

[54] WATER-SOFTENING SYSTEM FOR WASHING MACHINES

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[52] U.S. Cl. 38/12 R, 68/13 A

[51] Int. Cl. B01d 15/06, D06f 29/00

[58] Field of Search 68/13 A, 12

[56] References Cited

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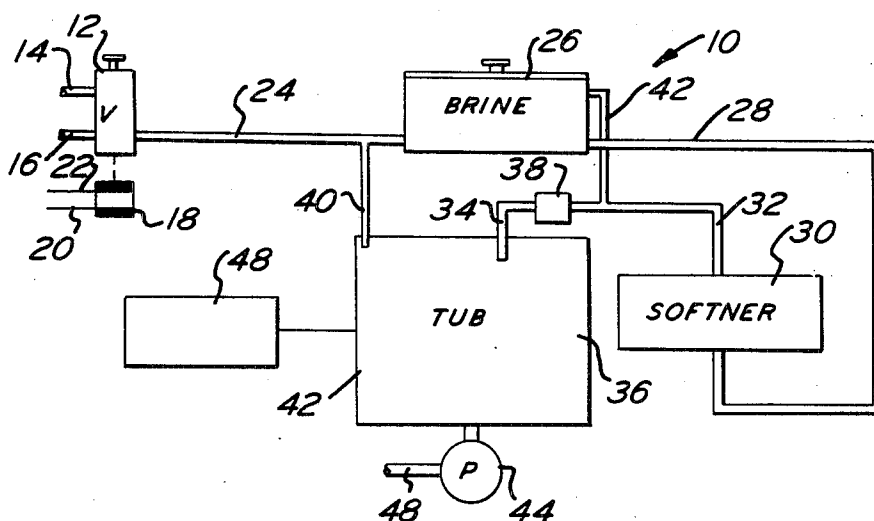
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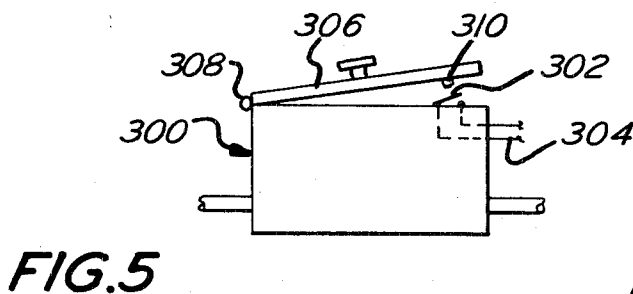
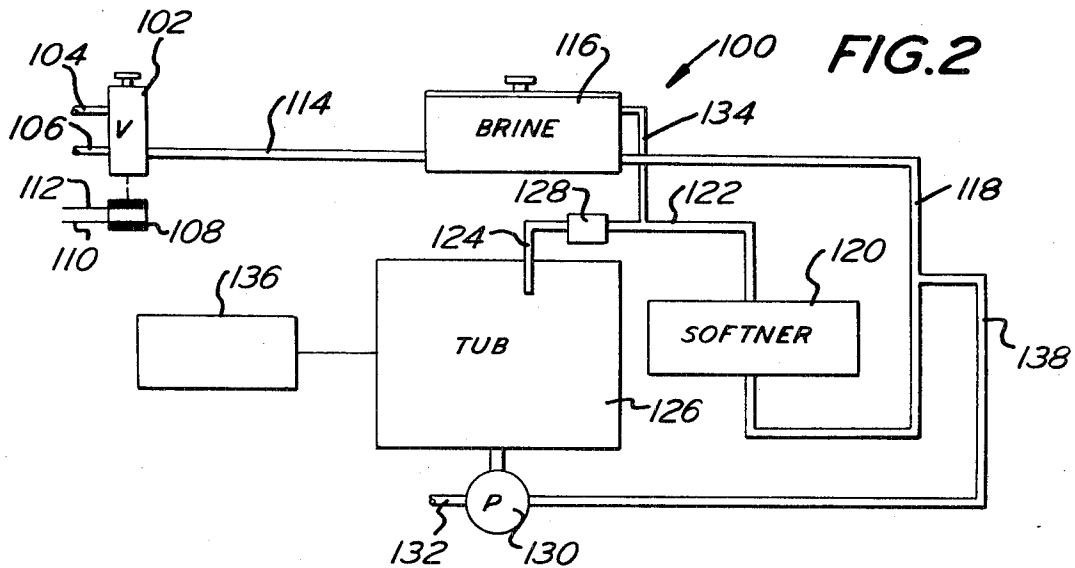
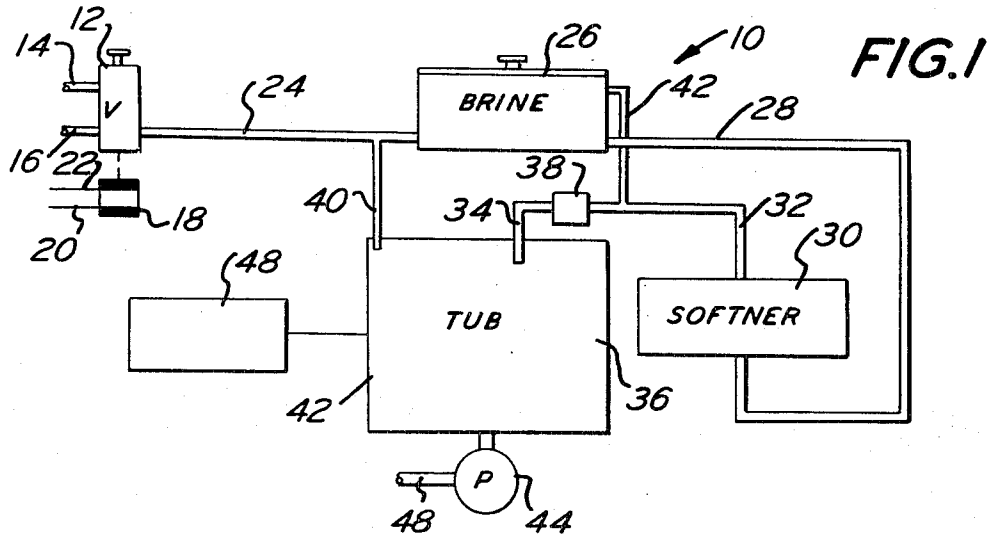
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[57] ABSTRACT

A water-softening system for washing machines and the like which comprises a regeneration chamber in direct circuit between the water supply and an ion-exchange chamber which is, in turn, in direct circuit with the washing machine tub. Normally, there is no regeneration material in the regeneration chamber so that water flows directly through to the ion-exchange chamber, where it is softened, and then into the tub. When it is necessary to regenerate the ion-exchange resin, regeneration material, either granular or fluid, is inserted into the regeneration chamber and the water from the source is permitted to flow for a brief interval sufficient to carry the regeneration material into the ion-exchange chamber. It is permitted to stay in the ion-exchange chamber for sufficient time to regenerate the ion-exchange resin and is then flushed out through the tub into the drain. No special control valves or other control means are necessary for the regeneration cycle.

2 Claims, 5 Drawing Figures





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FIG.3

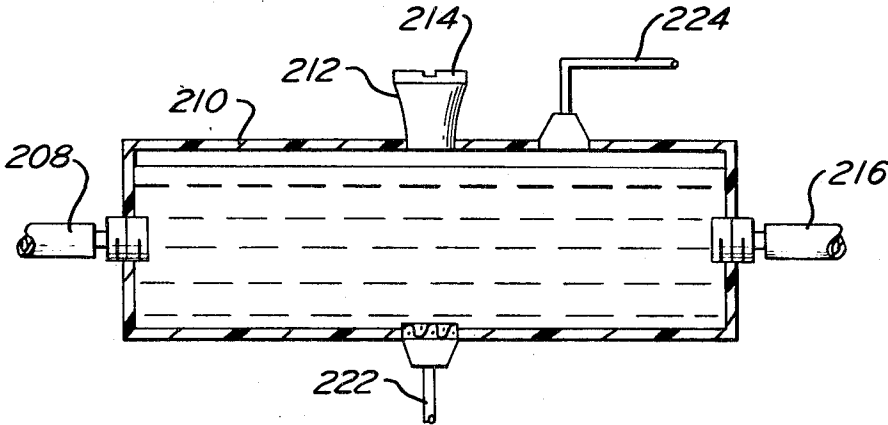
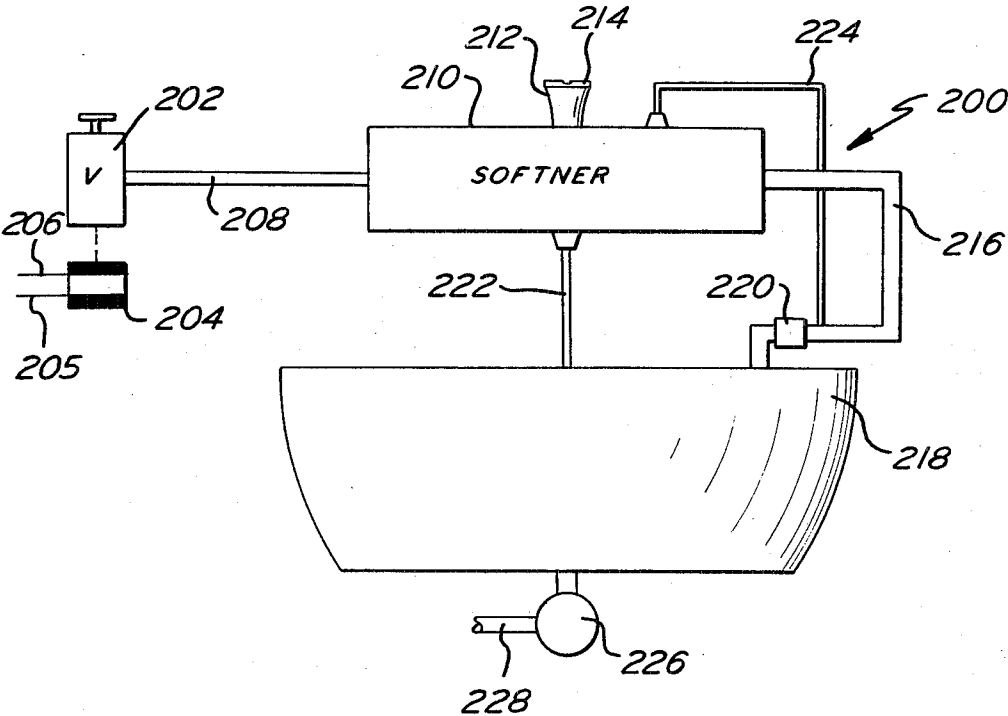


FIG.4

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WATER-SOFTENING SYSTEM FOR WASHING MACHINES

This invention relates to a water-softening system, and it particularly relates to a water-softening system utilizable in an automatic washing machine.

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 solutions 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 was, heretofore, not possible to eliminate all these valves, and especially the control valve for the regeneration fluid, and still have an operative and efficient system. This regeneration control valve was a particular problem because the regenerating fluid is a brine, such as sodium chloride solution. It was found that this brine, within a relatively short time, caused caking and corrosion of the valve, which, thereupon, began to constantly stick and ultimately became inoperable. As a result, it was necessary to continually clean and ultimately replace the valve after a relatively short period of use.

Furthermore, the piping in the system of the aforesaid patent, as well as in all other prior systems, was relatively complicated since not only was a separate line required for passage of the regeneration fluid to the ion-exchange chamber, and not only was a solenoid valve required in this line, but if the regeneration fluid chamber was to be supplied with water from the system to form the aqueous regeneration fluid, either a separate line was required from the source of water or a complicated double-action valve was required. The alternative was to make the solution outside the machine and then pour the solution itself into the regeneration chamber. This was undesirable since it required extra effort to which the ordinary housewife might object. It would be much simpler to merely insert the required amount of dry salt into the chamber whenever required.

As is readily apparent, the complex piping and the presence of the various valves not only increased the initial cost as well as the cost of maintenance of the machine, but also required additional space. This additional space was a problem in the case of small, relatively portable machines, where every amount of space and weight had to be utilized most economically.

It is, therefore, one object of the present invention, to provide a water-softening system for washing machines and the

like where all valving, and especially the control valve for the ion-exchange regenerating circuit, is eliminated.

Another object of the present invention is to provide a simple, straight-through flow water-softening system wherein the piping is reduced to a minimum with a consequent saving of space, weight and maintenance.

Another object of the present invention is to provide a system of the aforesaid type wherein the regeneration chamber is supplied with water for the brine solution directly from the source of water and without the necessity for using any bypass piping.

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:

FIG. 1 is a schematic view of one embodiment of the present invention.

FIG. 2 is a schematic view of an alternative embodiment of the present invention.

FIG. 3 is a partially schematic and partially elevational view of a simplified construction of the present invention.

FIG. 4 is a sectional view of the combined ion-exchange and regenerating unit shown in FIG. 3.

FIG. 5 is a schematic view of an optional feature in the regeneration chamber construction.

Referring now in greater detail to the various figures of the drawings wherein similar reference characters refer to similar parts, there is shown in FIG. 1 a system, generally designated 10, comprising a mixing valve 12, constituting the source of water for the system. Hot and cold water lines 14 and 16 lead into the valve 12 from sources (not shown) which would ordinarily be the hot and cold water lines of the house or other building. The valve 12 is actuated by a solenoid 18 electrically connected by lines 20 and 22 to a timer mechanism hereinafter described.

A conduit 24 leads from the mixing chamber 12 into the regeneration chamber 26. The chamber 26 is adapted to hold regeneration fluid for regenerating the ion-exchange resin after a period of use. This chamber 26 may have a removable or hinged lid for insertion of the regenerating material. This material is preferably granular, such as granular sodium chloride, but may be liquid if desired.

A conduit 28 leads from the regenerating chamber 26 to the ion-exchange chamber 30 which contains a supply of ion-exchange resin for softening the water. This ion-exchange resin may be of any standard type.

A conduit 32 leads to an inlet 34 into the inner tub 36 of the washing machine. An air brake 38, of standard construction, is interposed in the conduit 32, prior to the inlet 34. This air brake 38 is provided for the purpose of preventing backflow into the ion-exchange chamber 30 from the tub 36 in the event of a break or rupture in the conduit.

A drip line 40 of relatively narrow diameter, leads from the conduit 24 into the tub 36. However, if desired, the drip line 40 may alternatively lead directly to the drain line of the pump hereinafter described. A line 42, of similar diameter, leads from the conduit 32, adjacent to the air brake 38, into the regenerating chamber 26, above the conduit 28. Alternatively, the conduit 42 may lead to the tub 36 or be open directly to atmosphere.

A pump 44 is connected to the tub 36, this pump being connected to a drain pipe 46 in the ordinary manner.

The machine is actuated by a standard-type timer control means, indicated generally at 48. This timer mechanism may comprise any standard type now in use, as, for example, that disclosed in U.S. Pat. No. 3,204,767 or in U.S. Pat. No. 2,434,353. This timer mechanism causes the usual agitation, rinse and spin steps to occur in the desired succession. A separate timer circuit may be provided to activate and deactivate the water supply valve 12 and the pump 44 during the regeneration cycle. Such timer circuit would be similar to that used for the regular cycles. Alternatively, the main timer

mechanism may be provided with an additional regeneration cycle which is selectively actuated by a separate switch.

During the operation of the system, the water from the mixing valve 12 always flows through the regeneration chamber 26 as well as through the ion-exchange chamber 30 before entering the tub 36. In this manner, all the water used is first softened by the ion-exchange resin in chamber 30. However, it is not necessary to regenerate this resin each time. Only after a predetermined period of use is this necessary. A label with instructions for the periods of regeneration may be attached to the machine as a guide to the user.

Since regeneration is required only at predetermined intervals, in the usual operation of the machine, the water flows through the chamber 26 while it is empty. When regeneration is required, the user inserts the necessary amount of salt into the chamber 26, and pushes the button for "regeneration cycle." This activates the timing mechanism to open the valve 12 to cause water to flow through the regeneration chamber 26 into the ion-exchange chamber 30 for a very short period of time, for example, about 2 seconds. It then stops. The action remains stopped for a predetermined period, generally about 2 minutes, during which time, the salt regenerates the ion-exchange resin. The timer then activates the mixing valve 12 and the pump 44 to draw water through the tub and into the drain pipe in a flushing action of a predetermined period of time. In this manner, all the excess salt is flushed out of the system prior to the next washing cycle.

In order to permit the user to easily open the lid of the regeneration chamber 26, which might otherwise be hampered by the presence of fluid in the system when the machine is inoperative, the drip line 40, which is always open, acts as a fluid relief means. However, in order to permit this drip line to function properly, the vent line 42 is provided. This line receives air from the air brake 38 or from atmosphere if it is so constructed and arranged, and causes it to flow into the regeneration chamber 26. This permits the drip line to operate at all times.

The above-described operation of the regeneration cycle, utilizes no control valves and no moving parts other than the mixing valve and the pump. The mixing valve is, of course, never touched by the regeneration or salt solution, while the solution which does flow through the pump is so diluted by the time it reaches the pump that no buildup or encrustation of the pump is possible. At the same time, the water which constantly flows through the regeneration chamber 26, even when there is no salt present therein, acts to keep it always clean and unclogged.

In FIG. 2 there is shown a modified form of the system of FIG. 1. The system of FIG. 2, generally designated 100, is very similar to that of FIG. 1 in that it includes a mixing valve 102 connected by hot and cold conduits 104 and 106 to sources of water (not shown). A solenoid 108 electrically connects the mixing valve 102 to the timer mechanism through lines 110 and 112.

A conduit 114 connects the mixing valve 102 to the regenerating chamber 116. The regenerating chamber 116 is connected by conduit 118 to the ion-exchange chamber 120. The chamber 120 is connected by conduit 122 to an inlet 124 into the tub 126, an air brake 128 being interposed in the conduit 122. A pump 130 connects the tub 126 to drain through drain line 132. A pressure relief line 134 leads from the conduit 122, adjacent to the air brake 128, to the chamber 116. It can also alternatively, lead to the tub 126 or directly to atmosphere. A standard timer mechanism 136 is operatively connected to the system.

All the parts described above are generally the same as the corresponding parts in the system of FIG. 1. However, in this system, there is no drip line. Instead, a bypass conduit 138 leads from the conduit 118 directly to the pump 130. The system operates in the same manner as that of FIG. 1 except that during the regeneration cycle, after the time lag to permit the regeneration fluid to act on the ion-exchange resin in chamber 120, the mixing valve and the pump 130 are ac-

tivated by the timer mechanism to flush the excess fluid from the chamber 120, through the bypass conduit 138 and through the pump into the drain line.

This system is not quite as desirable as that of FIG. 1 because it requires a double action of the pump 130, once when operating in the regular washing action and another when acting in the regeneration cycle, so that two different pump settings are necessary. However, it otherwise performs a similar function.

FIGS. 3 and 4 illustrate a simplified construction utilizing the general system of FIG. 1 wherein the system, generally designated 200, comprises the mixing valve 202, which is provided with a solenoid 204 electrically connected by lines 205 and 206 to the timing mechanism (not shown). A conduit 208 connects the valve 202 to an ion-exchange chamber 210 having an upstanding dispensing housing or hopper 212 integrally connected thereto. The hopper 212 is provided with a removable lid 214.

A conduit 216 extends from the ion-exchange chamber 210 to an inlet for the tub 218. An air brake 220 is interposed in the conduit 216. A drip line 222 leads from the bottom of the chamber 210, while a pressure relief line 224 leads from the top of the chamber 210 to the conduit 216 adjacent to the air brake 220, or, alternatively, to the tub or directly to atmosphere. A pump 226, having a drain line 228, is provided at the bottom of the tub.

In this construction, the hopper 214 is used for insertion of the regeneration salt when required, and the chamber 210 acts as both the ion-exchange chamber and the regeneration chamber. During the regeneration cycle, the water flows from the conduit 208 into chamber 210 in which the salt has been inserted. This is a momentary flow just as described in the system of FIG. 1. Then after a predetermined period, the flow is restarted and the excess fluid is flushed out through conduit 216 by the pump 226.

As an optional feature, in order to prevent any possible overflow in the regeneration chamber while the lid is open, a normally open switch may be provided on the mouth of the chamber which is closed when the lid is closed. This switch would be in the solenoid circuit of the mixing valve and would close that circuit, thereby permitting the valve to operate only when the lid is in place. This is indicated in FIG. 5 where the regeneration chamber 300 is provided with a normally open switch 302 having leads 304 connected to the solenoid circuit (not shown). The lid 306 which is hinged to the chamber 300 at 308, has a lug 310 which depresses the switch into closed position when the lid is closed.

The invention claimed is:

1. In a washing machine having timer means for actuating the moving parts of said machine, a fluid circuit comprising a single source of water and a tub in direct, valveless fluid connection with said source of water, said tub having a pump in fluid connection therewith, said pump being in fluid connection with a drain conduit and in electrical circuit with said timer means, and a softener system interposed in said fluid circuit between said source of water and said tub, said softener system comprising an ion-exchange chamber adapted to hold a supply of ion-exchange resin and a regeneration chamber adapted to hold and dispense regeneration material for regenerating said ion-exchange resin after a period of use, said regeneration chamber being provided with a normally open switch in electrical circuit with a control means for said source of water, said closure means having actuating means to close said switch when said closure means is in closed position.

2. In a washing machine having timer means for actuating the moving parts of said machine, a fluid circuit comprising a single source of water and a tub in direct, valveless fluid connection with said source of water, said tub having a pump in fluid connection therewith, said pump being in fluid connection with a drain conduit and in electrical circuit with said timer means, and a softener system interposed in said fluid circuit between said source of water and said tub, said softener system comprising an ion-exchange chamber adapted to hold

a supply of ion-exchange resin and a regeneration chamber adapted to hold and dispense regeneration material for regenerating said ion-exchange resin after a period of use, said softener system being provided with a fluid relief means, said fluid relief means being constructed and arranged to remove 5 fluid from said softener system in the intervals between actuation of said system, said fluid relief means comprising a conduit in fluid connection with said regeneration chamber.

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