

April 24, 1962

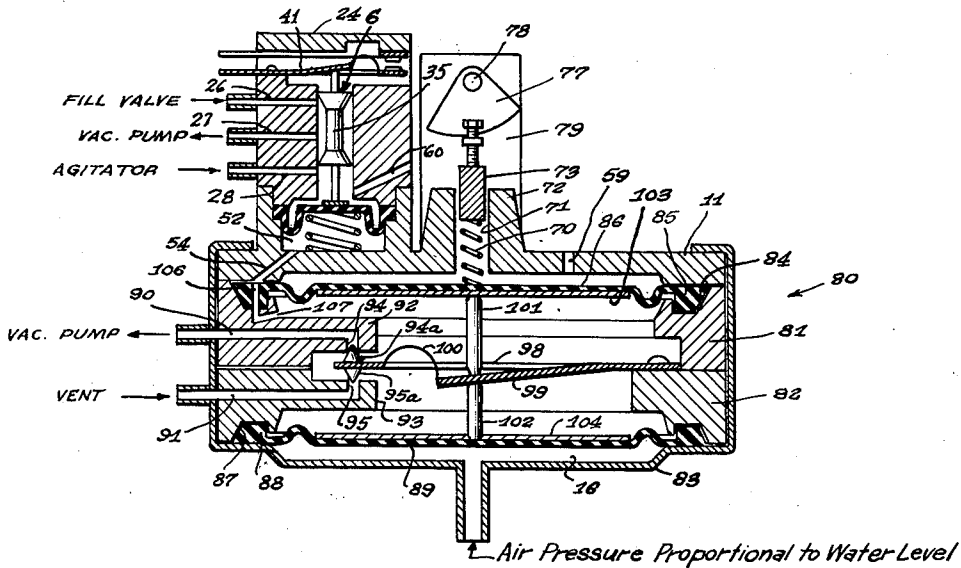
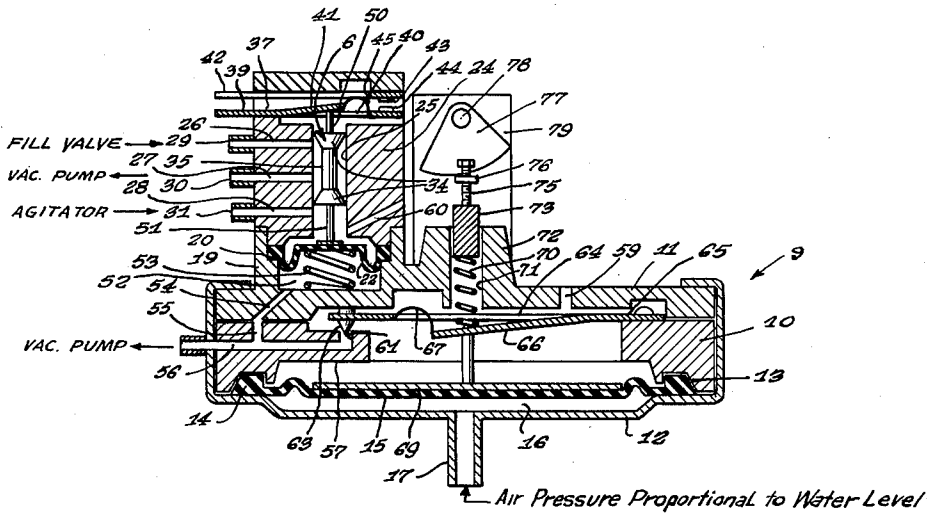
W. L. TAYLOR

3,030,778

PNEUMATIC RELAY

Filed May 27, 1958

2 Sheets-Sheet 1



Inventor
Wesley L. Taylor

Bill Sherman, Merri Gross & Simpson

Attys

By

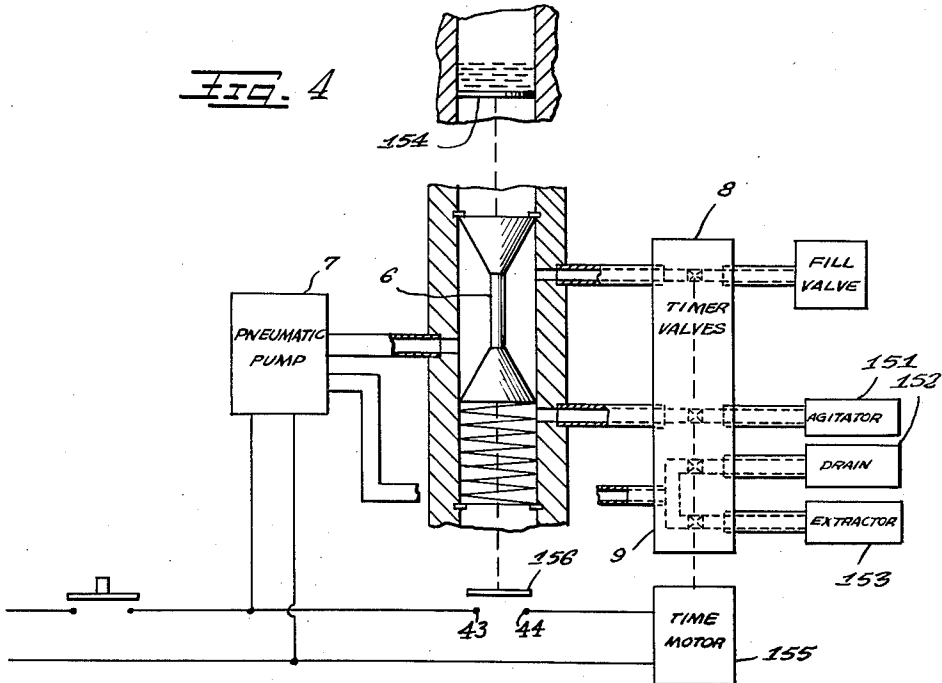
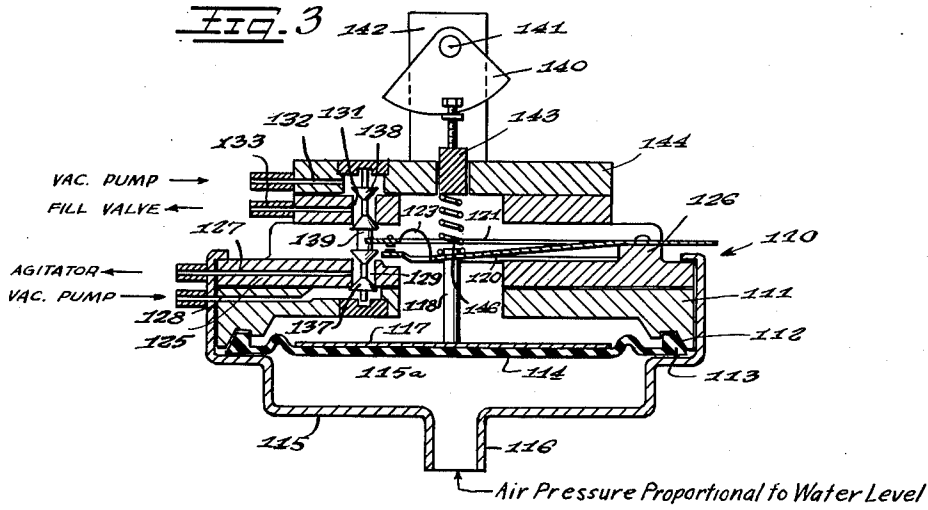
April 24, 1962

W. L. TAYLOR
PNEUMATIC RELAY

3,030,778

Filed May 27, 1958

2 Sheets-Sheet 2



Inventor
Wesley L. Taylor
Hill Sherman Meoni Gross & Simpson

By

Attys.

1

3,030,778

PNEUMATIC RELAY

Wesley L. Taylor, Glenview, Ill., assignor to The Dole Valve Company, Morton Grove, Ill., a corporation of Illinois

Filed May 27, 1958, Ser. No. 738,069

2 Claims. (Cl. 60—60)

This invention relates to pneumatic relays and more particularly to a pneumatically actuated device and switching arrangement which is especially advantageous in controlling at least some of the automatic operations of a clothes washing machine or the like.

In various types of apparatus, control operations are initiated in response to a changing condition or to the elapse of a predetermined period of time. For example, in automatic clothes washing machines, it is the preferred practice to start the actual washing operation only after the tub has been filled with water to the desired level. The time required to fill the tub to the desired level is variable, depending upon the desired level and upon available water pressure, so that during filling of the tub the motor on the timer of the machine is not running.

The present invention is directed to a novel pneumatic relay and control arrangement which is particularly suitable for use in automatic clothes washing machines.

One of the principal objects of the present invention is to provide a novel pneumatic control device.

Another object of this invention is to provide a novel pneumatically actuatable control valve for remotely controlling a plurality of pneumatically actuatable mechanisms.

A further object of the invention is to provide an air pressure control valve for controlling the actuation of a fluid supply valve in a washing machine or the like which is manually adjustable to select a desired water level within the washing machine.

A still further and important object of the invention is to provide a pneumatically actuatable control valve for remotely controlling the actuation of remotely located pneumatically controllable mechanisms within a washing machine which is itself pneumatically operable and which is manually adjustable to predetermine the desired water level within the washing machine and which is further provided with means for energizing and deenergizing an electrical circuit.

Still another and further object of this invention is to provide a novel pressure operated control device for substantially simultaneously shutting off the water supply from a pneumatically operated mixing valve after the desired level in the tub has been reached, starting the actual clothes washing operation by pneumatically engaging the agitator drive, and closing the electrical circuit to the motor of a pneumatic timer, said device being substantially snap acting in response to the low pressures, in the nature of one half pound or less per square inch, determined by the level of the water in the tub.

These and other objects of the invention will become apparent from time to time as the following specification proceeds and with reference to the accompanying drawings, wherein:

FIGURE 1 is a vertical sectional view through a valve constructed in accordance with the present invention;

FIGURE 2 is a vertical sectional view through a second embodiment of the invention;

FIGURE 3 is a vertical sectional view through a valve constructed in accordance with the principles of this invention and showing a third embodiment thereof; and

FIGURE 4 is a diagrammatic view of a portion of applicant's device showing the relation thereof with a

2

shut-off valve and agitator mechanism in a washing machine.

In the embodiment of the invention illustrated in FIGURE 1, there is shown a four way pneumatic valve arranged to be used in a system, such, for example, as that shown in FIGURE 4. The valve in general includes a movable spool valve 6 which is arranged to selectively connect a vacuum or other pneumatic pump 7 either to the water fill valve 8 through the timer valving mechanism 9, or to other control mechanism such as an agitator 151 through another portion of the timer valving mechanism 9. The pneumatic pump 7 may also be connected directly through a portion of the timer valving mechanism 9 to a drain control 152 and an extractor control 153. When the spool valve 6 is in its upper position as shown in FIGURES 1 and 4, the pump 7 is connected to the fill valve 8 to open the same and the other controls are vented to deenergize them. Although not shown (since they form no part of the present invention), it will be understood that the fill valve is normally biased to its closed position and opened by connection of the pump thereto. Similarly, the agitator and other controls 151, 152 and 153, respectively, are normally biased to their respective deenergized positions, and are rendered operative by connection of the pump thereto through the timer valving mechanism 9. The spool valve 6 is normally biased to its up position thus connecting the fill valve 8 to the pump 7 but is shifted to its lower position by means effective when the liquid level in the washing machine tub (not shown) has reached a predetermined level.

As shown in FIGURE 4, the timer 155 is not electrically actuated until after the completion of the water fill cycle and the closing of the switch 156 by downward movement of the spool valve 6. Energization of the timer 155 initiates the remaining cycle of operation of the machine and may, if desired, include such conventional steps as deactivating the agitator, draining the water from the tub, centrifugally drying, rinsing, etc., by selective connection through the timer valving mechanism 9.

Referring now particularly to FIGURE 1, the four way valve and water level actuator is illustrated as comprising a main body member 10 having a large central opening therein. End plates in the form of a cover plate 11 and a bottom plate 12 are secured to the body member 10.

An annular recess 13 in the underside of the body ring 10 is arranged to receive an annular flange 14 of a flexible diaphragm 15. The bottom plate 12 is depressed to form an air chamber 16 between the inner surface of the plate 12 and the undersurface of the flexible diaphragm 15. The bottom plate 12 is provided with a nipple 17 communicating with the air chamber 16 and is arranged to be connected to a source of pressurized air which is admitted to chamber 16 when the liquid level in the washing machine tub reaches a predetermined point.

The upper plate 11, includes a hollow boss 19 having an annular seat 20 formed on its inner wall. A flexible diaphragm 22 is peripherally seated on the annular seat 20 and is maintained in engagement therewith by abutment with a valve block 24. The valve block 24 is, of course, sealed in fluid tight relation with the boss 19.

A vertical valve chamber 25 is centrally located within the valve block 24 and is communicable with the passageways 26, 27 and 28 leading through the wall of the valve block and terminating in the fittings 29, 30 and 31, respectively.

A reciprocally movable piston or spool valve 6 is arranged to be slidably movable within the valve chamber 25 and is similar to a spool in configuration having radi-

ally enlarged end portions 34 and a radially reduced intermediate integral connecting shaft 35. A vent 60 is provided to the lower end of chamber 25, and the upper end of chamber 25 is directly vented through the opening in which switch 40 is mounted. Thus when spool valve 6 is in its upper position duct 28 is vented, while duct 26 is vented when spool valve 6 is in its lower position.

It will now become apparent that if a vacuum actuated fluid fill valve is operatively connected to the fitting 29 and if a vacuum controlled agitator control is connected to the fitting 31 and a vacuum source is connected to the fitting 30 reciprocal movement of the spool valve 6 within the valve chamber 25 will alternately communicate the passageway 26 and the passageway 28 with the vacuum source so as to alternately actuate the fluid valve to cause the flow of fluid therethrough and to activate the agitator control to cause operation of the agitator.

An electrically operable device, such as an electrically controlled cycling mechanism or timer may be advantageously controlled by the spool valve 6. As shown diagrammatically in FIGURE 4, the timer circuit is closed by downward movement of the spool valve 6 through contacts 43 and 44.

As is shown in more detail in FIGURE 1, a substantially longitudinal contact blade 39 forming a part of the energizing circuit for the timer is seated at one end portion thereof on the lower wall portion of the transverse passage 37 formed in the upper portion of the valve block 24 and is so formed as to have a main body portion 40 and an integrally formed snap blade 41. A contact blade 42 is seated against the upper wall portion of the transverse passage 37 and has a depending contact 43 on the outer end thereof directly opposed to contact 44 on the outer free end of the main body portion 40 of the blade 39. An overcenter spring 45 is connected to the main body portion 40 and the snap blade 41 so that when the snap blade 41 is moved to a position slightly below the plane of the blade 39, the spring 45 will act to snap the snap blade 41 downwardly and, at the same time, snap the contact 44 on the outer free end of the blade 39 into engagement with contact 43 to thus close the circuit between the blades 39 and 42 and energize the timing device energized thereby.

A pair of connecting shafts 50 and 51 interconnect each end of the spool valve 6 with the snap blade 41 and the flexible diaphragm 22, respectively. The flexible diaphragm 22 is biased upwardly by the spring 53 seated on the cover plate 11. The vacuum chamber 52 below the flexible annular diaphragm 22 is connected to a vacuum source, such as a vacuum pump, through the passageways 54 and 55 in the cover plate 11 and body ring 10, respectively, and through the main passage 56 within an inner radial boss 57 in the body ring 10.

A vent passage 60 is formed within the valve block 24 and extends diagonally through the wall thereof to communicate the upper surface of the diaphragm 22 with the atmosphere. Hence, when the chamber 52 is evacuated so as to create a partial vacuum therein, the flexible diaphragm 22 will be moved downwardly within the chamber 52 by atmospheric pressure acting on the upper surface thereof against the force of the spring member 53 and against the tension of the snap blade 45 to which it is indirectly connected. This moves the spool valve 6 downwardly within the valve chamber 25. When the snap blade 41 moves to a plane slightly below that of the main body 40 of the plate 39 the snap blade 45 will act to snap the snap blade 41 downwardly as has been hereinbefore described to thus quickly move the spool valve 6 downwardly within the valve chamber 25 to thus communicate the passageway 27 connected to a vacuum pump with the passageway 28 connected to the vacuum control of the agitator mechanism of a washing machine, and to simultaneously close communication between the vacuum source and the vacuum controlled valve connected to the

passageway 26 and vent the motor for the fill valve to the atmosphere. It will, of course, be understood that the combined fill and shut-off valve may be in the form of a mixing valve.

The passageway 56 within valve body 10 is provided at its inner end with a port 61 in the upper surface of the inwardly extending flange portion 57. A valve 63 is provided on the outer free end portion of a snap arm 64 which is connected at one end portion to the upper surface of the body 10. An overcenter spring 67 interconnects the free end portion of a snap blade 66, which is integrally formed with the snap arm 64, with the snap arm in a manner which is well known in the art. The snap blade 66 is connected to the supporting disk 69 which is bonded or otherwise firmly secured to the flexible annular diaphragm 15.

It will now be understood that any suitable means may be provided for directing air pressure to the air chamber 16. Such a means may constitute, for instance, a simple flexible diaphragm located at the bottom of the washing machine tub which will flex under pressure and thus direct air under pressure through suitable tubing to the air chamber 16 as a function of the weight of water thereagainst and consequently as a function of the water level within the washing machine tub.

A spring 70 is positioned within a bore 71 of an upstanding boss 72 in the cover plate 11 and abuts, at one end, the snap blade 66 near an outer free end thereof. A slidably mounted piston 73 is positioned within the bore 71 and is seated against the upper end portion of the spring 70. The piston 73 has a threaded rod 75 extending upwardly therefrom for the purpose of supporting an adjustable cam follower 76.

A manually movable cam 77 is mounted on a cam shaft 78 for corotatable movement therewith which shaft is journaled in a supporting bracket 79 for the purpose of providing a means for adjusting the position of the piston 73 within the bore 71.

It will now be understood that the cam 77 will function to vary the water level within the washing machine tub in the following way: Assuming that the filling cycle of the washing machine tub has just begun and the component parts of the valve structure are in substantially the position illustrated in FIGURE 1, pneumatic pressure will build up within the air chamber 16 as the level and as a consequence of the weight of the water within the washing machine tub becoming greater. When the air pressure within the air chamber 16 has risen sufficiently to overcome the resistive force of the overcenter spring 67 and spring 70, the snap blade 66 will move to a position slightly above the plane of the snap arm 64. The overcenter spring 67 will then snap the inner free end of the snap arm 64 downwardly, thus moving the valve member 63 into sealing engagement with the port 61.

In this manner the vent 61 is closed and the chamber 52 beneath the diaphragm 22 is connected to the vacuum pump through passages 54, 55 and 56. This will quickly evacuate the chamber 52 thus moving the piston valve 6 downwardly within the piston chamber 25 to vent the shut-off valve line 29 and cause the valve connected to line 29 (not shown) to close and stop the flow of water into the washing machine tub and simultaneously initiate the operation of the agitator.

If the operator desires to lower the level of water within the washing machine tub, he need only rotate the cam shaft 78 in a clockwise direction (as shown in FIGURE 1) to move the piston 73 upwardly within the piston channel 71 and thus release the tension acting on the spring blade 66 through the spring 70. Conversely, if the operator of the washing machine should desire to raise the water level within the machine, he need only rotate the cam shaft 78 in a counterclockwise direction to thus lower the piston 73 within the piston channel 71 to increase the resistive force acting on the spring arm 64.

It will now be understood that a simple control valve

5

mechanism has been provided which is manually adjustable to vary the level of water in the washing machine tub and which is automatically actuable to stop the flow of water into the tub and begin the operation of the agitator.

Referring now more particularly to FIGURE 2 of the drawings a second embodiment of the invention is shown which avoids the necessity of maintaining a continuous bleed for the vacuum pump and which has a valve body of slightly different configuration from that illustrated in FIGURE 1.

The five part hollow valve body 80 is shown as including generally upper and lower main body portions 81 and 82, respectively, which are sealed together in fluid tight relation with one another and which are maintained in engagement with the cover plate 11 by a backing plate 83 which has a configuration substantially the same as that of the backing plate 12 illustrated in FIGURE 1 and has a bleed hole 59 therein.

An annular groove 84 in the upper surface of the upper main body portion 81 is arranged to receive a peripheral lip 85 of a flexible annular diaphragm 86. Similarly, the lower surface of the main body portion 82 is grooved as at 87 to receive the peripheral lip 88 of a second annular diaphragm 89. Passageways 90 and 91 are formed within upper and lower radial bosses 92 and 93, respectively, and are each in communication with the interior of the hollow valve body 80 through the ports 94 and 95 respectively, which are in alignment with and face one another. Passageway 90 is arranged to be connected to a vacuum pump and passageway 91 is vented to the atmosphere.

A pair of opposed valve members 94a and 95a are arranged to control the flow of fluid through the ports 94 and 95, respectively, and are rigidly connected to the outer free end of the snap arm 98 which is rigidly connected at its other end portion to the upper surface of the lower body portion 82 of the valve body 80. The snap blade 99, which is formed integrally with the snap arm 98, is connected at its outer free end portion to overcenter spring 100 which, in turn, is connected to the outer free end portion of the snap arm 98 by means which are well known in the art.

Motion translation pins 101 and 102 are each connected at one end portion to the snap blade 99 and at their other end portions to annular supporting discs 103 and 104 which are bonded or otherwise firmly secured to the flexible annular diaphragms 86 and 89, respectively.

The hollow interior of the valve body is communicable with the vacuum chamber 52 through the passageways 54 in the cover plate 11, passageway 106 formed in the lip 85 in the flexible annular diaphragm 86, and through the passage 107 in the upper main body portion 81 of the valve body 80.

The spring 70 within the bore 71 abuts, at one end portion, the movable piston 73 and, at the other end portion, the flexible annular diaphragm 86. The spring pressure acting on the diaphragm 86 is variable through a cam 77 and cam shaft 78 in the manner described with reference to FIGURE 1.

The valving arrangement within the valve block 24 is generally the same as that described with reference to FIGURE 1 and like numerals refer to like numbered parts.

It will now be understood that when the piston 73 has been adjusted to the desired position, the pressure of water building up within the washing machine tub will continuously build up the air pressure within the air chamber 16 until the diaphragm 89 is moved upwardly a sufficient distance to move the snap blade 99 to a position slightly above the plane of the snap arm 98 so as to cause the outer free end of the snap arm 98 to move downwardly to simultaneously unseat the valve member 94a from the port 94 and to seat the valve 95a in the port 95. Closing of port 95 closes off the venting of chamber 52 through passages 54 and 91 and directly connects cham-

6

ber 52 to the vacuum pump through passage 90. In this manner, the vacuum pump connected to the passage 90 will quickly evacuate the chamber 52 to cause the spool valve 6 to move downwardly within the piston chamber 25 to stop the flow of water to the washing machine tub and to simultaneously actuate the agitator control mechanism. It will thus be seen that by shifting the arm 98, chamber 52 is either connected to the vacuum pump or is vented to the atmosphere, and hence the position of the spool valve 6 is controlled thereby.

Referring now more particularly to the embodiment of the invention illustrated in FIGURE 3, a five part hollow valve body 110 includes a main body portion 111 which is peripherally grooved as indicated at 112 to receive the outer peripheral lip 112 of a flexible annular diaphragm 114. A stepped backing plate 115 having a depending tubular connection 116 on the undersurface thereof is provided to abut the underside of the outer peripheral edge of the flexible annular diaphragm 114 and seal the same in fluid tight relation with the main body portion 111. An annular supporting disc 117 is bonded or otherwise firmly secured to the flexible annular diaphragm 114 and is centrally connected to an upstanding shaft 118. The shaft 118 is connected, at its upper end portion, to a snap blade 120 which is formed integrally with a snap arm 121. An overcenter spring 123 interconnects the outer end of the snap blade 120 and the outer free end of the snap arm 121 for the reasons which have hereinbefore been described.

A two part radial boss 125 formed integrally with the main body portion 111 and the cover plate 126 extends radially into the hollow interior of the valve body 110 and has a pair of passages 127 and 128 extending axially therethrough. The passageways 127 and 128 terminate, one above the other, in a valve channel 129. Similarly, a valve channel 131 is formed in axial alignment with the valve channel 129 and opens to passages 132 and 133 which lead through the valve body. A pair of spool valves 137 and 138 are positioned within the valve channels 129 and 131, respectively, and are rigidly interconnected by a connecting shaft 139.

The shaft 139 is connected to the outer free end portion of the snap arm 121 so that movement of the snap arm 121 will reciprocally move each of the spool valves 137 and 138 through the connecting shaft 139.

If a vacuum pump is connected to the passages 132 and 128 and a fill valve is connected to the passage 133 and an agitator mechanism is connected to the passage 127, the operation of applicant's control valve will be as follows: If it is assumed that the filling cycle of the washing machine tub has already begun, air pressure will be directed into the air chamber 115a through the tube connector 116 in proportion to the weight and consequently the level of the water in the washing machine tub as has been hereinbefore described. As the pressure of air within the chamber 115a gradually builds up, the diaphragm 114 will tend to move upwardly within the hollow valve body and translate this upward movement to the snap blade 120 through the connecting rod 118. When the snap blade has reached a position slightly above the plane of the snap arm 121 the overcenter spring 123 will act to snap the free end of the spring arm 121 downwardly. This downward movement of the spring arm 121 will tend to simultaneously move the spool valves 137 and 138 downwardly within their respective piston channels 129 and 131 to thus close the communication between the passages 132 and 133 to close the shut-off valve and to open communication between the passages 127 and 128 to actuate the agitator control mechanism connected to the passage 128. Downward movement also vents the combined fill and shut-off valve actuating mechanism by opening line 133 to the atmosphere. At the same time, the upper head of the lower spool valve 137 closes off the vent from passageway 127.

As has been previously described, a water level adjust-

ment cam 140 may be provided on a cam shaft 141 journaled in a mounting bracket 142 connected to the valve body 110. The water level adjustment cam 140 will be operative to adjust the position of the piston 143 within the two part valve block 144 to thus vary the biasing force acting on the snap blade 120 through the spring member 146.

It should be noted in connection with the structure illustrated in FIGURE 3 that even though the force available for the control action is very small the switch and control valve are directly operated rather than through a pilot operation such as described in FIGURES 1 and 2. This is made possible by an arrangement in which ports are merely covered or uncovered, thereby overcoming the friction of sliding a spool valve as shown in FIGURES 1 and 2.

It will herein be understood that applicant's device can readily be used with an air pressure system rather than a vacuum system and that the embodiments of the invention have been utilized for illustrative purposes only and that various modifications and variations of the present invention may be effected without departing from the spirit and scope of the novel concepts thereof.

It will further be understood that while in the specific description of FIGURES 1, 2 and 3, reference is made to the agitator, any other control function may be handled by connection in the place of the agitator or through a program selector.

I claim as my invention:

1. A fluid control valve comprising a valve body, a valve chamber within said valve body, a first passage communicating with said valve chamber, evacuating means connected to said first passage, a pair of second passages communicable with said valve chamber, a valve member within said valve chamber operable to communicate said first passage with one or the other of said second passages, a diaphragm chamber within said valve body, a flexible diaphragm within said diaphragm chamber connected to said valve member, means biasing said diaphragm in one direction, and means for communicating said evacuating means with said diaphragm chamber to withdraw air from one side of said diaphragm to overcome the force exerted by said biasing means to move said

diaphragm and valve member in an opposite direction, and means for controlling the energization of said evacuating means as a function of the position of said valve member within said valve chamber.

2. A fluid control valve comprising a valve body, a valve chamber within said valve body, a first passage communicable with said valve chamber, pneumatic pump means connected to said first passage, a pair of second passages communicable with said valve chamber, a valve member within said valve chamber operable to communicate said first passage with one or the other of said second passages, a second chamber within said valve body, a movable wall disposed within said second chamber and connected to said valve member, means biasing said movable wall in one direction, means for communicating said pneumatic pump means with said second chamber to effect movement of said movable wall to overcome the force exerted by said biasing means by fluid pressure differential on opposite sides thereof to move said movable wall and said valve member in an opposite direction, and means for controlling the energization of said pneumatic pump means as a function of the position of said valve member within said valve chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

1,292,013	Munger	Jan. 21, 1919
1,921,092	Newton	Aug. 8, 1933
2,218,936	Melown	Oct. 22, 1940
2,302,232	MacNeil	Nov. 17, 1942
2,323,519	Dean	July 6, 1943
2,373,259	Price	Apr. 10, 1945
2,457,874	Davis	Jan. 4, 1949
2,554,672	Johnston	May 29, 1951
2,607,207	Branson	Aug. 19, 1952
2,619,823	Palmer	Dec. 2, 1952
2,630,135	Johnson	Mar. 3, 1953
2,736,629	Smith	Feb. 28, 1956
2,811,167	Bott	Oct. 29, 1957
2,912,009	Cooksley	Nov. 10, 1959

FOREIGN PATENTS

231,630	Switzerland	July 1, 1944
---------	-------------	--------------