Dec. 12, 1961 J. M. EVJEN 3,012,429

PUMPING SYSTEM FOR CLOTHES WASHING MACHINES AND THE LIKE

Filed Dec. 19, 1960

FIG. 3

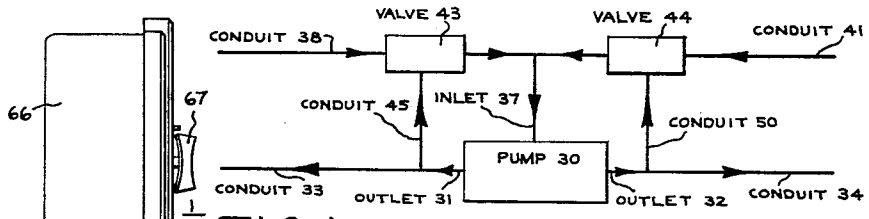


FIG. 1

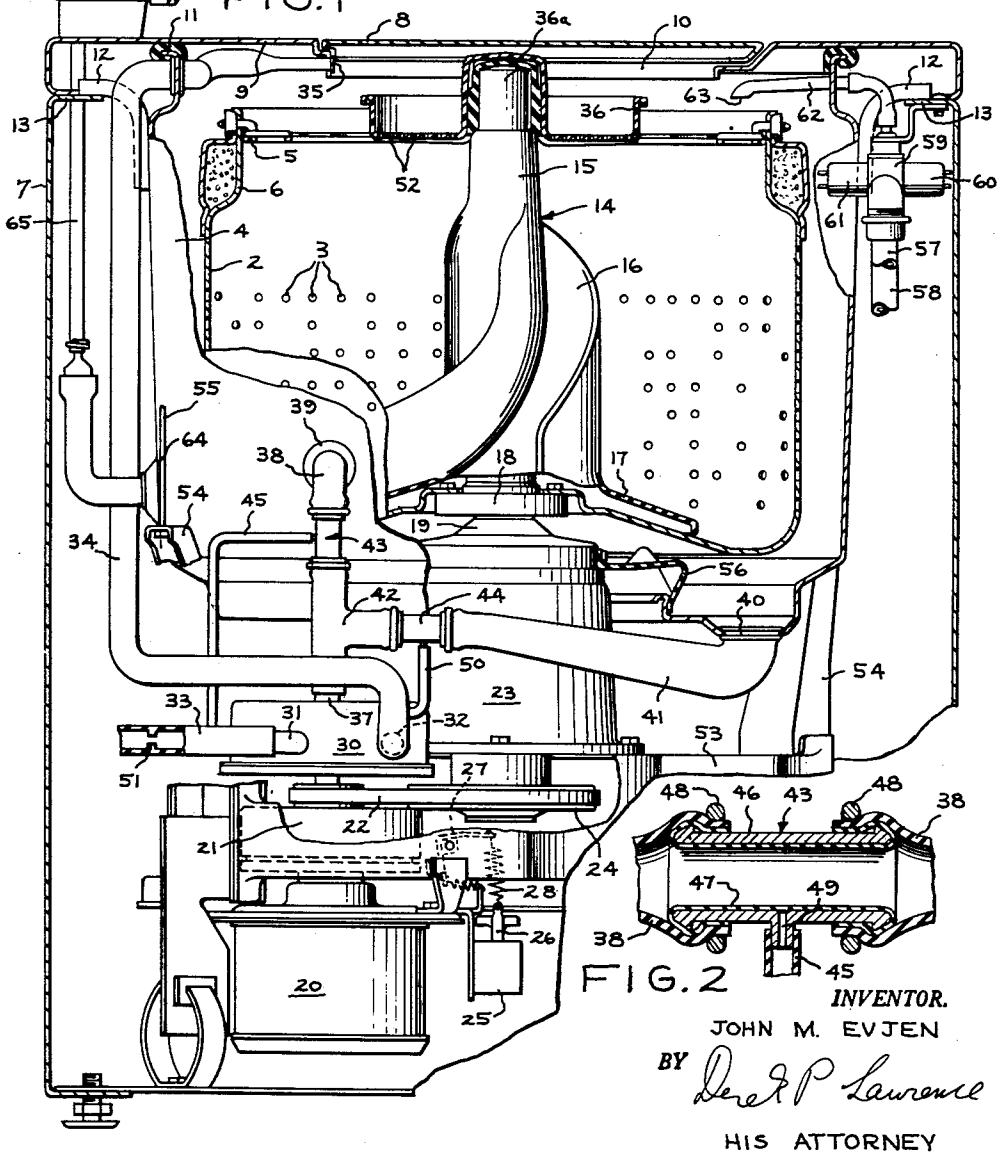


FIG. 2

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PUMPING SYSTEM FOR CLOTHES WASHING MACHINES AND THE LIKE

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This invenion relates to pumping systems, and more particularly to a pumping system in which a single centrifugal pump automatically selects flow from a particular inlet conduit and passes it through to a particular outlet conduit in response to the pumps direction of rotation.

It is an object of my invention to provide an improved reversible centrifugal-type pumping system wherein flow from one outlet—achieved in response to a first direction of rotation—induces flow through a particular one of two inlets, and, in addition, flow from another outlet—in response to the reverse direction of rotation—induces flow through the other inlet.

It is a further object of my invention to provide my improved centrifugal pump system in a clothes washing machine for the purpose of providing draining and recirculation in response to opposite drections of rotation of the pump.

In one aspect of my invention, I provide centrifugal-type reversible pumping means with inlet means and two different outlets. The pumping means is formed so as to pump fluid from the inlet means to a first outlet when the pump rotates in one direction and from the inlet means to a second outlet when the pump rotates in the opposite direction. First and second inlet conduits are provided leading to the inlet means, and in each of these inlet conduits there is provided a valve which controls flow through that conduit. Each valve is biased to normally allow passage of fluid and includes means responsive to pressure so that the valve closes when the pressure rises. First and second outlet conduits are respectively connected to the first and second outlets, and are formed so as to have an appropriately high pressure therein, this being accomplished by any suitable means such as, for instance, flow restrictors. First and second branch conduits are also connected to the first and second outlets, and lead to the pressure responsive means of the two valves respectively.

With this arrangement, when the pump rotates in the direction to emit fluid through the first outlet, pressure occurs therein and is transmitted through the first branch conduit to the pressure responsive means of the first valve so as to close that valve. This ensures that fluid flow will occur only through the second inlet conduit when the pump is rotating in the direction to emit the fluid through the first outlet. Conversely, when the direction of the pump is reversed so that fluid is emitted through the second outlet, the second valve is closed and the fluid must therefore enter the pump through the first inlet conduit.

The subject matter which I regard as my invention is particularly pointed out and distinctly claimed in the concluding portion of this specificaion. The invention itself, however, both as to its organization and method of operation, may best be understood by reference to the following description taken in conjunction with the accompanying drawing.

In the drawing:

FIGURE 1 is a side elevational view of a clothes washing machine including my invention, the view being partially broken away and partially in section in order to illustrate details;

FIGURE 2 is an enlarged fragmentary cross sectional

view of one of the pressure responsive valves included in the washing machine of FIGURE 1; and

FIGURE 3 is a schematic diagram illustrating my pumping system per se, that is, detached from use in a particular appliance such as the washing machine of FIGURE 1.

Referring now to FIGURE 1 of the drawing, I have shown therein an agitator type vertical axis clothes washing machine 1 having a conventional basket or clothes receptacle 2 provided over its side and bottom walls with perforations 3, and disposed within an outer imperforate tub or casing 4. Basket 2 may be provided with a suitable clothes retaining member 5 for preventing clothes from being floated over the top of the basket, and with a balance ring 6 to help steady the basket when (as will be explained) it is rotated at high speed.

Tub 4 is rigidly mounted within an appearance cabinet 7 which includes a cover 8 hingedly mounted in the top portion 9 of the cabinet for providing access to an opening 10 to basket 2. As shown, a gasket 11 may be provided so as to form a seal between the top of tub 4 and portion 9 of the cabinet thereby to prevent escape of moisture and moist air into the cabinet around the tub. A rigid mounting of tub 4 within the cabinet 7 may be effected by any suitable means. As a typical example of one such means, I have provided strap members 12, each of which is secured at one end to an inturned flange 13 of the cabinet and at its other end to the outside of tub 4. At the center of basket 2 there is positioned a vertical axis agitator 14 which includes a center post 15 and a plurality of curved water circulating vanes 16 joined at their lower ends by an outwardly flared skirt 17.

Both the clothes basket 2 and the agitator 14 are rotatably mounted. The basket is mounted on a flange 18 on a rotatable hub 19, and the agitator is mounted on a shaft (not shown) which extends upwardly through the hub 19 and through the center post 15 and is secured to the agitator so as to drive it. During the cycle of operation of machine 1, water is introduced into the tub 4 and basket 2, and the agitator 12 is then oscillated back and forth on its axis, that is, in a horizontal plane within the basket, to wash the clothes therein. Then, after a predetermined period of this washing action, basket 2 is rotated at high speed to extract centrifugally the washing liquid from the clothes and discharge it to drain. Following this extraction operation, a supply of clean liquid is introduced into the basket for rinsing the clothes and the agitator is again oscillated. Finally, the basket is once more rotated at high speed to extract the rinse water.

Basket 2 and agitator 14 may be driven through any suitable means from a reversing motor as the specific transmission means is not a feature of the present invention. By way of example, we have shown them as driven from a reversible motor 20 through a drive including a clutch 21 mounted on the motor shaft. When the motor starts up, clutch 21 allows it to start without load and then accept the load as the motor comes up to speed. A suitable belt 22 transmits power to transmission assembly 23 through a pulley 24. Thus, depending upon the direction of motor rotation, pulley 24 of transmission 23 is driven in opposite directions. Transmission clutch 21 may also be a two-speed clutch so as to provide for various operating speeds of the machine, and in this connection a solenoid member 25 having a plunger 26 which operates a control member 27 through a spring 28 is provided in order to achieve the two-speed operation. Specifically, in the illustrated machine, when solenoid 25 is de-energized, the clutch 21 provides a direct drive between motor 20 and pulley 24, and when solenoid 25 is energized clutch 21 provides a reduced speed drive to

pulley 24. A two-speed clutch of this type, particularly suited for use in the illustrated machine, is described in detail and claimed in Patent 2,869,699 issued to John Bochan on January 20, 1959, and assigned to General Electric Company, assignee of the present invention.

Transmission 23 is so arranged that it supports and drives both the agitator drive shaft and basket mounting hub 19. When motor 20 is rotated in a first direction the transmission causes agitator 14 to oscillate in a substantially horizontal plane within the basket 2. Conversely, when motor 20 is driven in the opposite direction, the transmission rotates wash basket 2 and agitator 14 together at a high speed for centrifugal liquid extraction. While the specific type of drive mechanism used does not form part of the invention, reference is made to Patent 2,844,225 issued to James R. Hubbard et al. on July 2, 1958 and owned by the General Electric Company, assignee of the present invention. That patent discloses in detail the structural characteristics of a transmission assembly suitable for use in the illustrated machine.

In addition to operating transmission 23, as described, motor 20 also provides a direct drive to a pump structure generally indicated at 30. While the details of the pump are not shown, the pump may be of any suitable construction provided it is of the reversible centrifugal type wherein operation of motor 20 in a first direction causes fluid emission through an outlet 31 and operation of the motor in the opposite direction causes emission of fluid through an outlet 32. While, as stated, the specific internal structure of reversible centrifugal pump 30 is not shown herein, such pumps are well known in the art. For instance, suitable pumps for the purpose are disclosed in Patent 2,883,843, issued to John Bochan on April 28, 1959; Patent 2,864,312 issued to Winston L. Shelton et al. on December 16, 1958; and Patent 2,838,002 issued to David Cohen on June 10, 1958, all three patents being assigned to General Electric Company, assignee of the present invention.

When motor 20 rotates in a first direction to cause oscillation of agitator 14, the direction of rotation of pump 30 is such as to cause emission of fluid through outlet 32. When the reverse direction of rotation of motor 20 is provided so as to spin basket 2, the reversal of the pump causes the fluid to be emitted through outlet 31 instead of outlet 32. Outlet 31 is connected through a suitable conduit 33 to a drain (not shown). Outlet 32 is connected to a suitable conduit 34 which terminates in a nozzle 35 positioned as shown so as to discharge into a filter pan 36 secured on the top portion 36*a* of agitator 14 so as to be movable therewith.

Pump 30 is provided with an inlet 37 which, in the conventional manner for centrifugal pumps, is centrally located with respect to the pump. An inlet conduit 38 leads from an opening 39, formed fairly low in the side of tub 4 down to the inlet 37 of the pump. Similarly, an opening 40 is formed at the lowest part of the tub 4 and leads through an inlet conduit 41 to a junction point 42 with conduit 38 so that inlet 37 serves both conduits 38 and 41. A valve 43 is included in conduit 38, and a similar valve 44 is included in conduit 41.

Referring to FIGURE 2, wherein the specific structure of valve 43 is shown, the valve is formed so as normally to allow flow, this being achieved with valve 43 by forming it to be normally open, but closed in response to increased pressure provided through a branch conduit 45. This may be effected by a simple and economical structure, such as that shown wherein the valve includes a rigid tubular outer casing 46 within which is positioned a flexible generally tubular inner member 47. Casing 46 and member 47 form a leak-proof chamber between them whenever member 47 is deformed inwardly from its position as shown. Both members 46 and 47 are joined to the other parts of conduit 38 in leak-proof relation by any suitable means such as, for instance, clamp 48. With the structure shown, there is free flow through valve 43 until pressure is applied through branch conduit 45, at which time the application of pressure through opening 49 in the chamber between members 46 and 47, i.e., to the exterior of member 47, causes the member 47 to be deformed inwardly so as to shut off flow through the valve. It will be understood that valves of this type are known in the art, and that the valve illustrated is merely intended to be typical of any pressure operated valve (such as, for instance, bellows operated valves) which may be desired to be used in this particular context.

Returning now to FIGURE 1, it will be seen that branch conduit 45 is connected at its other end to the outlet 31. In the particular example shown, this is most readily effected by connecting the conduit 45 directly to conduit 33 so that the ultimate connection to outlet 31 is effected through conduit 33. Valve 44 is identical to valve 43 in both structure and operation, and is provided with a branch conduit 50 which is connected at its other end through conduit 34 to outlet 32. When fluid flow occurs through outlet 31, there is sufficient pressure on the outlet side of the pump to cause closure of valve 43. If necessary, of course, a flow restrictor such as that shown by the numeral 51 may be provided in drain conduit 33 so as to cause the pressure transmitted through branch conduit 45 to be sufficient. In the case of branch conduit 50 it will be observed that the nozzle 35 at the end of conduit 34 may function as a flow restrictor in order to achieve a suitably high pressure within the conduit 34 and conduit 50.

With the structure shown then, operation of the pump to pass fluid out through opening 31 causes closure of valve 43, and operation of the pump in the reverse direction to pass fluid out through outlet 32 causes closure of valve 44. Thus, when valve 43 is closed it will be seen that any flow from tub 4 must pass through conduit 41 and valve 44 which, of course, is open. Conversely, when the pump direction is reversed and flow occurs through outlet 32, the flow to the pump must occur through conduit 38 since valve 44 is closed and valve 43 is open.

When the motor 20 is operating in the direction to cause oscillation of agitator 14, liquid from tub 4 passes through conduit 38 into pump 30 and then through outlet 32 and conduit 34 to nozzle 35. As stated, the nozzle discharges into a filter pan 36; pan 36 may be provided with small openings 52 in the bottom thereof so that the liquid flows down through the filter pan; any lint in the recirculated water is separated and retained in the pan so as to prevent it from being redeposited on the clothes. This type of structure is more fully described and claimed in Patent 2,481,979 issued to Russell H. Colley on September 13, 1949 and assigned to General Electric Company, owner of the present invention.

This recirculation flow occurs from the opening 39 in tub 4 only, since valve 44 is closed by the pressure occurring as a result of flow through conduit 34. This means that any heavy soil particles which are washed out of the clothes will not be recirculated; such particles normally sink to the bottom of the tub 4, and since the recirculation is provided from a point substantially above the bottom of the tub, these particles are allowed to remain at the bottom of the tub without interference. Thus, the recirculation of the water and the resulting removal of lint is effected without interfering with the deposition of heavy soil particles at the bottom of tub 4.

When the direction of the motor 20 is reversed in order to spin basket 2 so as to extract liquid from the clothes in the basket, the pump 30 causes liquid received through inlet 37 to be passed out through outlet 31 to conduit 33 and the drain. This in turn causes the pressure transmitted through branch conduit 45 to close valve 43, valve 44 opening because there is no longer any pressure being transmitted through conduit 50. As a result, liquid is drawn out of tub 4 through opening 40 and none is drawn out through opening 39. This has the desirable result of

providing a rapid flow through the opening **40** so as to cause all heavy soil particles to be swept down through conduit **41** and then through the pump to the drain. Thus, automatically in response to the direction of rotation, the pump not only selects the particular outlet for the liquid to be passed through but also selects the particular inlet conduit from which the liquid is to be received.

Completing now for illustrative purposes the description of machine **1**, the motor **20**, transmission **23**, basket **2** and agitator **14** forms a suspended system which is suspended from the stationary structure of the machine so as to permit isolation of vibrations from the stationary structure; it will be understood that such vibrations occur primarily as a result of high speed spinning of basket **2** with a load of clothes therein as mentioned above. While any suitable suspension structure may be used, I prefer to use a suspension structure which includes a bracket member **53**. Bracket **53** has transmission **23** mounted on the top thereof and motor **20** mounted to the underside thereof, the bracket member in turn being secured to oppositely positioned upwardly extending rigid members **54**. Each upwardly extending member **54** is connected to a cable **55** which extends upwardly so as to be supported from the top of the machine. While only a portion of the suspension structure is shown in the drawing, in order not to abscure unduly the features of my invention, such a vibration isolating system is fully described and claimed in application Serial No. 843,611, now Patent No. 2,987,190, for Vibration Isolating System filed on September 21, 1959, by John Bochan and assigned to General Electric Company, owner of the present invention. Such a suspension system provides for flexible support of the motor, transmission, agitator, and basket so as to isolate vibrations in that system from the casing of the machine.

In order to accommodate the relative movement which occurs between basket **2** and tub **4** without any danger of leakage of liquid between them, stationary tub **4** is joined to the upper part of transmission **23** by a suitable flexible boot member **56**. Boot **56** may be of any suitable configuration, many of which are known in the art, to permit relative motion of the parts to which it is joined without leakage therebetween. Also, conduits **38** and **41** may be formed of flexible material, such as rubber, for the same purpose.

Hot and cold water may be supplied to the machine through a pair of conduits **57** and **58** which are adapted to be connected respectively to sources of hot and cold water (not shown). Conduits **57** and **58** extend into a conventional mixing valve structure **59** having solenoids **60** and **61** so that energization of solenoid **60** permits passage of hot water through the valve to hose **62**, energization of solenoid **61** permits passage of cold water through the valve, and energization of both solenoids permits mixing of the hot and cold water in the valve and passage of warm water into hose **62**. Hose **62** terminates in an outlet **63** positioned to discharge into basket **2** so that when one or both of the solenoids **60** and **61** are energized water enters into basket **2** and tub **4**. It will be understood that water is thus introduced at the beginning of washing and rinsing operations until the water reaches a suitable liquid level in tub **4**.

One typical means of controlling the liquid level is to provide an opening **64** in the side of tub **4** adjacent the bottom thereof, the opening **64** being connected through a conduit **65** to a conventional pressure sensitive mechanism (not shown) which may be positioned within the back splasher **66** of the machine. In the conventional manner, as the water rises in basket **2** and tub **4** it exerts increasing pressure on a column of air trapped in conduit **65**, and at a predetermined pressure level the column of air then trips the pressure sensitive mechanism to shut off whichever of solenoids **60** and **61** may be energized. The backsplasher **66** may have suitable manual controls such as that shown at **67** extending therefrom so that the particular type of cycle including washing and spin speeds and water temperature may be controlled to effect the washing of different types of fabrics. While many different control arrangements are well known and may be used, one specific suitable such arrangement is shown and described in Patent 2,950,612 issued to Wallace H. Henshaw, Jr., on August 30, 1960 and assigned to General Electric Company, owner of the present invention.

It will be seen from the foregoing description that the operation of washing machine **1** is substantially enhanced by the provision of my inventive pumping system whereby automatically, in response to reversal of rotation of pump **30**, recirculation flow from tub **4** occurs only through conduit **38** and draining of water from tub **4** occurs only through conduit **41**.

It will be recognized that my pumping system will find usefulness in other applications in addition to the one specifically described above and, with that in mind, I have shown in schematic form in FIGURE 3 the pumping system as used in the washing machine of FIGURE 1, with the same numerals being applied to the schematically shown components for purposes of clarity. Inasmuch as the operation of the components of the system has already been explained, it will not be repeated in connection with FIGURE 3 other than to state that, as shown by the arrows and as understood by the operation of the valves **43** and **44**, flow out through conduit **33** will cause the flow into the pump to occur only through conduit **41**, and flow out through conduit **34** will cause flow into the pump to occur only through conduit **38**.

While my invention has been described by reference to a particular embodiment thereof, it is to be understood that modifications may be made by those skilled in the art without actually departing from the invention, and it is therefore my aim in the appended claims to cover all such equivalent variations as come within the true spirit and scope of my invention.

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

1. Centrifugal type reversible pumping means having inlet means and first and second outlets, said pumping means being formed to pump fluid from said inlet means to said first outlet upon rotation in one direction and from said inlet means to said second outlet upon rotation in the other direction; first and second inlet conduits leading to said inlet means; first and second valves controlling flow through said first and second inlet conduits respectively, said valves being arranged to normally allow fluid flow therethrough and including respectively first and second means responsive to pressure to close said valves; first and second outlet conduits respectively connected to said first and second outlets, each of said outlet conduits being formed to provide a substantial pressure at its associated pump outlet; and first and second branch conduits connecting said first and second outlets to said pressure responsive means of said first and second valves respectively; said first pressure responsive means closing said first valve in response to fluid flow from said first outlet, said second pressure responsive means closing said second valve in response to fluid flow from said second outlet.

2. The apparatus defined in claim 1 wherein each of said outlet conduits include flow restricting means for providing said substantial pressure.

3. The apparatus defined in claim 1 wherein each of said valves is formed with a rigid tubular member and a flexible generally tubular member positioned therewithin so as to form an air-tight chamber between said tubular members, each said branch conduit communicating with one of said chambers, each said flexible tubular member being collapsed to flow-blocking position upon an increase of pressure within its associated chamber as transmitted thereto through its associated branch conduit.

4. A clothes washing machine comprising: a rotatably mounted perforated clothes receptacle; means for effect-

ing movement of clothes and liquid in said clothes receptacle; an imperforate liquid receptacle substantially surrounding said clothes receptacle so as to retain liquid within said clothes receptacle, said liquid receptacle having a recirculation opening formed in the side thereof and a drain opening formed in the bottom thereof; centrifugal type reversible pumping means having an inlet and first and second outlets, said pumping means being formed to pump fluid from said inlet to said first outlet upon rotation in one direction and from said inlet to said second outlet upon rotation in the other direction; a common reversible drive motor for said pumping means, said clothes receptacle, and said movement effecting means, intermediate means causing operation of said motor in a first direction to rotate said pump in one direction and to operate said movement effecting means, said intermediate means causing operation of said motor in the opposite direction to rotate said pump in the opposite direction and to rotate said clothes receptacle at a centrifuging speed; a first inlet conduit connecting said side liquid receptacle opening and said inlet; a second inlet conduit connecting said bottom liquid receptacle opening and said inlet; first and second valves controlling flow through first and second inlet conduits respectively, said valves being biased to open position and including respectively first and second means responsive to pressure to close said valves; a first outlet conduit connected to said first outlet and adapted to connect said first outlet to a drain; a second outlet conduit connected at one end to said second outlet, said second outlet conduit being formed to have its other end in position to emit liquid back into said liquid receptacle, each of said outlet conduits being formed so that flow of liquid therethrough by said pump provides a substantial pressure at the associated outlet; and first and second branch conduits connecting said first and second outlets to said pressure responsive means of said first and second valves respectively; said first pressure responsive means closing said first valve in response to fluid flow from said first outlet, said second pressure responsive means closing said second valve in response to fluid flow from said second outlet.

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