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PRESSURE FILL SYSTEM

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Fig. 1

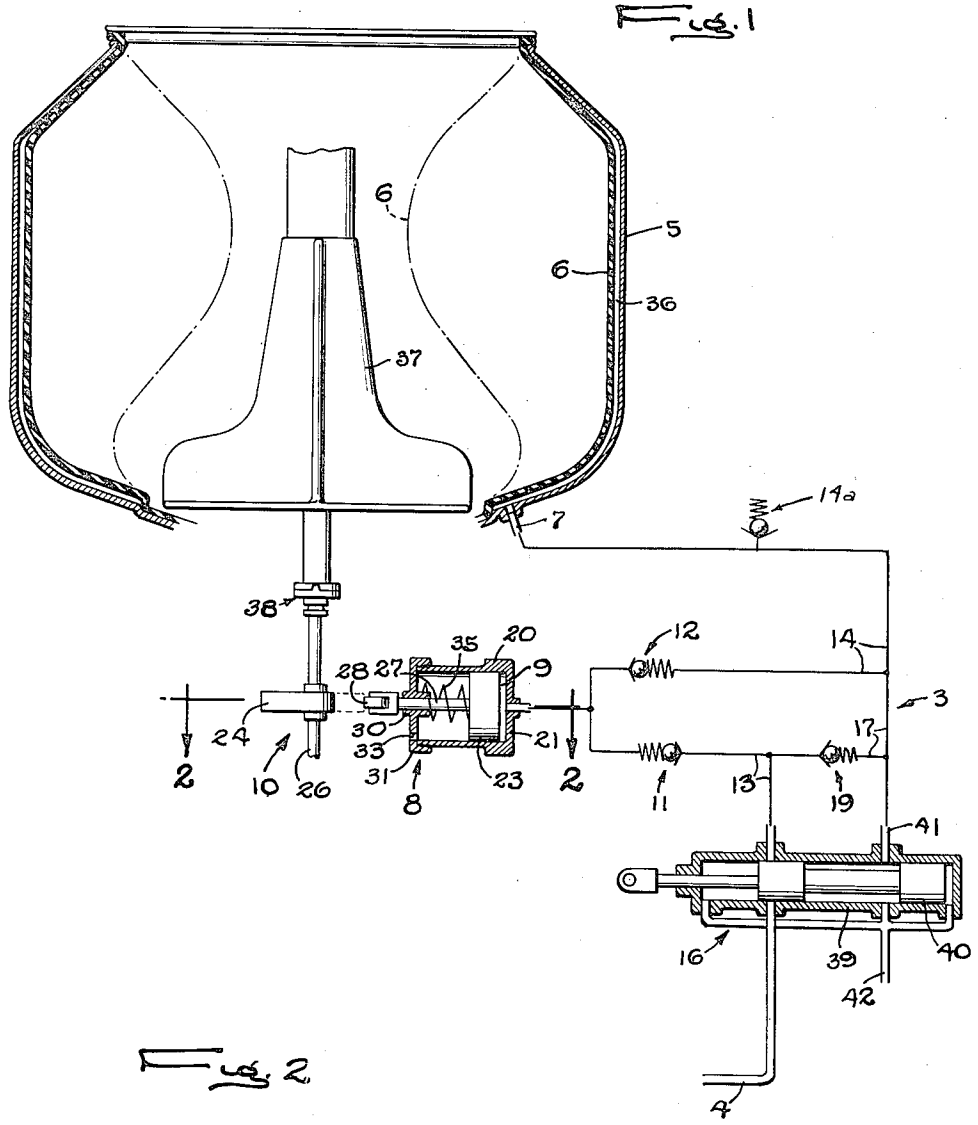
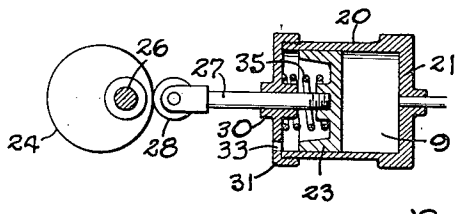


Fig. 2



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PRESSURE FILL SYSTEM

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4 Claims. (Cl. 68—21)

The present invention relates to a system for supplying fluid under pressure into a receptacle or the like in which the fluid pressure may vary from time to time.

It is one object of the invention to provide an improved fluid supply system of the character recited having a novel booster pump incorporated therein which is automatically operable to supply fluid at increased pressures in response to pressure changes within the receptacle receiving the fluid.

Another object is to provide a booster pump arrangement for a fluid supply system which can be operated from a continually moving drive and automatically controlled by the fluid within the system without the use of gauges, clutches, or other control linkages or mechanisms.

A further object is to provide a novel and greatly simplified booster pump having a minimum number of parts adapted for economical manufacture and assembly, the pump nevertheless being capable of producing the complex functions of sensing the pressure conditions existing in the fluid system in which it is used and producing pumping actions in accordance with these conditions.

A more specific object is to provide a novel and simplified booster pump which is not subject to undue wear and will not absorb driving energy when not actually pumping fluids.

In connection with the foregoing objects, it is a further object to provide a fluid system for a washer which is particularly well suited for effectively and efficiently supplying pressurized fluid to the washing tub to cause a flexible diaphragm to squeeze excess water from a batch of clothes.

An additional object is to provide an integrated pressure fluid system of the above character having a booster pump adapted for operation by the washer drive without substantial modification of the parts involved and capable of automatic self-control in accordance with the fluid pressure in the washer tub behind the flexible squeezing diaphragm.

Other objects and advantages will become apparent as the description proceeds.

In the accompanying drawing:

Figure 1 is a partially diagrammatic view showing the invention and illustrating the manner in which it may be arranged for use with a washer.

Fig. 2 is a view taken generally along line 2—2 of Fig. 1, and illustrating the coaction of the booster pump with the drive therefor.

While the invention is susceptible of various modifications and alternative constructions, there is shown in the drawing and will herein be described in detail the preferred embodiment, but it is to be understood that it is not thereby intended to limit the invention to the form disclosed, but it is intended to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

Referring more particularly to the drawing, a fluid system 3 embodying the invention is designed to receive

fluid from a relatively low pressure source such as a city water main 4 and discharge it into a receptacle 5. As illustrated, the receptacle 5 constitutes the tub of a washing machine and the system 3 is arranged to charge water into the tub behind a flexible squeezing diaphragm 6. However, it will be understood that the invention in its broader aspects is not limited to use with washing machines, but may be used to supply fluid to any receptacle or similar fluid receiving means of such a character that the internal fluid pressure may vary from time to time.

The operating characteristics of the system 3 are such that whenever the pressure within the receptacle 5 is lower than the pressure of fluid in the supply main 4, fluid may flow through the system from the supply main into the receptacle under force of the supply main pressure. When the pressure within the receptacle 5 increases appreciably or approaches the pressure in the supply main, the system 3 automatically adapts itself to the changed conditions. A booster pump 8 incorporated into the system then comes into operation to increase the pressure at the fluid outlet 7 of the system and positively forces the fluid into the receptacle at pressures above that in the supply line.

The improved and simplified booster pump 8 used in the system 3 not only serves as a pump but is capable of sensing pressure conditions existing in the system and automatically controlling its own pumping action in accordance with these conditions. It will become evident that the fluid pressure within the system 3 varies somewhat in proportion to the pressure within the receptacle 5, thus allowing the pump 8 to control itself in accordance with the pressure in the receptacle.

The improved pump 8 basically comprises an expansible chamber 9 interconnected with an intermediate portion of the system 3 in a manner whereby the chamber may be expanded through entrance of fluid into the chamber from the system whenever the pressure in the adjacent portion of the system exceeds a predetermined value. A continually moving actuator 10 is arranged to engage and compress the expanded chamber 9 forcing the fluid out through conduit 14 and outlet 7 into the receptacle 5 under increased pressure. A suitable relief valve 14*a* is provided in conduit 14.

In the present instance, the pump chamber 9 is connected into the fluid system 3 between an inlet check valve 11 and an exhaust check valve 12 interposed in the fluid conduits 13 and 14 respectively leading from a cut-off valve 16 associated with main 4 and to the receptacle 5, as indicated diagrammatically in Fig. 1. In this manner the pump chamber 9 is exposed to fluid pressure in the system at all times. When pressure in the receptacle 5 is low, fluid flowing into the system from the supply main 4 through valve 16 can pass through check valves 11 and 12 successively and enter the receptacle 5 under its own pressure. It will be appreciated that fluid friction and other ordinary resistances to passage of the fluid through the lines will cause the fluid pressure in the supply system 3 at the point where the pump is interconnected to the system to drop to an intermediate pressure between that in the supply main 4 and that in the receptacle 5. Normally this intermediate pressure will not be sufficiently strong to cause expansion of the pump chamber 9 whenever the flow of fluid into the receptacle is initiated through opening of valve 16. Consequently, the pump will remain inoperative during this initial filling period.

In the preferred form of the system 3, provision is made for expediting the initial filling of the receptacle 5 while its internal pressure is still low. For this purpose, an additional fluid passageway 17 having a check valve 19 interposed therein is provided between the conduits 13 and 14 leading to and from the pump 8. A sizable

portion of the incoming fluid can be shunted through passage 17 around valves 11 and 12 and the pump 8 to be channeled directly into the receptacle.

After the receptacle 5 has been filled sufficiently to cause a significant increase in its internal pressure, the pressure within the system 3 increases, producing a corresponding increase within the pump chamber 9. When this pressure reaches a certain point, the pump chamber is caused to expand thereby initiating the booster pumping action needed for forcing additional fluid into the receptacle. As pressure in the receptacle rises above that in the supply main 4, the check valve 19 closes. From that point on, fluid is charged into the receptacle 5 by being introduced through check valve 11 into the pump chamber 9 where it is forced out into the receptacle through check valve 12.

Referring more particularly to the construction of the pump forming the instant embodiment of the invention, the expansible pump chamber 9 is formed by a cylinder 20 closed at the forward end by plate 21 and adapted to slidably receive a piston 23. The chamber 9 is interconnected into the fluid system in any convenient manner, the connection being shown diagrammatically in Figure 1. The chamber is expanded through rearward motion of the piston 23 under force of fluid within the cylinder 20 as shown in Fig. 2. Contraction of the pump chamber through forward movement of the piston 23 is effected by the continually moving actuator 10. A most suitable actuator is an eccentric cam 24 mounted on a rotating shaft 26 and arranged to engage a piston rod 27 extending rearwardly from the piston 23 to drive the rod and piston forwardly. To reduce wear on the parts and improve the mechanical efficiency of the drive, a roller 28 is mounted on the rear end of the piston rod 27 for engaging the drive cam 24. The intermediate shank of the piston rod is slidably received in a guide 30 formed in a cap 31 secured to the rear end of the cylinder 20. A suitable drain 33 is provided in the rear portion of the cylinder to permit escape of small quantities of fluid which may seep past the piston 23.

For some applications, the frictional forces between the piston 23 and the cylinder 20 are sufficient to resist rearward movement of the piston until it is desirable to initiate the booster pump operation. In other applications, where it is advantageous to delay operation of the booster pump 8 until the pressure within the system has reached a higher value, a spring is associated with the piston 23 to bias it into forward position. As shown, a compression spring 35 is assembled between the rear face of the piston 23 and the cap 31 for this purpose. The presence of the spring, however, does not have a critical effect on the pumping action aside from determining the point when the pumping will begin.

From the foregoing description it is clear that until the pressure within the pump chamber 9 exceeds a certain critical value, the pump 8 remains dormant. The revolving cam 24 does not engage the piston rod 27 and the parts are not subjected to wear. Moreover, the booster pump does not absorb driving energy except when actually in use.

It will also be appreciated that the pump 8 is composed of a minimum number of parts which are inexpensive to manufacture and assemble. Because of the simplicity of its design, the pump is durable in use and not subject to functional failures. Additional advantages of the novel pump arrangement reside in the elimination of intricate controls made possible by the inherent ability of the pump to sense the pressure of the fluid within the system and to control its own action in response to changing pressure conditions without the use of clutches or control links of any sort.

It will be remembered that even though the illustrated embodiment of the invention is used for supplying fluid to the tub of a washer, the invention in its broader aspects is not restricted to this use. A fluid system or pump embodying the invention may be used to supply fluid to any type of receptacle or conduit but is particularly advantageous where the pressure in the receptacle varies between values below and above the pressure of the fluid source.

However, the fluid system 3 with the novel booster pump arrangement is particularly well adapted for use in washing machines. As previously indicated, the system is used in this connection to charge water into the space or cavity 36 between the tub 5 of a washer (not fully shown) and a flexible diaphragm 6 to cause the latter to bulge inwardly for pressing a batch of clothes against an agitator 37 to squeeze out excess water. The instant diaphragm 6 is annular in form and is attached to the tub in a fluidtight manner along its upper and lower marginal edges. The normal pressure of water in most city mains is sufficient to extend the diaphragm 6 inwardly into pressure engagement with the clothes. The pump 8 then comes into play for charging additional water into the tub 5 behind the diaphragm 6 to perform the final squeezing operation. The amount of water supplied at the increased pressures is usually relatively small so the pump can be made of small capacity, further reducing its cost of manufacture. Where the fluid system is used with a washer as shown, the drive shaft 26 for the cam 24 may also be the drive shaft for the agitator 37, thus eliminating the necessity of additional motors and transmissions for actuating the pump 8. A suitable clutch 38 is provided between the shaft 26 and the agitator for convenient control of the agitator.

Preferably, the system 3 for supplying squeezing fluid to the washer is integrated with the drainage system so that the expansible cavity 36 behind the flexible diaphragm 6 can be filled and drained through the single valve 16. In this instance the valve is of a combined type and comprises a casing 39 having a multiple headed piston 40 slidably mounted therein to afford a common control over the supply and drainage systems. The casing 39 is connected with conduits 41 and 42 respectively leading to the tub 5 and to a suitable drainage outlet. In the position shown, the piston 40 is shifted to the right for drainage of squeezing fluid.

Since the shaft 26 will normally be rotating while the washer is in operation, the only necessary control movement required for charging squeezing water into the cavity 36 is that needed to shift the piston 40 to the left closing the drain and interconnecting the supply conduit 12 with the supply main 4. The fluid system 3 then operates automatically to charge water behind the flexible diaphragm 6 as previously described. Whenever the desired amount of water is pumped in behind the diaphragm the valve piston 40 may be shifted back to an intermediate or neutral position to maintain the squeezing pressure on the clothes for a short time before the squeezing water is drained off by shifting the piston all the way to the drain position.

It will be appreciated that the improved fluid system as incorporated into a washing machine gives rise to numerous advantages in regard to simplicity of design and economy of manufacture as well as to a most efficient and dependable mode of operation. The integrated nature of the system with the simple cut-off valve needed for initiating the filling and draining cycles is well suited for use in washing machines of this type which are controlled either manually or automatically.

I claim as my invention:

1. In a washing machine, the combination of a tub, an agitator mounted in said tub, a flexible annular diaphragm disposed in said tub and secured thereto in a fluidtight manner along the upper and lower peripheral edges of said diaphragm to form an expansible cavity, a fluid supply and drainage system for charging water into said cavity to cause bulging of said diaphragm for squeezing excess water from a batch of clothes and for draining the water from said cavity after a squeezing

operation, said system including a supply conduit adapted for connection to a source of water under pressure and extending to said tub, a cut-off valve interposed in said conduit, a booster pump interconnected into an intermediate portion of said conduit and comprising a cylinder, a piston slidably mounted in said cylinder to define an expansible pump chamber, inlet and exhaust valves associated with said chamber, a piston rod secured to said piston and extending rearwardly therefrom, a continually rotating drive shaft disposed rearwardly of said cylinder and having an eccentric cam mounted thereon and disposed in alinement with the free end of said rod, said cam being so located and dimensioned that its path of movement clears said rod whenever said piston is in its forward position, said drive shaft also being arranged to drive said agitator, means defining a fluid passageway interconnecting said line on opposite sides of said inlet and exhaust valves for shunting water around said last mentioned valves and said pump during initial filling of the space behind said diaphragm, a check valve in said passageway, said piston being slidable rearwardly under the force of water entering said chamber above a predetermined pressure, said piston being movable back to initial position by said cam for forcing water out of said chamber into said tub under increased pressure, a drainage line interconnected between said tub and said cut-off valve, said cut-off valve being shiftable to initiate the flow of water into said tub and to drain water from said tub.

2. In a washing machine, the combination of a tub, means for agitating water in said tub, a power source for moving said agitating means, means disposed in said tub and defining therewith an expansible cavity, a fluid supply system for charging water into said cavity to cause expansion of said cavity for squeezing excess water from a batch of clothes, said system including a supply line adapted for connection to a source of water under pressure, a cut-off valve interposed in said line, a booster pump comprising a cylinder, a piston slidably mounted in said cylinder to define an expansible pump chamber, inlet and exhaust valves associated with said chamber, said inlet valve being connected to said cut-off valve, said exhaust valve being in communication with said cavity, a motion transmitting element secured to said piston and extending rearwardly therefrom, a continually rotating drive shaft connected to said power source and disposed rearwardly of said cylinder and having a movable actuator associated therewith, said actuator being so located and dimensioned that its path of movement clears said element whenever said piston is in its forward position, said piston being slidable rearwardly under force of water entering said chamber above a predetermined pressure, said piston being movable back to initial position by said actuator, forcing water out of said chamber into said cavity under increased pressure and a valve in communication with said cavity for draining water therefrom.

3. In a washing machine, the combination of a tub, an agitator mounted in said tub, means including a flexible diaphragm disposed in said tub and defining an expansible cavity, a fluid supply system for charging water into said cavity to cause bulging of said diaphragm for squeezing excess water from a batch of clothes, said system including a supply line adapted for connection to a source of water under pressure, a booster pump having an expansible pump chamber connected to said line, an inlet valve interposed between said source and said chamber, a conduit connecting said chamber to said cavity, an exhaust valve interposed between said chamber and said cavity, a motion transmitting element associated with said pump and operable to contract said chamber, a continually moving actuator associated with said element, said actuator being so located and dimensioned that its path of movement clears said element whenever said chamber is in its contracted position, said agitator and said actuator being driven from a common power source, means defining a fluid passageway interconnecting said supply line and said conduit for shunting water around said inlet and exhaust valves and said pump during initial filling of said cavity, a check valve in said passageway, said pump chamber being expansible under force of water entering said chamber above a predetermined pressure, said actuator then engaging said element to contract said chamber and force water out of said chamber into said cavity under increased pressure.

4. In a washing machine, the combination of a clothes receptacle, a flexible squeezing element disposed in said receptacle defining an expansible chamber, means including a power source for agitating water in said receptacle, a fluid supply system for charging water into said cavity to cause said element to bulge and squeeze excess water from a batch of clothes, said system including a supply line extending from a source of water under pressure, a booster pump having an expansible pump chamber connected to said line, inlet and exhaust check valves associated with said chamber, said inlet valve being connected to said supply line, a conduit connecting said exhaust valve to said expansible cavity, a motion transmitting element associated with said pump and operable to contract said chamber, a continually moving actuator associated with said element and drivingly connected to said power source, said actuator being so located and dimensioned that its path of movement clears said element whenever said chamber is in its contracted position, said pump chamber being expansible under force of water entering said chamber above a predetermined pressure, said actuator then engaging said element to contract said chamber and force water out of said chamber into said tub under increased pressure and a pair of cut-off valves, one cut-off valve being interposed in said supply line, the second cut-off valve being in communication with said cavity for draining the latter.

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