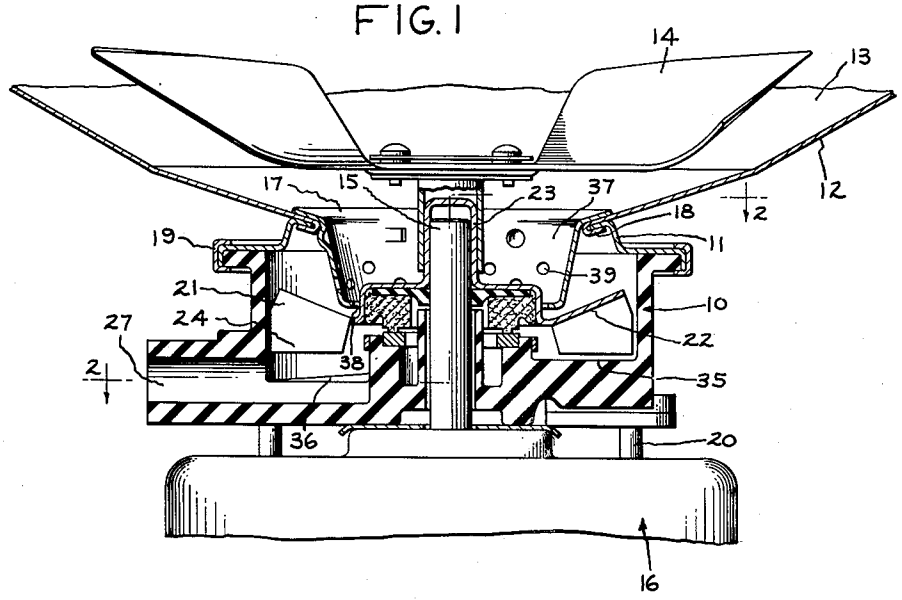
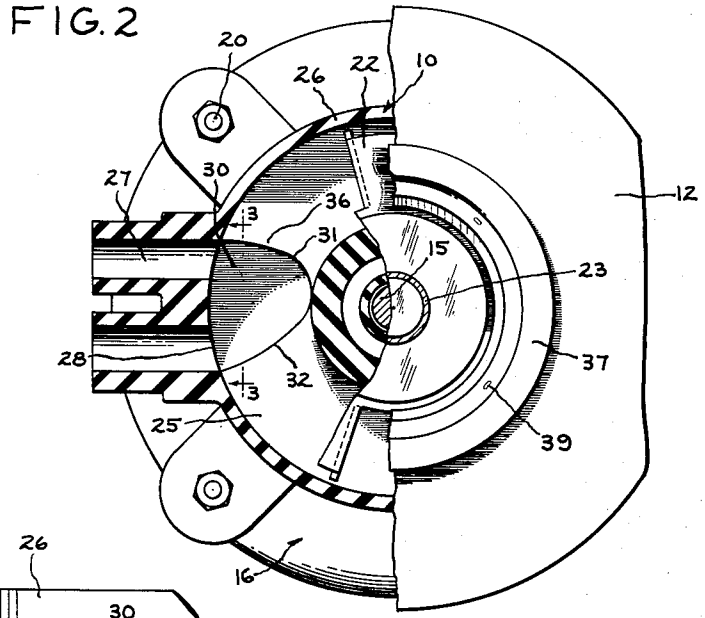



FIG. 2



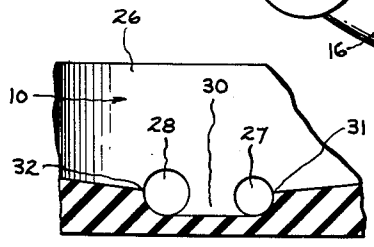




FIG. 3

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FIG. 4

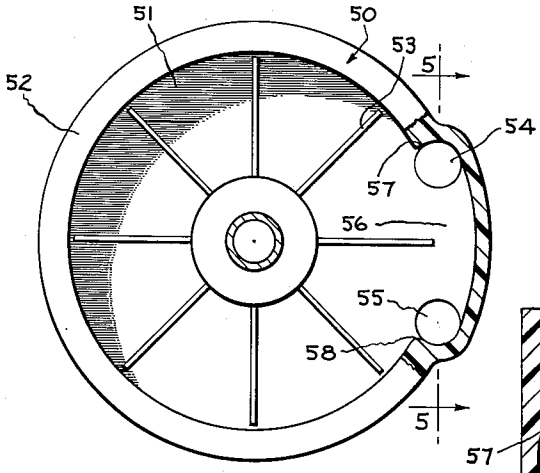
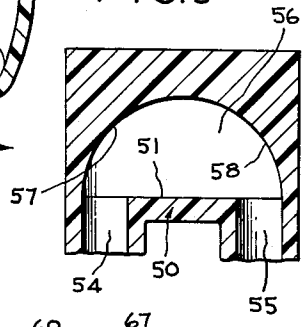



FIG. 5



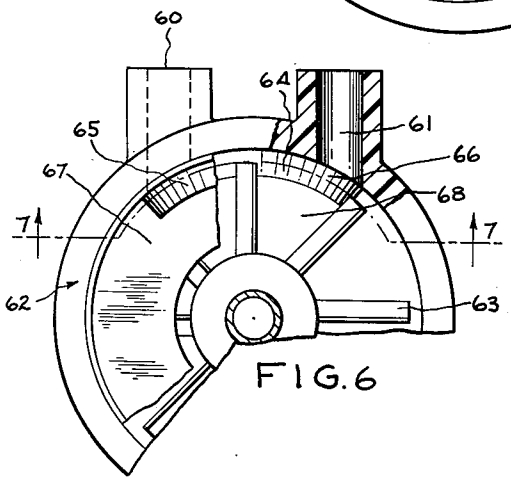




FIG. 6

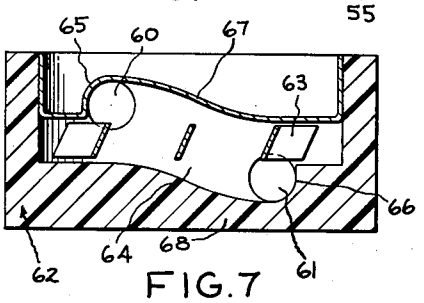



FIG. 7

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# TWO-WAY VALVELESS PUMP

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9 Claims. (Cl. 103—2)

The present invention relates to the two-way pumping action of a reversible pump where there are no valves for opening and closing the discharge ports. This invention is directed toward pump structure per se but it is particularly advantageous as the drain pump of an automatic dishwasher.

Two-way pumps have been known in the art for many years but as a general rule they have all included a valve arrangement for alternately opening and closing the two discharge ports so that only one port will be open at a time. These pumps work satisfactorily when new but the more moving parts that are included in a design the more chance for wear to take place and for failure to occur. An optimum design for a pump would be one having the least number of moving parts.

The principal object of the present invention is to provide a two-way valveless pump with two discharge ports that are alternatively opened and closed in opposition to each other depending upon the direction of rotation of the pump impeller.

A further object of the present invention is to provide a two-way valveless pump where the discharge ports are combined with a sump that serves to direct the flow of water through one port while stopping any flow through the other port.

The present invention has several modifications but the preferred embodiment comprises a pump housing having a bottom wall, a circular side wall and a top wall having a central opening formed therein that cooperate to define a pump chamber with an inlet. A multi-bladed impeller is rotatably mounted about a central axis of the chamber and it is capable of being driven in either a clockwise or a counterclockwise direction. The side wall of the housing includes a pair of closely spaced discharge ports that are arranged adjacent the periphery of the impeller so as to extend out from the chamber generally transverse to the flow of liquid caused by the impeller. The bottom wall of the housing is recessed in the vicinity of the two discharge ports so that the ports are respectively positioned within the recess at opposite circumferential ends of the recess. In effect, the recess forms a sump which constitutes a minor part of the wall within which the recess is formed. The junction of the sump and the remainder of the chamber forms arcuately shaped side walls or dams that are joined with the outermost sides of the two discharge ports for directing the flow of water into the ports. As is the case with the ports, both dams are disposed generally transverse to the flow of liquid caused by the impeller. Each dam is associated with a port, and is positioned on the side of its associated port which is circumferentially remote from the other of the ports. The rotation of the impeller in one direction will force the water to flow over one dam and into the sump where it will strike the other dam and be directed toward the related discharge port. The flowing of the water over the first mentioned dam will create a low pressure area at the first discharge port thereby preventing flow through that port. The reverse action is obtained when the impeller is turned in the opposite direction.

My invention will be better understood from the following description taken in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

FIG. 1 is a cross-sectional elevational view of a two-way pump embodying the present invention suspended below the bottom wall of the tub of an automatic dishwasher with the drive motor positioned below the pump.



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

FIG. 3 is a fragmentary elevational view looking from the inside of the pump chamber toward the two discharge ports and taken on the line 3—3 of FIG. 2.

FIG. 4 is a second modification of the present invention partly in cross-section showing in plan view the two discharge ports vertically disposed in the bottom wall of the pump housing.

FIG. 5 is a fragmentary elevational view taken on the line 5—5 of FIG. 4.

FIG. 6 is a third modification of the invention showing in plan view the two discharge ports in the side wall of the pump housing, one above and one below the impeller.

FIG. 7 is a cross-sectional elevational view of the third modification taken on the curved line 7—7 of FIG. 6.

Turning now to a consideration of the drawings and in particular to FIG. 1, there is shown a pump **10** embodying the present invention suspended from a collar **11** that is fastened to the underside of a tub **12** of an automatic dishwasher. While this invention is illustrated as being incorporated in an automatic dishwasher it should be appreciated that the invention has general utility in the pump art; and the use to which the invention is to be put is not to be considered as a limitation of the invention. The bottom wall of the tub **12** is generally conical or funnel shaped to form a sump **13** in which is positioned a wash impeller **14** for paddling the water in the sump upwardly through the dish racks (not shown) in the tub and scouring the soil from the load of dishes. The wash impeller **14** is fastened on the vertical shaft **15** of a drive motor **16** of the dishwasher. The bottom wall of the tub **12** is provided with a drain opening **17** for emptying the water in the sump axially into the pump **10**. The edge of this drain opening **17** is rolled under as at **18** for gripping the collar **11** that is adapted to support the pump housing from the bottom of the tub. A clamping member **19** is used to join the top portion of the pump with the collar **11** as is best shown in FIGURE 1.

The motor **16** is suspended from the pump housing by means of fastening bolts **20** in a conventional manner which will not be described here in detail as it forms no part of the present invention. The shaft **15** of the motor extends through the bottom of the pump housing and upwardly through the drain opening **17** in the tub. This shaft supports both the wash impeller **14** and a pump impeller **21** so that operation of the motor turns both impellers. The wash impeller **14** is a double-bladed impeller while the pump impeller **21** is a multi-bladed impeller having for example five blades. Each blade of the pump impeller **21** has a substantially horizontal supporting portion **22** extending from a hub **23** of the impeller, and a down-turned paddle portion **24**.

Reference will now be made in FIGURES 2 and 3 of the drawing for an understanding of the preferred embodiment of the pump housing. The pump has been illustrated as being made of molded insulating material such as hard rubber, but in actual practice there is a metal insert over which the rubber is molded to form a reinforced rubber housing. Hence there will be no metal-to-metal contact between the motor and the housing and the housing and the tub. The pump housing **10** is generally cylindrical in shape having a bottom wall **25**, circular side walls **26** and an open top portion. The central axis of the cylindrical housing coincides with the rotational axis of the motor shaft **15**.

In this particular dishwasher it is important that the pump be a two-way pump because the pump serves a

dual function of either draining the tub or supplying water to a rotating spray nozzle (not shown) on the underside of the cover of the tub for rinsing the soil from the dishes on the top rack. These two functions do not occur simultaneously but alternately during opposite rotational movement of the motor shaft. As an example, the spray nozzle on the top cover of the tub is to be operated when the wash impeller **14** is turned in the clockwise direction to paddle the water in the sump **13** upwardly into the tub. In other words, water will be spraying upwardly from the bottom of the tub and downwardly from the top of the tub for washing the dishes from two directions. In the reverse direction of rotation when the tub is to be drained, the wash impeller will draw the water toward the sump and out through the drain opening **17** axially into the pump impeller **21**.

Looking at FIGURES 2 and 3 the side walls **26** of the pump housing include a pair of discharge ports **27** and **28** which are closely spaced from each other and are each provided with a nipple over which flexible hoses (not shown) may be installed for carrying off the water that is pumped through the respective ports. Adjacent the inner ends of the discharge ports **27** and **28** is a sump **30** which is formed as a recess in the floor of the bottom wall **25** of the pump housing. This recess or sump **30** is formed with arcuately shaped side walls or dams **31** and **32** which are joined to each other near the center of the bottom wall, and then curve outwardly and toward the outermost sides of the two discharge ports **27** and **28** as is best illustrated in FIGURE 2. Port **27** cooperates with dam **31** while port **28** cooperates with dam **32**. When the pump impeller **21** is turning in the clockwise direction as seen in the plan view of FIGURE 2, the water will spill over dam **32** and flow against the opposite dam **31** causing some of the water to be directed into the discharge port **27** that is connected with a spray nozzle (not shown) in the upper portion of the tub. Simultaneously, the other discharge port **28** will be closed due to a low pressure area at substantially zero pressure above atmospheric pressure that is created by the water spilling over the adjacent dam **32**. Accordingly, when the motor shaft **15** is turning in the clockwise direction the wash impeller **14** will propel some of the water in the sump **13** upwardly into the tub, while the pump impeller **21** will draw off some of the water from the sump and discharge it through the port **27** from which it is carried upwardly to the top of the tub for rinsing the dishes in the top rack.

In the reverse direction, when the motor shaft is turning in the counterclockwise direction the wash impeller **14** will draw the water down through the drain opening **17** and axially into the pump chamber. The drain impeller **21** will cause the water to spill over the dam **31** and against the opposite dam **32** thereby closing port **27** and directing the water through the larger discharge port **28** that carries the water off to a sewer connection.

The top surface of the bottom wall **25** of the pump housing is gradually sloping from a high point **35** shown in FIGURE 1 that is diametrically opposite the two discharge ports **27** and **28** and slopes gradually downward on both sides of the motor shaft toward the sump **30**. The drop in the sloping floor is measured between the high point **35** and a low point **36**, where the sloping floor meets the dam **31**. Notice in FIG. 3 that the tops of the dams are approximately at the mid-height of the two discharge ports **27** and **28**. By varying the relationship between the diameters of the discharge ports, the dam height, and the position of the top of the dam to the top of the discharge port, various pump rates can be obtained. These variations do not materially affect the characteristics of the other discharge port as long as certain minimum physical dimensions are held, depending upon the pump size and the speed of rotation.

In this particular combination where the wash impeller is mounted on the same shaft as the pump impeller there



are different pump feeding characteristics in each direction of rotation of the wash impeller. For example, a vortex is formed by the wash impeller as it turns in the counterclockwise direction to drain the water of the tub into the pump. A pump inlet flow conditioner **37** of substantially conical shape is lowered into the pump through the drain opening **17**. The lower portion of the flow conditioner **37** is provided with a circular opening **38** that is only slightly larger than the hub of the pump impeller **21**. In addition the conical walls of the flow conditioner are provided with a small number of holes **39** for increasing the amount of water that is capable of flowing through the drain opening in the tub and axially into the pump impeller **21**. This flow conditioner **37** directs the inlet flow axially into the central part of the pump impeller and it also prevents small objects such as nuts, bolts, or other hardware from entering the pump and damaging the mechanism.

Turning now to a consideration of the second modification of FIGS. 4 and 5, the pump housing is identified as element **50** having a bottom wall **51**, circular side walls **52** and an open top portion. A pump impeller **53** is positioned in the center of the pump housing for rotation in either a clockwise or counterclockwise direction. In the preferred embodiment of FIGS. 1–3 the two discharge ports extend radially through the side walls from the center of the pump chamber. The second modification has the two discharge ports **54** and **55** extending vertically downward through the bottom wall **51** of the pump chamber. It is important that a sump and associated dams be combined with the discharge ports for controlling the water leaving the pump chamber. A sump **56** is provided in the side walls **52** of the pump housing by locating the discharge ports **54** and **55** in the plane of the cylindrical side wall **52** and then extending the side walls around the two discharge ports so that the sump is actually vertically arranged in one section of the side wall. The dams are of arcuate shape and are formed by the sides of the sump namely at **57** and **58** as seen in FIG. 5. This modification will operate in a manner quite similar to that of the preferred embodiment of FIGURES 1–3. When the pump impeller **53** is turned in the clockwise direction the water will be discharged through the port **55** and port **54** will be closed. When the pump impeller is turned in a counterclockwise direction the water will be discharged from port **54** and the opposite port will be closed.

The third modification of this invention is illustrated in FIGS. 6 and 7. This modification is similar to the preferred embodiment of FIGURES 1–3 in that the discharge ports **60** and **61** extend radially through the side walls of the pump housing **62**. One distinction is that one port **60** is above the pump impeller **63** while the other discharge port **61** is below the impeller as is best seen in the elevational view of FIGURE 7. This modification also has a sump **64** that is formed by a pair of dams **65** and **66** to cooperate with the discharge ports and cause the water to build up at the mouth of each port for passage therethrough. Dam **65** is formed by a dished cover or cap **67** which is fitted into the top of the pump housing **62** as is best seen in FIG. 7. The other dam **66** is formed as a recess in the bottom wall **68** of the pump housing.

Having described above my invention of a valveless two-way pump that is for use with a reversible motor, it should be appreciated by those skilled in this art that an important consideration in this invention is that the performance of each discharge port can be controlled to a large extent independently of the other port by variations in each dam approach angle, dam height, discharge hole size and relative position of the dam to the discharge port. Also variations may be made in the pump impeller such as turning the blades of the pump impeller upwardly instead of downwardly to use the full impeller area for carrying the water, thereby positioning the dis-

charge ports above the impeller for most efficient operation.

Modifications of this invention will occur to those skilled in this art and it is to be understood, therefore, that this invention is not limited to the particular embodiments disclosed but that it is intended to cover all modifications which are within the true spirit and scope of this invention as claimed.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A two-way valveless centrifugal type pump comprising a cylindrical housing with a bottom wall, a circular side wall, and a top wall having a central opening formed therein to define a pump chamber with an inlet, a multi-bladed impeller rotatably mounted about a central axis of said chamber, first and second circumferentially spaced constantly open valveless discharge ports arranged in said housing immediately adjacent the periphery of said impeller, each of said ports being formed to extend generally transverse to the flow of liquid caused by said impeller, a sump formed within said chamber as a recess extending into at least one of said walls thereof and arranged so that said ports are respectively positioned within said sump at opposite circumferential ends thereof, said recess constituting a minor part of the wall within which it is formed, the walls of said sump defining in part first and second upright dams each disposed generally transverse to the flow of liquid caused by said impeller, said first and second dams being respectively positioned adjacent said first and second ports, each of said dams being positioned on the side of its associated port circumferentially remote from the other of said ports, said first dam for one direction of impeller rotation causing a negative pressure within said sump adjacent said first dam so that said first port is also in a location of negative pressure, said second dam for said one direction of impeller rotation diverting the water out through said second port, the effects of said first and second dams on the liquid flow being reversed in the opposite direction of rotation of said impeller.

2. The apparatus defined in claim 1 wherein said two discharge ports are arranged adjacent and parallel to each other.

3. The apparatus defined in claim 2 wherein said two discharge ports extend outwardly through said side wall and said recess is formed in said bottom wall.



4. The apparatus defined in claim 3 wherein said sump is recessed into said bottom wall of said housing and is formed by substantially curved upright side walls extending down from said bottom wall.

5. The apparatus defined in claim 4 wherein part of each port is within said sump and the remainder of each port is above said sump thereby to create almost zero pressure at said first and second ports for said first and opposite directions of impeller rotation respectively.

6. The apparatus defined in claim 1 wherein said inlet to said pump includes a foraminous conically-shaped inlet flow conditioner extending downwardly toward said impeller.

7. The apparatus defined in claim 4 wherein said bottom wall slopes downwardly from a high point opposite said sump in both directions around the center of impeller to said sump.

8. The apparatus defined in claim 1 wherein said ports extend through said bottom wall of said pump housing and the portion of said side wall circumferentially including said ports is recessed to form said sump, the top wall of said sump being substantially semi-circular to provide arcuately shaped dams associated with each of said ports.

9. The apparatus defined in claim 1 wherein said discharge ports are located in said side wall of said housing, said first port being positioned above said impeller and said second port being positioned below said impeller, said sump being formed by a recess in said top wall forming said first dam and a recess in said bottom wall forming said second dam.

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