

Oct. 20, 1953

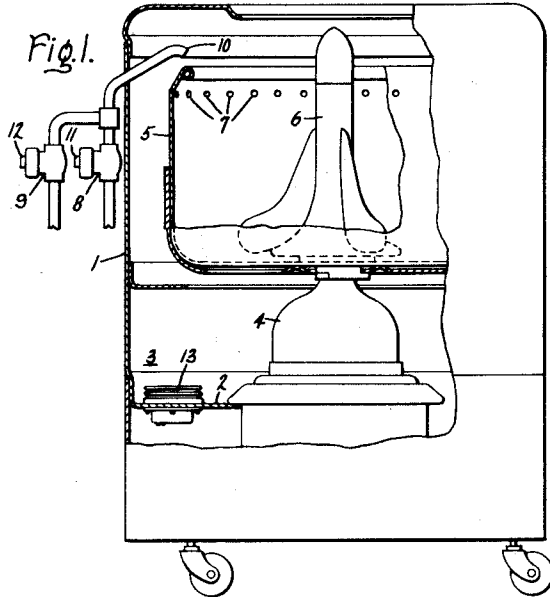
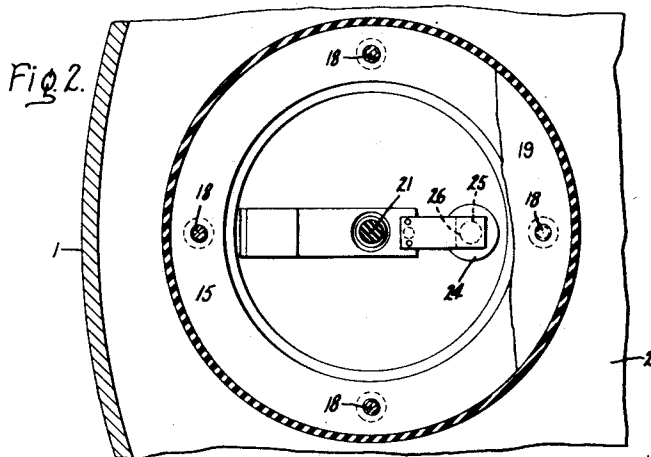
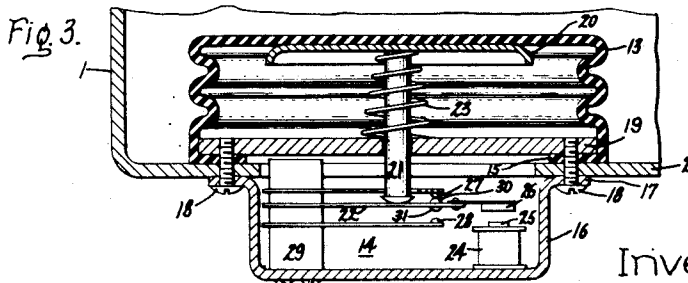
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2,656,431

CONTROL FOR AUTOMATIC WASHING MACHINES

Filed April 21, 1951

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 4.

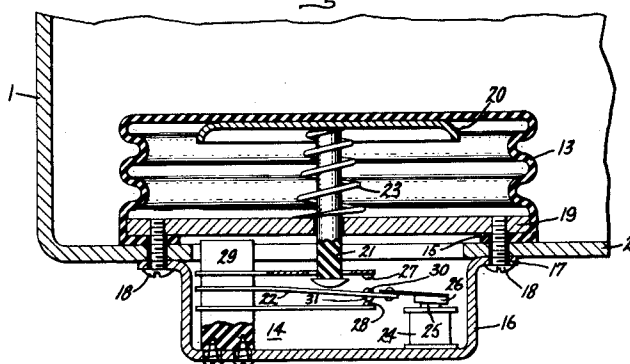


Fig. 5.

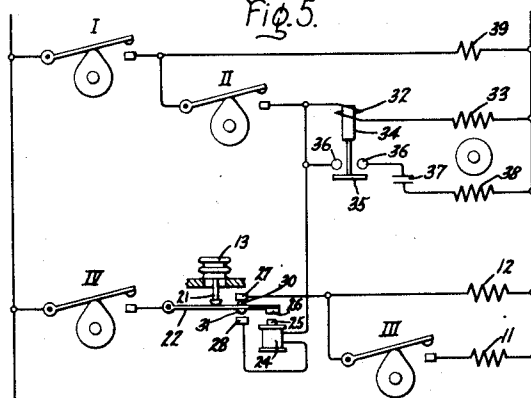
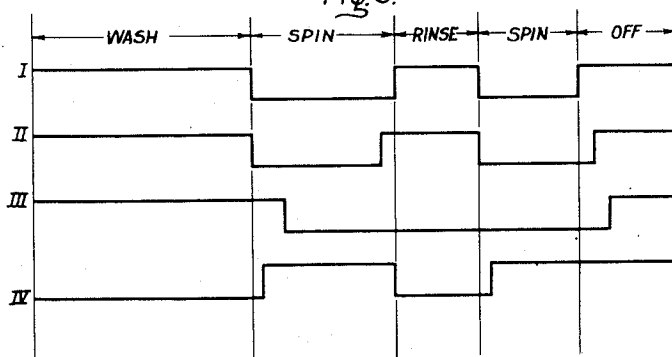


Fig. 6.



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UNITED STATES PATENT OFFICE

2,656,431

CONTROL FOR AUTOMATIC WASHING
MACHINESJohn Bochan, Trenton, N. J., assignor to General
Electric Company, a corporation of New York

Application April 21, 1951, Serial No. 222,255

1 Claim. (Cl. 200—83)

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This invention relates to an improved extractor type washing machine and in particular to an improved control means for such machines.

Many well-known types of domestic washing machines use a single basket in which the clothes are washed, which basket may be rotated at high speed to centrifugally extract the liquid from the clothes. Such machines commonly employ a timer operated control system under the dictates of which the clothes basket is filled until the water overflows and accumulates in a tub surrounding the basket. Upon the accumulation of a small amount of water in this tub, a float is elevated which shuts off the incoming water by operating a float switch which switch also energizes a circuit for the operation of a motor for driving washing means provided within the basket. The basket during this period is held stationary by suitable brake means. After a predetermined washing time has elapsed, the timer operated program controller energizes a valve to direct liquid under pressure to a combined clutching and braking system to release the brake and disconnect the agitator and couple the basket shaft directly to the drive motor. The basket is then rotated at a high speed to remove the washing liquid by centrifugal action. The liquid removed during spinning collects in the tub and is pumped therefrom by a drain pump operated at the appropriate time by the program controller. The washing basket is then refilled with clear rinsing water, again to overflowing, and the float control switch is again operated to shut off the flow of water and to cause operation of the mechanical agitator so that the clothes may be thoroughly agitated in the rinse water. Following this rinse cycle, the water is again extracted by spinning the clothes basket, which operation takes place in response to the energization of the spin solenoid valve in the hydraulic pressure system just as took place following the wash cycle. It will be understood that there may be one or more rinsing periods. A washing machine utilizing the essentials of the foregoing control system is described and claimed in the presently pending application of Thomas T. Woodson, Serial No. 639,816, filed January 8, 1946, now Patent No. 2,561,257, for Control for Automatic Washing Machine and owned by the General Electric Company, assignee of the instant application. A program control switch useful with such a machine is disclosed and claimed in the presently pending application of Harold A. Jones, Serial No. 33,943, filed June 19, 1948, now Patent No. 2,608,082, for Automatic Washing Machine Control and also owned by the General Electric Company.

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The drain pump in this type of machine is generally driven by a separate motor because its operation is correlated to the several cycles and consequently it must be capable of being independently controlled and timed as by the program controller. The presently pending application of David L. Clark, Serial No. 213,546, filed March 2, 1951, for Control for Automatic Washing Machine, owned by the General Electric Company, discloses and claims a control system pursuant to which the drain pump may be directly mounted on an extension of the drive motor shaft, thus eliminating the necessity for a separately powered pump and simplifying the assembly and maintenance of the machine. In the Clark application an electromagnetic holding device, energized upon the attainment of a desired level of overflow water, is provided to maintain the float in its raised position and thus establish and retain the standard control circuit even though the accumulated water will have quickly been removed by the operation of the pump. This hold in circuit is made effective, moreover, only during the cycles in which the further operation of the machine depends upon water accumulation within the tub. The system disclosed and claimed by the Clark application is very successful in permitting the use of a drain pump driven directly by the drive motor shaft but a rather large electromagnet is required in order to support the weight of the float and hold it in its elevated position. I have devised an improved water level responsive member for such a control system in which the drain pump may be directly driven by the drive motor shaft or a continuously open gravity drain employed of a smaller capacity than the water inlet flow, and in which a considerably smaller and less powerful electromagnet or a relatively small solenoid can be substituted for the hold-in means of Clark. Moreover, my improved control means is particularly adapted for use when a water pressure responsive diaphragm or bellows is used in place of the pivoted float member.

It is an object of my invention to provide an improved clothes washer control switch and mounting therefor, which switch is responsive in part to the depth of water accumulation in the outer drain tub.

It is a further object of my invention to provide means whereby upon operation of a pressure actuated switch in response to the accumulation of a predetermined amount of water in the overflow tub, a circuit is completed to prevent return of this pressure actuated switch to its normal position even though upon its operation the main

drive motor is energized and the pump driven thereby immediately exhausts the water accumulated in the overflow tub.

It is a more specific object of my invention to provide a clothes washer control switch system utilizing a small, economical and compact holding means for a pressure responsive switch.

In my presently preferred embodiment of my invention I provide an improved diaphragm operated switch completely sealed upon mounting in a washing machine tub with an electromagnetic holding device energized, upon the attainment of the desired level of overflow water in the overflow tub, by said pressure responsive switch.

Other features and advantages of my invention will be readily apparent from the following detailed description read in association with the accompanying drawings showing the application of my control system to an automatic domestic washing machine, and in which Fig. 1 is a side elevation of an automatic washing machine embodying the invention, certain portions of the machine elements having been broken away to reveal underlying structure; Fig. 2 is a sectional plan view of a pressure responsive member located in the bottom of the washing machine tub shown in Fig. 1; Fig. 3 is a sectional plan view of the pressure responsive member of Fig. 2 showing it with the tub empty and the pressure responsive switch in its normal position; Fig. 4 is a view similar to Fig. 3 with the tub empty but showing the pressure responsive switch held by the holding device in its operated position; Fig. 5 is a schematic wiring diagram of a control system; and Fig. 6 is a representation of the program control cam operations.

Referring now to the drawings there is shown a domestic clothes washer including an imperforate container 1 provided with a bottom wall 2 which forms the bottom of tub 3 within which water accumulates as presently described. Suitably resiliently supported within a central opening in said bottom wall is a casing 4 which contains a motor gearing and transmission (not shown) by means of which a basket 5 rotatably supported within the container 1 may be rapidly spun during water removal periods, and a mechanical agitator 6 mounted within the basket 5 may be oscillated during washing periods. It will be noted that the side walls of the basket slope upwardly and outwardly to a zone of maximum diameter at which are a plurality of overflow ports 7 which define the normal level of washing liquid. Water is introduced directly into the basket by means of cold and hot water valves 8 and 9, the outlets of which merge into a single discharge spout 10. The valves 8 and 9 are controlled by suitable solenoids 11 and 12. For simplification of a description of the operation it will be assumed that solenoid control valve 8 is connected directly to the cold water service line of the building and that solenoid controlled valve 9 is connected to the hot water line. Warm water, represented by a mixture of hot and cold water, is supplied to the machine for all rinsing operations and may be optionally supplied for washing clothes which might be damaged in hot water. In the following description, however, it will be assumed that all of the washing operations are conducted in hot water, pursuant to which only the solenoid valve 9 would be energized and the rinsing operations are conducted with a mixture of hot and cold water following the joint energization of solenoid valves 8 and 9.

To further simplify the description it will be assumed that one wash and one rinse are employed, although it is understood that the washing may be preceded by a soaking period and followed by several rinsing operations. During washing and rinsing, water is discharged from the spout 10 into the basket 5 where it collects until the water level reaches the height of overflow port 7, through which ports all excess water supplied will drain. This overflow water collects in the bottom of the tub 3 until a sufficient quantity has been accumulated to depress a pressure responsive resilient bellows or diaphragm 13. The bellows 13 is resilient, convoluted, and liquid impervious and located on the bottom wall 2 of the tub 3. It may be constructed of any suitable resilient material such as rubber. Actuated in response to a depression of the bellows 13 is a switch 14, suitably supported below the lower end of the bellows, as more particularly described hereinafter.

The bellows 13 is open at its lower end and is provided with an inwardly turned bottom flange 15 in abutment with the bottom wall 2 of the tub 3. The wall 2 is provided with an opening beneath the bellows 13 and corresponding with its bottom opening, as defined by the bottom flange member 15. Below the tub opening I provide a cup 16 in which the switch 14 is housed. This cup has an outwardly turned upper flange 17 which is held in tight engagement with the underside of the wall 2 by a plurality of screws 18 which are threaded upwardly through the flange 17, the wall 2, the flange 15 and a flat circular plate 19 positioned on the upper side of the flange 15. The plate 19 is drawn downwardly by the screws 18 so as to compress the rubber flange 15 of the diaphragm 13, thereby sealing the bottom opening in the diaphragm against the bottom wall 2 of the tub 3.

I provide means of transmitting the water pressure changes acting on the diaphragm 13 to the switch 14 in the form of a disc 20 to the underside of which I fix a switch actuator shaft 21, which shaft extends loosely through an opening in the plate 19. The free end of the shaft 21 bears against a switch arm 22 of the switch 14. A coil spring 23 is positioned between the plate 19 and disc 20, around the shaft 21, to bias the plate 20 inwardly against the upper end of the bellows 13, which is biased thereby upwardly against the pressure of the accumulated water in the tub 3.

Within the cup 16 I provide an electromagnet 24 having a pole piece 25. I further provide an armature 26 engageable with the armature and carried by and extending from the end of the switch arm 22. Also within the cup 16 are a pair of electrical contactors 27 and 28, each carried by an electrically conducting arm supported on an insulating post 29, which post also supports the switch arm 22, which carries on its free end a pair of electrically conductive contact members 30 and 31, engageable respectively with contactors 27 and 28. The arm 22 is made of a resilient electrically conductive material and is biased upwardly so that contact member 30 is normally in engagement with contactor 27. Upon the accumulation of water in sufficient depth in the tub 3, the bellows 13 is depressed, and the plate 20 is moved downwardly, overcoming the bias of the spring 23. The switch actuator shaft 21 then moves the arm 22 to its lower position, in which contact member 31 is in engagement with contactor 28.

When the water is exhausted from the tub 3, the pressure causing the depression of the diaphragm 13 is relieved permitting the upper end of the diaphragm to be moved upwardly by the disc 20 under the biasing influence of the spring 23. Since the switch actuator shaft 21 is fixed on the under side of the disc plate 20, it is moved upwardly with it, permitting the switch arm 22 to return to its normal position in which its contact member 30 is in engagement with contactor 27. As more fully explained hereinafter the return of the switch arm 22 to its upper normal position is restrained at selective intervals during the washing and rinsing cycles by the action of the electromagnet 24 which is energized by a circuit completed through the contact member 31 and the contactor 28. When thus energized the armature 25 of the electromagnet engages the pole piece 26 carried by the arm 22 and holds it down with sufficient force to maintain engagement between contact member 31 and contactor 28 so long as the holding circuit is neither interrupted nor shunted. As a result the bellows 13, the plate 20, and the actuator shaft 21 can all be moved upwardly under the influence of spring 23 without having any effect on the position of the switch 14.

A pump (not shown) driven directly by the main drive shaft, within the casing 4, will exhaust the water which has accumulated in the tub 3 whenever the main drive motor is energized. Consequently as soon as the motor is started, the water in the tub 3 will be drained almost immediately and the bellows will expand. Except for the electromagnet 24 the switch contact arm 22 would then return to its normal upper position. As will be understood by the following description of the control circuit, this would prevent proper sequential operation of the machine during the remainder of the washing and rinsing cycles. It is to be understood, however, that the control circuitry of the washing machine forms no part of the invention of this application, but does form the subject matter claimed by the aforementioned Clark application Serial No. 213,546, owned by the common assignee.

Referring now to Figs. 5 and 6 in which all the control switches are shown in their open position and the switch 14 is shown with its contact arm 22 in its normal upper position, it can be readily seen that some holding device, such as the electromagnet 24, is necessary to the proper control of the operation of the machine. At the beginning of the wash cycle, as shown in Fig. 6, switches I, II, and III are open and switch IV is closed in response to the program controller (not shown), which controller may be of any suitable type such as that disclosed in the aforementioned Jones application. This completes a circuit to the solenoid 12 of the hot water valve 9, which opens the valve, permitting hot water to be discharged by the spout 10 to the basket 5. This circuit remains energized until the overflow water from the basket 5 has accumulated in the drain tub 3 in sufficient quantity to depress the diaphragm 13, whereby the actuator shaft 21 is pushed downwardly to move the switch arm 22 from its upper to its lower position, moving contact member 30 out of engagement with contactor 27 and moving contact member 31 into engagement with contactor 28. The circuit to the solenoid 12 is thereby interrupted and a circuit through the electromagnet 24, a starting relay 32, and the main motor winding 33 is completed. The starting relay 32 is provided with

a plunger 34 which carries contact arm 35 which is arranged to bridge a pair of open contacts 36. The relay 32 is of a sufficient rating that the plunger 34 will be raised to cause the contacts 36 to be bridged only when the high starting current for the motor is flowing through the relay coil. The consequent bridging of the contacts 36 completes a circuit through a starting capacitor 37 and a motor start winding 38. When the motor comes up to operating speed, its current requirements decrease and the current through the start relay 32 is insufficient for the relay to hold the plunger 34 in its raised position. Consequently it falls, opening the contacts 36, thus automatically removing the starting capacitor and start winding from the circuit. At this point in the cycle, the motor is driving the clothes agitator because until the switch I is closed the drive mechanism will not shift to its spin position. Although the motor is also driving the drain pump and the water accumulated in the tub 3 is being rapidly exhausted, the bellows 13 being permitted to expand under the influence in the spring 23, the switch arm 22 is held in its lower position by the electromagnet. Consequently, this circuit is undisturbed during the remainder of the wash period, even though the bellows has been expanded to its normal position.

At the end of the wash period, switches I and II are closed by the action of the program controller, the switch I completing a circuit through a spin valve solenoid 39 and the switch II completing a new circuit through the starting relay 32 and the main motor winding 33 which new circuit has the effect of shunting the previous circuit through the electromagnet 24. Energization of the spin solenoid 39 causes the hydraulic drive mechanism to shift from its normal agitating position to its spin position in the manner described in the aforementioned Woodson application so that the basket 5 will be rotated at high speed for centrifugal extraction of the wash water from the basket and clothes. As this wash water is thrown by centrifugal force to the point of maximum diameter in the basket 5, it passes through the overflow ports 7 from where it drains into the tub 3. Since the switch II shunts the circuit through the electromagnet 24, the pole piece 26 is no longer held in engagement with the armature 25 and the switch arm 22 is permitted to return to its normal upper position. Thus the switch 14 is again responsive to the accumulation of water in the tub 3. Since the motor and consequently the drain pump are operating continuously during the entire spin cycle, any water accumulated in the tub 3 will be promptly exhausted, the bellows 13 will be expanded under the influence of the spring 23 and the switch actuator shaft 21 will return to its normal upper position. Consequently the electromagnet being ineffective to restrain its movement, the switch arm 22 will rise so that contact member 30 is in engagement with contactor 27, thus completing a circuit through the solenoid 12 to open the hot water valve 9 and once again supply hot water to the basket 5. Shortly after the beginning of the spin cycle, as shown in Fig. 6, the switch IV is opened by the program controller and the circuit to the solenoid 12 is interrupted, shutting off the hot water. Then the switch III is permitted by the program controller to close so that the solenoid 11 for the cold water valve 8 is placed in parallel relation with the solenoid 12 for the hot water valve 9. Consequently, upon the next

closing of the switch 4 a circuit will be made through both solenoids 11 and 12 to open the hot and cold water valves to supply a warm water mixture to the machine. Since switch III remains closed for the duration of the operation of the machine, warm water only will be supplied in all subsequent operations.

Near the close of the spin period, the switch II is opened by the program controller cam, breaking the circuit to the main motor winding, whereupon the motor will coast to a stop. In this particular arrangement the program controlling cams are driven by the main drive motor through suitable gear reductions so that certain switching operations necessary at the end of the spin cycle are accomplished during the coast period. By a suitable conventional circuit arrangement (not shown) a separate timer motor to drive the program controller may be employed. During this coast period switch IV is permitted to close completing a circuit through the solenoids 11 and 12 for the hot and cold water valves 8 and 9. Warm water is then supplied by the spout 10 to the basket 5. Switch I is opened simultaneously with switch IV breaking the circuit to the spin solenoid 39 so that upon reenergization of the motor winding the agitator and not the spin basket will be driven. When the basket 5 is filled with rinse water to the overflow ports 7 and sufficient water has accumulated in the tub 3, the bellows 13 is again depressed, moving the switch 14 to its lower position and thereby completing the circuit through the electromagnet 24, the motor start relay 32 and the main motor winding 33. Then as previously described, the starting capacitor 36 and the start winding 37 are temporarily placed in the circuit while the motor is coming up to speed. Depression of the plunger 21 has interrupted the circuit to the solenoids 11 and 12 so that no more rinse water is admitted. As before, the electromagnet 24 prevents the switch arm 22 from rising when the water is exhausted from the tub 3, so that the agitator 6 continues to flex the clothes for the duration of the rinse cycle. At the end of the rinse period, switches I and II are closed and the spin operation previously described is repeated. Following the spin operation, the program controller opens all of the switches and the machine has now been through the full series of operations.

It is now apparent that electromagnet 24 must be energized to maintain the switch arm 22 in its lower position and contact member 31 engaged with contactor 28 to complete the circuit through the motor winding 33, except when both switches I and II are closed. When switches I and II are closed the electromagnet 24 is shunted out and the hold-in circuit becomes ineffective,

but, of course, it is now unneeded because the motor winding is independently energized. This hold-in circuit is effective only during the cycles in which the further operation of the machine would ordinarily depend upon water accumulation within the tub and consequently make it necessary for the switch arm 22 to be kept in its lowered position to simulate this condition of accumulated water.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made; and I therefore contemplate by the appended claim to cover any such modifications as fall 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:

A fluid pressure activated switch comprising a cup shaped open ended collapsible bellows having a marginal flange, a cup shaped casing having a marginal flange, said bellows and casing being adapted to have their flanges fastened together to form a liquid tight housing and to have clamped between the flanges the edge of an opening through a wall of a vessel adapted to contain a liquid, spring means in the housing for biasing said bellows to its extended position, an actuating plunger in the housing which at its one end engages the end wall of said bellows, the other end of the plunger extending into said casing, a switch enclosed in said casing having a movable switch arm with which the lower end of said plunger engages for actuating the switch by movement of said bellows, an armature carried by said switch arm, and an electromagnet in the casing positioned below said armature in a series circuit relation with said switch and which when energized serves to hold said switch arm in actuated position independently of said bellows.

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