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AUTOMATIC WASHING MACHINE WITH WATER-SOFTENING MEANS

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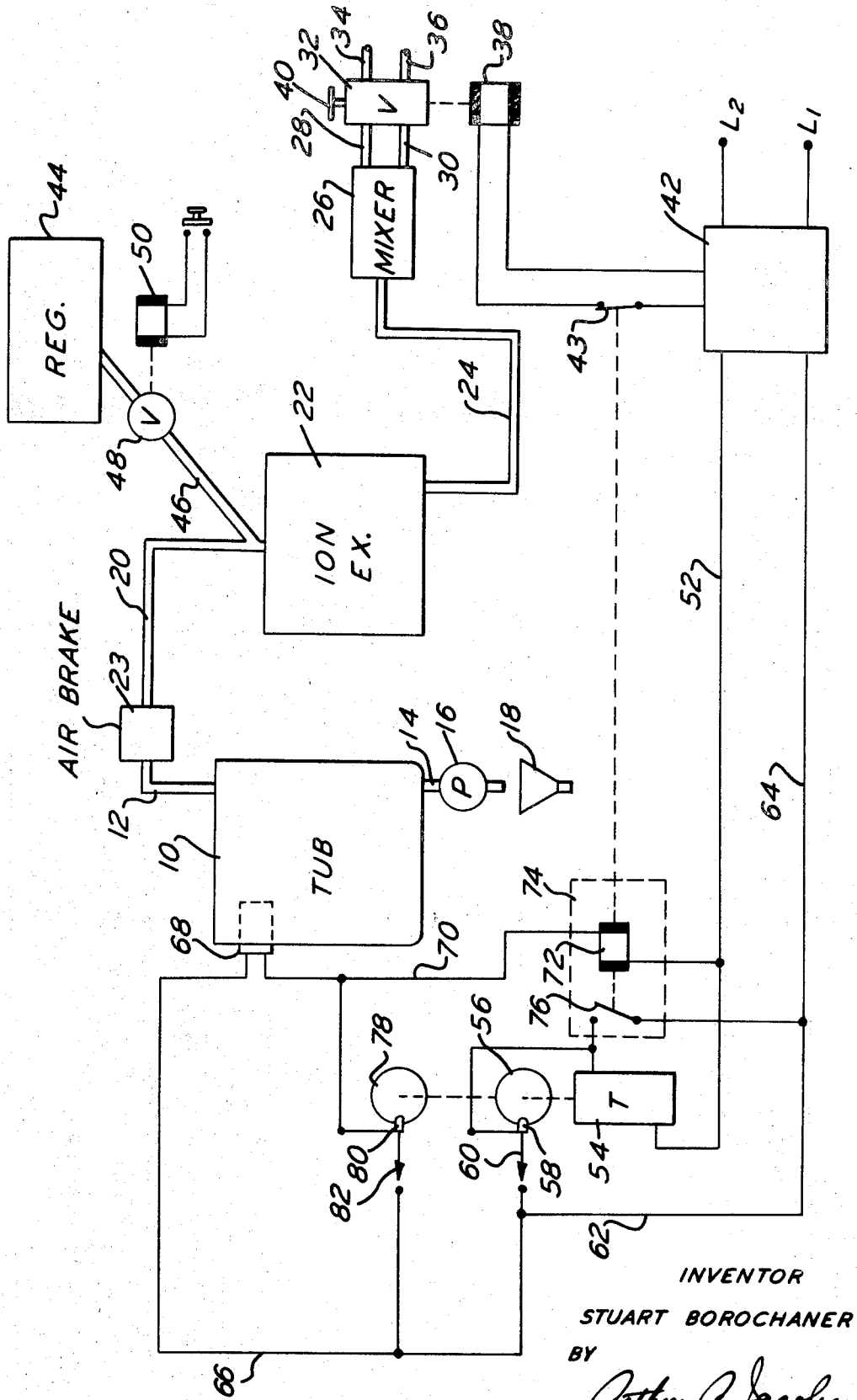

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AUTOMATIC WASHING MACHINE WITH WATER-SOFTENING MEANS

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ABSTRACT OF THE DISCLOSURE

A water softening system for a washing machine which comprises an ion-exchange chamber, containing an ion-exchange resin, and a regenerating chamber, containing fluid for regenerating the ion-exchange resin prior to the next washing operation. The regenerating chamber is directly connected to the ion-exchange chamber and has no connection with the water system itself. The regenerating fluid is flushed through the ion-exchange chamber into the drain by the operation of the drain pump.

This is a division of co-pending application Ser. No. 708,675, filed Feb. 27, 1968.

This invention relates to automatic washing machines utilizable for washing clothes, dishes, etc., and it particularly relates to machines of the above type having means for softening hard water.

It has long been known that hard water, i.e., water that contains relatively large amounts of calcium and magnesium, is undesirable for most household purposes such as cooking, washing, and the like. It is known that fabrics which have been washed in detergent solutions of hard water are not as soft and pliable as fabrics that have been washed in soap solution of soft water because detergents tend to remove the natural oils and moisture from the fibers of the fabrics. However, in hard water, it is necessary to use a great amount of detergents, even when using soap because otherwise, there is a tendency for the soaps to react with the calcium or magnesium ions to form insoluble salts which precipitate upon the fabrics.

In order to overcome the aforementioned problems, it was heretofore proposed to provide a mechanism within the machine itself that was constructed to automatically soften the water as it flowed through the machine into the washing tub therein. This mechanism included an ion-exchange chamber through which the water passed prior to entering the tub and means to pass regenerating material through the ion-exchange chamber to regenerate the ion-exchange material and maintain it in ready condition for each flow of water therethrough. This was all accomplished automatically during the machine cycles.

The above-described ion-exchange system, which is embodied in applicant's U.S. Pat. No. 3,204,767, proved to be an important advance over prior systems. However, it required a large number of valves, solenoid operating means for the valves, and a relatively complicated piping system which not only materially increased the cost of the machine but also provided increased possibility of breakdowns due to malfunctioning of the valves and solenoids. An especial problem was that if a solenoid valve was used between the water system and the tub, if a break should occur in the water main and if the valve should

malfunction at the same time, the sewerage from the drain line would be sucked back into the water system.

It is, therefore, one subject of the present invention to overcome the above difficulties by providing a softening system in a washing machine which, although effective to automatically soften the water during the washing operation, eliminates all the valves and solenoids other than those already present in existing machines, as well as much of the complicated piping previously required.

Another object of the present invention is to provide a softening system of the aforesaid type wherein the water system will be free of any possibility of contamination from the drain line if there is a break in the main line.

Another object of the present invention is to provide a softening system of the aforesaid type which is adapted to utilize parts of the washing machine itself and thereby eliminate additional parts which would otherwise be required.

Another object of the present invention is to provide a softening system of the aforesaid type having maximum efficiency with a minimum of cost.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following description when read in conjunction with the accompanying drawings wherein:

The single figure is a schematic view of a system embodying the present invention.

Referring now in greater detail to the drawings wherein similar reference characters refer to similar parts, there is shown a system comprising a washing machine tub **10** having a water inlet **12** and a water outlet **14**. The water outlet **14** is connected to a pump **16** which is of standard construction and arrangement whereby it pumps the drainage from the outlet **14** into a drain outlet **18**.

The inlet **12** is connected by a conduit **20** to an ion-exchange chamber **22**. An air brake **23**, of standard construction, is interposed in the conduit **20** for the purpose of preventing back flow into the ion-exchange chamber **22** from the tub **10** in the event there is a break or rupture in the conduit.

The ion-exchange chamber **22** may be of any standard construction, and the ion-exchange resin therein may comprise any desirable and feasible resin of this type. A conduit **24** leads into the bottom of the chamber **22** from a mixing chamber **26** that is, in turn, provided with hot and cold conduits **28** and **30** leading from a mixing valve **32**. Hot and cold water lines **34** and **36** lead into the valve **32** from sources (not shown) which would ordinarily be the hot and cold water lines of the house or building.

The mixing valve **32** may be of any standard type and is normally in the closed position whereby both the hot and cold water inlets are shut off. It may be of a piston type with two heads, one for each of the hot and cold inlets, which is moved into the open position by a solenoid **38**, and which is urged into the closed position by a spring or the like. Manually adjustable means of any standard type, actuated by a handle **40**, may, if desired, be provided to supply varying proportions of hot and cold water. The solenoid **38** is electrically actuated by turning on the master switch **42** which is connected thereto through a normally closed switch **43**.

A tank **44**, adapted to hold a regenerating fluid for the ion-exchange resin in chamber **22**, is provided with a conduit **46**, which is connected to the outlet conduit **20** just

above the chamber 22. The outlet is, therefore, also used as a gravity inlet for the regenerating fluid, the gravity-fed pressure of the fluid being sufficient to overcome any pressure in the conduit 20. However, if desired, a separate inlet may be used. It may, furthermore, be desired to pass the fluid into the side instead of the top of the ion-exchange chamber. In such case, it would be preferable to not only provide a separate inlet for the fluid but also a distributor therefor, of standard design, within the ion-exchange chamber.

The tank 44 is preferably the standard "bleach dispenser" which is found already installed in many automatic washing machines. However, the regenerating fluid is here substituted for the "bleach", thereby avoiding the installation of additional equipment. It is, of course, within the scope of this invention to retain the tank 44 for use as a "bleach dispenser" and to install a separate tank for the regenerating fluid, if so desired. A valve 48 is interposed in the conduit 46 and is actuated by a solenoid 50. This solenoid valve is presently installed as standard equipment for the bleach dispenser unit. The solenoid 50 is preferably in electrical circuit with a push button switch or the like, indicated at 51, which may be actuated when desired (usually at the end of a day's washing) to open the valve for a sufficient time to permit regenerating fluid to flow into the chamber 22. It is also possible, within the scope of the present invention, to electrically connect the solenoid 50 to the timer of the machine, so that it will automatically open and close at a selected interval during or at the end of the washing operation. The timer is also constructed to operate both the valve 32 and the pump 16 at timed intervals during the washing operation and, optionally, for the regeneration cycle as hereafter described.

The master switch 42 is electrically connected through a line 52 with the timer mechanism 54. The timer 54 may comprise any standard type now in use, for the purpose of causing the various agitation, spin, rinse, etc. steps in accordance with the particular type of machine into which the present system is incorporated. It also controls the actuation of the pump 16 in accordance with the predetermined cycling system and may, if desired, operate the solenoid 50 when automatic regeneration is desired.

In the particular illustrative embodiment shown here, the timer is illustrated as being provided with a rotatable cam 56 having a notch at one portion thereof. A follower 58 is engageable within this notch and is connected to a linearly movable switch 60. The switch 60 is connected by a line 62 to the return power line 64 leading to master switch 42, and by a line 66 to a normally open switch 68 which is, in turn, connected by a line 70 to a solenoid 72 of a relay 74.

The switch 68 is preferably of the pressure-responsive type, being operatively connected to a tube communicating with the interior of the clothes basket within the tub 10. As the basket fills with water, the water forces the air in tube ahead of it and creates an air piston arrangement which operates the pressure switch when the pressure head of the water reaches a predetermined level.

The solenoid 72 is operatively connected to the normally closed switch 43 and to a normally open switch 76 which is adapted, when closed, to complete the circuit between the master switch 42 and the timer 54.

In the operation of the machine, the master switch 42 is closed, thereby actuating the valve 32 to move into the open position to permit the hot and cold water, with their relative flow adjusted as desired, to flow into the mixing chamber 26. The water then flows through the ion-exchange chamber 22 into the tub 10. At this time the switch 76 is open.

Upon the water in the tub reaching the predetermined level, the switch 68 is closed, thereby energizing the solenoid 72, which opens the switch 43 and closes the switch 76 to actuate the timer 54. The timer 54 thereupon begins to rotate the cam 56. This causes the follower 58 to drop out of the notch in the cam and to ride along the cam surface. The follower 58 is biased by a spring or the like to move against the cam and to hold the switch 60 open. However, the cam surface of the cam 56, except at the notch, is contoured to push the follower 58 and switch 60 into the closed position. This closed position is maintained throughout the rotation of the cam 56 and keeps the timer circuit closed.

The timer 54 is provided with standard means for causing the usual agitation, rinse and spin steps in the desired succession. The timing means may be similar to that shown in the aforesaid Pat. 3,204,767 or to any other standard type timing means of the type already used in commercial washing machines. The timer causes the circuit to the solenoid 72 to open and close in accordance with the functioning of the timer mechanism thereby opening and closing the switch 43 controlling the solenoid 38 which, in turn, controls the water flow.

If a timer mechanism such as shown in Pat. No. 3,204,-767 is used, a second cam 78, operated by the timer, is provided with a follower 80 connected to a linearly movable switch 82. The cam 78 opens and closes the circuit to the solenoid 72, while the switch 68 is open, to control the switch 43 and, therefore, the flow of water. In this system, the cams 56 and 78 preferably rotate once during each half of the cycle, as in Pat. No. 3,204,767.

At some selected time, usually at the end of the washing operation, if the timer mechanism is used, it actuates the solenoid 50 to open the valve 48 to cause the regenerating fluid to flow, by gravity, from tank 44 into the ion-exchange chamber. At this time, the water flow is cut off. The timer then, after a predetermined interval, actuates the solenoid 38 to open the valve 32, causing the water to flow, and also actuates the pump 16. The pump then draws the water and excess regenerating fluid from the ion-exchange chamber 22 to the drain 18.

If the push button switch 51 is used, it opens the valve 48. The regenerating fluid is then permitted to remain in the ion-exchange chamber 22 until the washing machine is again activated. In such case, the first step, when the machine is again started, is a flushing step, whereby the excess regenerating fluid in the ion-exchange chamber and water from the mixing chamber 26 are drawn through the tub into the drain by the pump. This is the preferable mode of operation since it permits the regenerating fluid to stay in the ion-exchange chamber longer and keeps the mechanism much simpler.

The push button switch may also, if desired, be electrically connected to the solenoid 38 and to the pump through a delay switch (not shown), so that after a predetermined interval following the opening of valve 48, the water would flow and the pump would operate to flush the excess regenerating fluid from the ion-exchange chamber.

After the regeneration of the ion-exchange resin has taken place in the above manner, the machine is ready for further use with the ion-exchange resin again ready to soften the water.

Obviously, many modifications of the present invention are possible in the light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced oherwise than as specifically described.

The invention claimed is:

1. A method of softening hard water during the operation of a washing machine having a wash tub provided with a drain outlet and a pump operatively connected to said drain outlet which comprises passing water from a source thereof upwardly through a first conduit communicating with the bottom of a bed of ion-exchange resin through said bed and into said tub, then passing into the top of said bed through a second conduit a

sufficient amount of regenerating fluid to regenerate said bed, terminating the flow of regenerating fluid and allowing the regenerating fluid sufficient time to regenerate the bed, flushing said regenerating fluid from the bed by passing water upwardly through said first conduit and through said bed, and discharging the flushed regenerating fluid through said wash tub and through said drain outlet by operation of said pump.

2. The method of claim 1 wherein the flushing step takes place immediately prior to the succeeding washing operation.

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