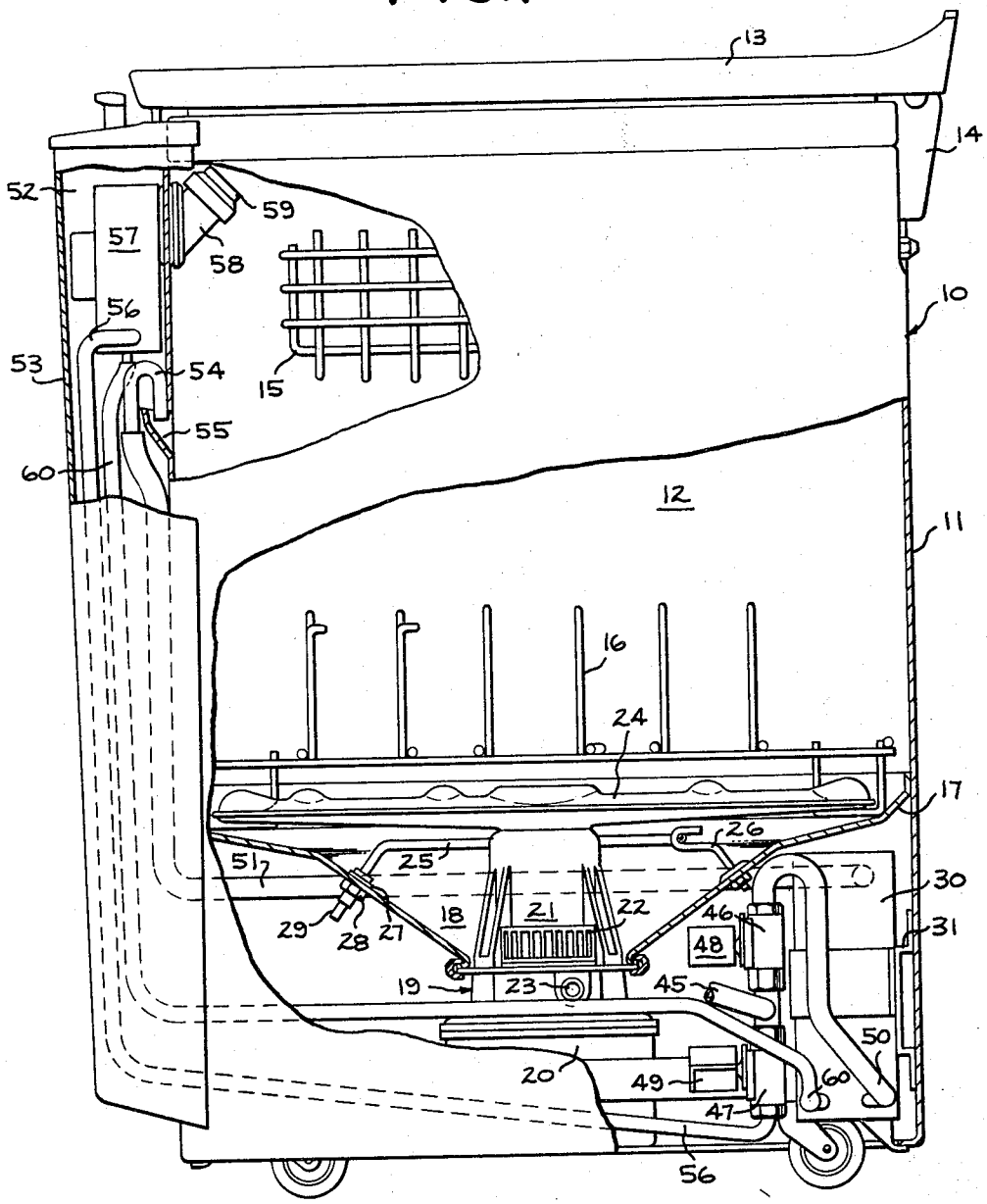
June 4, 1968 N. L. KENDT 3,386,454

DISHWASHER WITH INTEGRAL WATER SOFTENER

Filed March 30, 1966 2 Sheets-Sheet 1

FIG. 1



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DISHWASHER WITH INTEGRAL WATER SOFTENER

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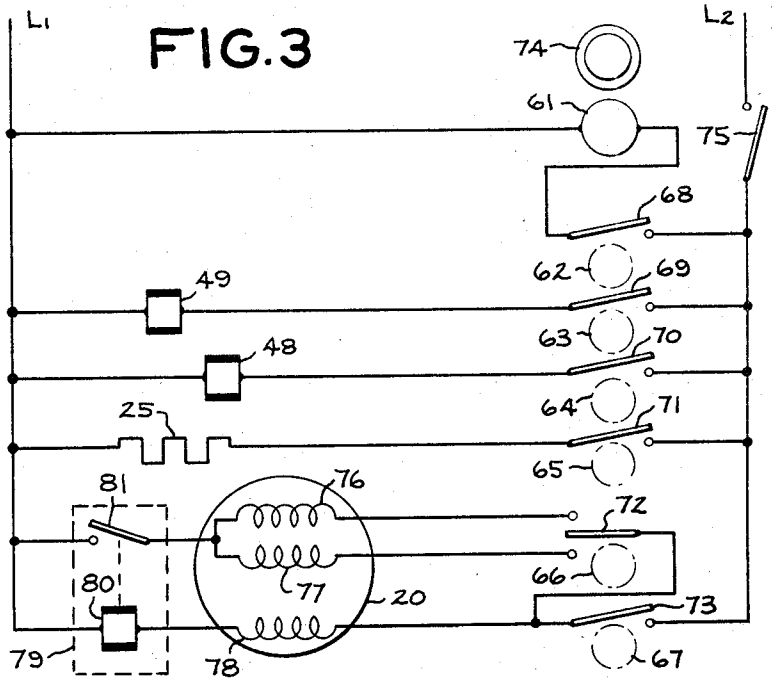
FIG. 3



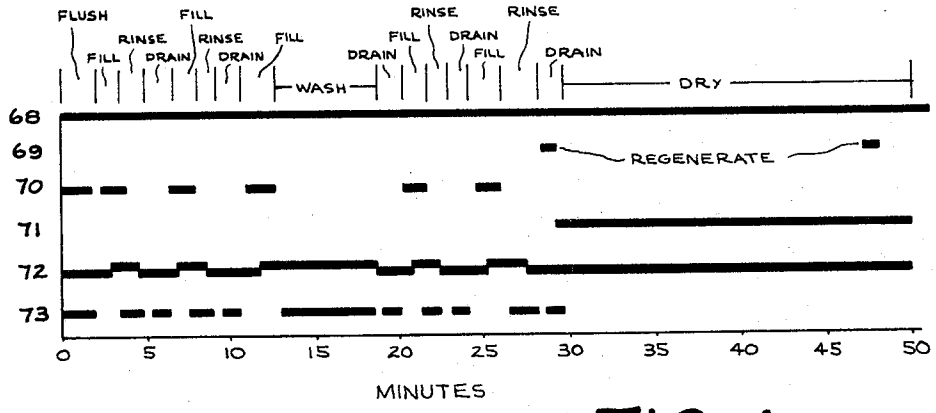


FIG. 4

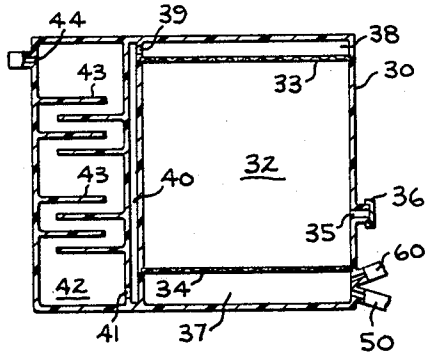


FIG. 2

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3,386,454

DISHWASHER WITH INTEGRAL WATER SOFTENER

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10 Claims. (Cl. 134—58)

ABSTRACT OF THE DISCLOSURE

An automatic dishwasher having a water softener integrated therewith and including means for automatically supplying two charges of regenerating solution to the softener without elongating the normal operational cycle of the dishwasher and yet minimizing the corrosive action of the solution on the dishwasher wash chamber.

This invention relates generally to an automatic dishwasher and, more specifically, to an automatic dishwasher having a water softener integrally associated therewith.

It is well known that soft water is more effective than hard water in washing clothes, dishes or other articles. Accordingly, many households in areas having hard water are provided with central water softener to soften all the water entering the household from a central supply. Others make provision to soften only the water entering the water heater so that only the hot water within the house is softened. In some cases, it is impractical to provide a central softener but yet the available water is of sufficient hardness to compromise, at least to some measurable extent, the effectiveness of an automatic washing machine or dishwasher. To solve this problem others heretofore have proposed a small water softener associated with either a dishwasher or a washing machine to soften only the water entering the machine and, in some cases, only a portion of that water.

Such arrangements have been generally successful for many years to the extent that they have overcome the disadvantages of hard water; however, they have tended to neutralize many of the benefits and advantages of present day automatic appliances. For example, some of these have required manual regeneration or periodic replacement of the softener thereby defeating the "automatic" feature of the machine. Others have provided "automatic" regeneration but this regeneration heretofore has involved undesirable extension of the length of the operational cycle whereby the operation must wait for regeneration to occur before the machine may be used a second time.

Moreover, many of the arrangements known heretofore failed to adequately protect the automatic dishwasher against the highly corrosive characteristics of the saline regenerative solution used to regenerate the water softener. For example, if the regenerative solution is allowed to enter the dishwasher and remain there for any substantial time, the high concentration of salt which is required to efficiently regenerate the ion-exchange media of the water softener, will corrode at least the metal components of the dishwasher.

Accordingly, it would be desirable to provide an automatic dishwasher, or another automatic washing machine, with an arrangement which effects automatic regeneration of the ion-exchange media of the water softener without elongation of the overall operational cycle and which also minimizes corrosive action by the regenerative solution upon the components of the dishwasher by providing suitable handling means for the regenerative solution before, during and following regeneration of the ion-exchange media.

It is therefore, an object of this invention to provide

an automatic dishwasher having a water softener integrally associated therewith in an improved manner.

It is another object of this invention to provide an automatic dishwasher having a water softener integrally associated therewith wherein said water softener is automatically regenerated.

It is another object of this invention to provide a dishwasher having an improved water softener associated therewith wherein said water softener is automatically regenerated.

It is another object of this invention to provide a dishwasher having an automatically regenerated water softener associated therewith wherein the automatic regeneration does not appreciably extend the length of the overall cycle of operation of the dishwasher.

It is a further object of this invention to provide an automatic dishwasher having an automatically regenerated water softener with means to handle regenerative solution so as to minimize corrosive action upon the components of the dishwasher.

It is a further object of this invention to provide an improved water softener for integral use with an automatic dishwasher.

It is another object of this invention to provide an improved control means for an automatic dishwasher having an integral water softener to achieve automatic regeneration of water softener in a manner which will not appreciably extend the length of the overall cycle of operation of the dishwasher.

Briefly stated, in accordance with one aspect of the present invention, there is provided an automatic dishwasher having a water softener integrally associated therewith. Means are provided to achieve automatic regeneration of the water softener without elongation of the overall operational cycle of the dishwasher. This includes a sequence control means to energize a regenerating system at approximately the same time that the normal dishwasher drying cycle begins. After the regenerating system has filled the softener with a first charge of regenerating solution, the sequence control means de-energizes the regenerating system. This allows the first charge of regenerating solution to remain in the softener throughout substantially the entire drying cycle. Near the end of the drying cycle, the sequence control means again energizes the regenerating system which admits a second charge of regenerating solution to the water softener. The second charge displaces the first charge. The sequence control means then de-energizes the regenerating system, leaving the second charge to remain in the softener until the dishwasher is next employed to wash dishes.

The present invention further contemplates an improved water softener for use with an automatic dishwasher wherein a reservoir is provided to receive the first charge of regenerating solution as it is displaced from the softener by the second charge and retain the first charge until the dishwasher is next employed to wash dishes.

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention, it is believed the invention will be better understood from the following description taken in connection with the accompanying drawings, in which:

FIGURE 1 is an elevational view, partly cut away to show details, of an automatic dishwasher employing the present invention;

FIGURE 2 is a sectional view of the water softener of the present invention;

FIGURE 3 is a schematic representation of the control system of the present invention; and

FIGURE 4 is a sequence control cam chart illustrating the sequence of operations of the schematically shown elements of FIGURE 3.

Referring now to the drawings, and particularly to FIGURE 1 thereof, an automatic dishwasher 10 is provided with an outer cabinet 11 defining therein a wash chamber 12. Access to wash chamber 12 is provided by means of a closure member or door 13 which pivots about a substantially horizontal axis defined by a pair of hinges 14, only one of which is visible in FIGURE 1. Dish-supporting racks 15 and 16 are provided within wash chamber 12 to support dishes or other articles to be washed therein.

The bottom wall 17 of wash chamber 12 has a centrally depressed portion forming a sump 18 wherein wash fluid or other liquids will collect. Disposed within sump 18, and supported by bottom wall 17, is a motor-pump assembly 19 including an electrically-reversible motor 20 and a pump 21. Pump 21 is provided with an inlet 22 through which fluid is withdrawn by pump 21 from sump 18 and, in one direction of rotation of motor 20, is propelled through an effluent discharge outlet 23 and, in the opposite direction of rotation of motor 20, is propelled upwardly into a spray means or arm 24. Spray arm 24 is mounted on the top of pump 21 for rotation about a substantially vertical axis and is provided with a plurality of orifices which eject the fluid pumped by pump 21 upwardly into wash chamber 12 to effectuate a wash action upon articles supported by racks 15 and 16. Certain of the orifices in arm 24 are directed in a manner whereby the reaction force created by the ejection of the fluid causes arm 24 to rotate.

A generally annular electrical resistance heating element 25 is supported by bottom wall 17 at one point by means of a bracket 26 and at another point by means of a flange 27 on element 25 and a threaded nut 28. Heating element 25 has an electrical terminal 29 to which an electrical conductor (not shown) may be connected to provide electrical energy to heating element 25. Heating element 25 may be employed to heat wash fluids present within wash chamber 12 during the washing and/or rinsing operation of dishwasher 10; however, the more important function of heating element 25 is to effectuate drying of articles supported by racks 15 and 16 upon completion of the washing and rinsing operations.

The foregoing structure is substantially conventional and may vary from the specific structure illustrated and described without seriously affecting the present invention. With the foregoing arrangement, a conventional complete dishwasher cycle of operation includes initially the admission of water into wash chamber 12. After a sufficient quantity of water has been admitted to wash chamber 12, a motor 20 is energized to rotate in a direction wherein the water is pumped by pump 21 up through spray arm 24 to effectuate a pre-rinse of the articles supported by racks 15 and 16. Motor 20 is then de-energized and then re-energized in the opposite direction of rotation so that water is withdrawn from pump 18 and pumped out through discharge outlet 23. This sequence of events is repeated several times with at least one of the times including the addition of a detergent to the water. Following the final rinse, heating element 25 is energized to heat the air within wash chamber 12 and wash chamber 12 may be vented so that the heated air will pick up moisture from the articles supported by the racks 15 and 16 and will be vented out of the wash chamber 12 to be replaced by dry cool air which in turn is heated. This process, commonly referred to as the drying cycle, continues for a time period in the magnitude of twenty minutes. After completion of the drying cycle, all components of the dishwasher are de-energized and the complete cycle of operation is terminated.

The present invention does not affect the conventional dishwasher cycle of operation as just described but incorporates into this conventional cycle an integrated water softener which softens the water entering wash chamber 12 and, further, incorporates an automatic regeneration of the water softener without elongating the overall dishwasher cycle of operation.

The present invention includes a water softener 30 supported on the inner surface of outer cabinet 11, below bottom wall 17, by means of a bracket 31. Referring briefly to FIGURE 2, it can be seen that water softener 30 includes a resin chamber 32. Resin chamber 32 is defined at its upper extremity by an upper screen 33 and at its lower extremity by a lower screen 34. Screens 33 and 34 have openings therethrough which allow water or other liquids to pass through but which prevent passage of the particulate ion-exchange resin, or other ion-exchange media, disposed within resin chamber 32. An opening 35 is provided in one wall of resin chamber 32 so that the ion-exchange media may be replenished or replaced if necessary. Opening 35 is provided with a threaded cap 36 to prevent the escape of liquid or ion-exchange media through opening 35. An inlet chamber 37 is defined at the lower portion of water softener 30 by lower screen 34 and the bottom wall of water softener 30. Similarly, an outlet chamber 38 is defined at the upper portion of water softener 30 by upper screen 33 and the upper wall of water softener 30. Outlet chamber 38 has a port 39 which opens into a passageway 40 extending downwardly adjacent resin chamber 32. A port 41 provides communication between the lower end of the passageway 40 and the lower portion of a reservoir 42. Reservoir 42 has a series of baffles 43 projecting thereinto from the side walls defining reservoir 42. An outlet 44 is provided at the upper portion of reservoir 42. The purpose and function of reservoir 42 and baffles 43 will be discussed in detail hereinafter. At this point, it is only necessary to appreciate that any liquid entering inlet chamber 37 will pass upwardly through lower screen 34, through resin chamber 32, through upper screen 33 and into outlet chamber 38. From outlet chamber 38, the liquid will pass through port 39, downwardly through passageway 40, then through port 41 into reservoir 42. The liquid will then flow upwardly through reservoir 42 and out through outlet 44. As shown, reservoir 42 and resin chamber 32 are preferably formed integrally of a molded plastic compound.

Referring again to FIGURE 1, a water inlet conduit 45 is suitably connected to a source of hard water (not shown). In the case of a portable dishwasher such as that illustrated in FIGURE 1, conduit 45 would be connected to the faucet associated with the kitchen sink by means of a connecting device (not shown). Water entering dishwasher 10 through conduit 45 encounters two electrically-operated valve 46 and 47. Valve 46 is operated by a solenoid 48 while valve 47 is operated by a solenoid 49. When solenoid 48 opens valve 46, water passes from conduit 45 through valve 46 into conduit 50. Water passing through conduit 50 enters inlet chamber 37 of water softener 30 to pass through water softener 30 in the manner described above. This water will pass from reservoir 42 through outlet 44 and then into conduit 51. Conduit 51 extends across dishwasher 10 below wall 17 and then upwardly outside of wash chamber 12 in a compartment 52 defined by a housing 53 secured to, but having a wall spaced from, outer cabinet 11. Conduit 51 terminates in an inverted U-shaped nozzle 54 which directs the water into a fill funnel 55 formed in the front wall of outer cabinet 11. Fill funnel 55 directs the water issuing from nozzzle 54 into wash chamber 12.

Thus, it can be seen that all water entering wash chamber 12 for the purpose of washing or rinsing articles supported by racks 15 and 16 passes through the resin chamber 32 of water softener 30. When employed with a dishwasher having an operational cycle including two pre-rinses, a wash and two subsequent rinses, each of which requires the admission of a charge of water to wash chamber 12, it has been found that approximately 95 cubic inches of ion-exchange resin within resin chamber 32 will suitably remove the calcium chloride constituent from

the quantity of water necessary to provide the five charges to chamber 12 under reasonably expectable conditions of water hardness. However, in order to integrally associate the water softener with the dishwasher without increasing the overall size of the dishwasher, it is necessary to limit the size of the water softener. Accordingly, because the size of the water softener is limited, and in turn the size of resin chamber 32 is limited, it is necessary to periodically regenerate the ion-exchange media within resin chamber 32. It has been found that approximately 95 cubic inches of ion-exchange media such as, for example, the ion-exchange resin sold under the tradename "Amberlite 200" by Rohm and Haas Company, will soften 13 gallons of water, this being approximately the quantity necessary to provide the five charges of water to wash chamber 12, having a hardness of approximately 600 parts of calcium chloride per million parts water such that the water entering wash chamber 12 for the last rinse will have less than 100 parts calcium chloride per million parts water. The earlier charges of water, of course, have less concentration of calcium chloride. Although the present invention is applicable to arrangements wherein the ion-exchange media is regenerated less frequently, it is presently considered desirable to regenerate the ion-exchange resin once for each complete operational cycle of the dishwasher to insure that all water entering wash chamber 12 will have a concentration of calcium chloride not appreciably exceeding 100 parts per million parts of water.

In accordance with the present invention, means are provided to automatically regenerate the ion-exchange media and to carry out this automatic regeneration, there is provided a regenerating system as described below. To achieve regeneration, the valve 47 is opened by solenoid 49 and water is allowed to pass through valve 47 into conduit 56. Conduit 56 extends up into compartment 52 and terminates at a regenerating agent container 57. Container 57 is provided with a funnel-like inlet 58 so that regenerating agent may be inserted into container 57 conveniently. Inlet 58 is provided with a removable cap 59 which prevents water or wash fluid from entering container 59 during rinse or wash operation of the dishwasher 10 and prevents leakage out of container 57. Water entering container 57 from conduit 56 places the regenerating agent in solution and forces the solution from container 57 into conduit 60. Conduit 60 extends down through compartment 52 and across dishwasher 10 below bottom wall 17 and terminates at water softener 30 in a manner wherein it communicates with inlet chamber 37. Thus, the regenerating solution entering inlet chamber 37 will, from that point on, follow the course described above with respect to water entering inlet chamber 37 from conduit 50.

The most suitable regenerating agent for the ion-exchange media described above, is ordinary table salt (sodium chloride). The water passing through container 57 creates a saline solution and it is this saline solution which passes through conduit 60 and up through the ion-exchange media within resin chamber 32. As the saline solution is in contact with the ion-exchange granules, the granules release calcium ions in exchange for sodium ions released by the saline solution in a manner well known in the water softening art. However, the regenerating solution maintains a relatively high degree of salinity after regenerating the ion-exchange media. This high degree of salinity would prove corrosive to the components of the dishwasher if it were immediately admitted to the dishwasher and allowed to remain therein for any substantial length of time. Accordingly, the present invention makes provisions to minimize the possibility of corrosion of dishwasher elements.

The conventional methods of regenerating an ion-exchange media in a water softener include a continuous method wherein a saline solution of about 10% salinity is continuously passed through the ion-exchange media at a very low flow rate which, for the above system, would approximate .01 gallon per minute. Another conventional method is that of batch regeneration which involves applying a very concentrated saline solution of about 25% salinity to the ion-exchange media and allowing it to remain in contact with the media for approximately one-half hour. Each of these methods has disadvantages. Although the continuous regeneration method is most widely used and most efficiently regenerates the ion-exchange media, the continuous method requires very accurate flow control of the saline solution when the resin chamber is small and it requires a greater quantity of saline solution than the batch method. The batch method is less efficient since it will only regenerate the media as long as the salinity is sufficiently high to cause regeneration and this salinity decreases as the individual particles of the ion-exchange media are regenerated. An equilibrium condition is reached at which point no further regeneration occurs. This equilibrium condition occurs at a point where the media particles are not completely regenerated and this results in a less efficient regeneration than the continuous method. Although the continuous method is more efficient, it requires continuous flow of saline solution from the resin chamber and this highly corrosive solution must be adequately handled to avoid corrosion of elements of the dishwasher.

In accordance with the present invention, a modified regeneration method is provided and includes, in the preferred form of the present invention, a double charge of regenerating solution with the first charge remaining in contact with the ion-exchange media throughout substantially all of the drying portion of the dishwasher operational cycle while the second charge remains in contact with the ion-exchange media from the termination of the drying portion of the operational cycle until the dishwasher is next employed to wash dishes. Referring to FIGURES 3 and 4, the control system and its sequence of operation is schematically represented. A sequence control means is provided and includes a synchronous timer motor 61 which drives a plurality of cams 62, 63, 64, 65, 66 and 67 which control, respectively, switch elements 68, 69, 70, 71, 72 and 73. A manually operable control knob 74 extends beyond outer cabinet 11, preferably through housing 53 with the remainder of the sequence control means being housed within compartment 52, for convenient manual rotation to initiate operation of the sequence control means. The sequence control means and knob 74 are not seen in FIGURE 1 because of the portion of housing 53 being cut away to more clearly illustrate regenerating agent container 57.

Switch element 68 controls energization of timer motor 61 so that when control knob 74 is initially manually rotated a few degrees, cam 62 closes switch element 68 thereby energizing timer motor 61. From that moment on, timer motor 61 will continue to drive all cams throughout a complete dishwasher operational cycle. Power is introduced to the control systetm through terminals L_1 and L_2. A master switch 75 is operative with the closing of door 13 such that the control system cannot be energized until door 13 is securely closed. Switch 69 controls the energization of solenoid 49 which, as explained above, opens valve 47 when energized. Similarly, switch element 70 controls energization of solenoid 48 which opens valve 46 when energized. Switch element 71 controls energization of heating element 25. Switch element 72 controls the direction in which motor 20 will rotate and this is accomplished by energizing either of two start windings 76 or 77. If switch element 72 is in its uppermost position, start winding 76 will be energized which will result in motor 20 rotating in a direction whereby pump 21 will propel fluid upwardly through spray arm 24. When switch element 72 is in its lowermost position, start winding 77 will be energized thereby causing motor 20 to rotate in a direction whereby pump 21 will propel fluid out through effluent discharge 32. Switch element 73 controls the energization of main winding 78 as well as controlling the energiza-

tion of both start windings 76 and 77 due to the series electrical circuit relationship between switch element 72 and switch element 73. A start winding cut-out switch 79 includes a solenoid 80 in electrical series circuit with main winding 78 of motor 20 and mechanically linked to a switch 81 which is in electrical series with both start windings 76 and 77. Start winding cut-out switch 79 is arranged so that when motor 20 reaches essentially its normal running speed, the current passing through solenoid 80 causes solenoid 80 to open switch 81 thereby de-energizing whichever start winding had been energized.

FIGURE 4 sets forth the sequence of opening and closing for each of the switches 68, 69, 70, 71, 72 and 73. This sequence provides a complete operational cycle for the dishwasher which includes the following periods or cycle: an initial flush of approximately two minutes duration during which valve 46 is opened and motor 20 is driving pump 21 in a direction wherein fluid is pumped out through effluent discharge 23; a fill period wherein valve 46 is opened to admit water to wash chamber 12; a rinse period wherein motor 20 is energized in a direction whereby pump 21 propels the water admitted during the prior fill period up through spray arm 24 to effect a rinse of the articles supported by racks 15 and 16; a drain period wherein motor 20 drives pump 21 to force the water out through effluent discharge 23. The fill, rinse and drain periods are repeated to provide a second rinse. This is followed by a fill period which in turn is followed by an elongated period during which detergent is added to the water and pump 21 propels the water-detergent solution up through spray arm 24 to effect a wash action upon articles supported by racks 15 and 16. This is followed by a drain period. There then occurs two rinses similar to the rinses described above. The drain period of the final rinse is followed by a drying cycle wherein heating element 25 is energized for approximately twenty minutes. It should be realized that heating element 25 may be intermittently energized and de-energized to control the quantity of heat generated within wash chamber 12 or, alternatively, a thermostat may be placed in series with switch 71 to control the energization of heating element 25 in response to the temperature within wash chamber 12.

Switch 69 is closed for approximately one minute at the initial portion of the drying cycle which allows water to pass through regenerating agent container 57 and then into resin chamber 32. The length of time during which switch 69 is closed is determined by the flow rate provided by the particular valve 47 employed. In the particular embodiment of the present invention wherein switch 69 is closed for approximately one minute, valve 47 has a flow rate of approximately one-tenth gallon per minute. In any event, switch 69 is closed for a length of time sufficient to allow regenerating solution to enter resin chamber 32 in a quantity sufficient to substantially fill resin chamber 32. The chart of FIGURE 4 shows that this regenerating solution will remain in the resin chamber 32 for approximately eighteen minutes at which time switch 69 is again closed to energize solenoid 49 and open valve 47 to admit a second charge of regenerating solution into resin chamber 32. This second charge of regenerating solution will remain in contact with the ion-exchange media in chamber 32 until the dishwasher is next employed to wash dishes at which time the cycle of operation illustrated in FIGURE 4 will start over.

As the second charge of regenerating solution enters the chamber 32, the first charge is displaced and, since the first charge as it leaves resin chamber 32 has a degree of salinity which would prove highly corrosive to the elements of the dishwasher, the present invention contemplates means for adequately handling this saline soltuion to minimize the possibility of corrosion. Reservoir 42 serves to receive and contain the first charge of regenerating solution as it is forced from chamber 32 by the second charge of regenerating solution. When the second charge of solution has entered chamber 32, chamber 32 and reservoir 42 are substantially filled with saline solution and will remain in this condition until dishwasher 10 is again employed to wash dishes. As dishwasher 10 is energized to start a cycle following regeneration, it will be noted from FIGURE 4 that switch 70 opens valve 46 at the beginning of the cycle to admit fresh water into water softener 30. Simultaneously, switches 72 and 73 energize motor 20 in a direction which causes pump 21 to propel fluids entering pump 21 out through effluent discharge 23. As the fresh water enters the water softener 30, the saline solution is forced up through condiut 51 into wash chamber 12 where it collects in sump 18 and is immediately withdrawn by pump 21 and forced out through discharge 32. Thus, the control system of the present invention provides an initial flush of fresh water with the pump operating in the drain condition so that the saline solution is, within a few seconds, transferred from water softener 30 into the household sewer system.

As the second charge of regenerating solution enters resin chamber 32, and the first charge is displaced into reservoir 42, it is important that the regenerating agent of the first charge entering reservoir 42 does not pass out of reservoir 42 and into wash chamber 12. If this would happen, then the highly corrosive regenerating solution would remain in wash chamber 12 until the dishwasher is next employed to wash dishes. In the normal household, this could be in excess of twenty-four hours. Accordingly, the present invention includes means to minimize the possibility of the first charge of regenerating solution passing through reservoir 42 and into wash chamber 12. This is achieved by providing the plurality of baffles 43 in reservoir 42 which causes any fluid passing through reservoir 42 to follow a tortuous path. This greatly minimizes the possibility that the regenerating agent will "short circuit" from port 41 directly to outlet 44 without forcing out ahead of it the fresh water remaining in reservoir 42 from the prior use of dishwasher 10.

Ideally, the ion-exchange media will not completely fill chamber 32 but will extend to a level spaced from screen 33 a short distance as illustrated in FIGURE 2. This "head room" allows the granules of ion-exchange media to fluff upwardly as water or regenerating solution passes through chamber 32. This limited movement and resettling of the granules enhances the efficiency of both the softening process and the regenerating process. Moreover, the head room thus provided, along with the outlet chamber 38, provides additional volume to contain the first charge of regenerating solution when the second charge is admitted to the softener.

Thus, it can be seen that the present invention provides an automatic dishwasher, or other automatic washing machine, with an arrangement which effects automatic regeneration of the ion-exchange media of the water softener without elongation of the overall operational cycle and which also minimizes corrosive action by the regenerative solution upon the components of the dishwasher by providing suitable handling means for the regenerative solution before, during and following the regeneration of the ion-exchange media.

As will be evident from the foregoing description, certain aspects of the invention are not limited to the particular details of construction of the example illustrated, and it is contemplated that various other modifications or applications will occur to those skilled in the art. It is therefore intended that the appended claims shall cover such modifications and applications as do not depart from the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A water softener for an automatic washing machine having a wash chamber comprising:

(a) a resin chamber adapted to contain an ion-exchange media,

(b) an inlet to allow regenerating solution to pass into said resin chamber,
(c) an outlet to allow regenerating solution to pass from said resin chamber,
(d) a reservoir communicating with said outlet whereby regenerating solution passing from said resin chamber enters said reservoir, and
(e) baffle means within said reservoir to provide a tortuous path for regenerative solution passing through said reservoir,
(f) means providing communication between said reservoir and the wash chamber of the automatic washing machine whereby regenerating solution passing from said reservoir enters the wash chamber.

2. The invention of claim 1 wherein said inlet is at the lower portion of said resin chamber and said outlet is at the upper portion of said resin chamber.

3. The invention of claim 1 wherein said resin chamber and said reservoir are formed integrally.

4. An automatic dishwasher comprising:
(a) a wash chamber adapted to receive and contain articles to be washed therein,
(b) means including an electric motor to effectuate a washing action within said wash chamber by moving a liquid containing water around within said wash chamber,
(c) an electric heatinng element to facilitate drying of articles within said wash chamber upon completion of said wash action,
(d) a first conduit in communication with a source of unsoftened water,
(e) a first valve in water-receiving relationship with said first conduit,
(f) a water softener containing an ion-exchange media,
(g) means interconnecting said first valve and said water softener whereby water is passed through said ion-exchange media when said first valve is opened,
(h) a second valve in water-receiving relationship with said first conduit,
(i) a container for ion-exchange regenerating agent in water-receiving relationship with said second valve,
(j) means interconnecting said container and said water softener whereby said ion-exchange media is regenerated when said second valve is opened, and
(k) sequence control means to energize and de-energize said electric motor, said heating element, said first valve and said second valve in predetermined sequence comprising:
(aa) means to energize said heating element, and
(bb) means to open said second valve at approximately the same time that said means to energize said heating element energizes said heating element for a length of time sufficient to allow a quantity of liquid into said water softener having a volume substantially the same as the volume of the water softener,
(cc) said means to open said second valve being adapted to open said second valve a second time at approximately the same time that said means to energize said heating element operates to de-energize said heating element.

5. An automatic dishwasher comprising:
(a) a wash chamber adapted to receive and contain articles to be washed therein,
(b) a heating element to heat air within said wash chamber to facilitate drying of articles within said wash chamber,
(c) a water softener including a resin chamber communicating with said wash chamber,
(d) an ion-exchange resin disposed within said resin chamber,
(e) a regenerating agent container to contain an agent for regenerating said ion-exchange resin,
(f) water admitting means having a first operative condition to admit water directly to said resin chamber and a second operative condition to admit water to said regenerating agent container,
(g) said regenerating agent container communicating with said resin chamber whereby water admitted to said regenerating agent container will pick up regenerating agent and subsequently pass into said resin chamber to regenerate said ion-exchange resin, and
(h) a sequence control means to control the operation of the dishwasher and to cycle the dishwasher through a series of operations including a drying operation during at least a portion of which said heating element is energized,
(i) said sequence control means including means to operate said water admitting means in said second operative condition during the early portion of said drying operation and again during the latter portion of said drying operation.

6. An automatic dishwasher comprising:
(a) a plurality of operative elements the sequential operation of which comprise a complete operational cycle including a terminal drying cycle,
(b) a sequence control means to sequentially energize said plurality of operative elements,
(c) a water softener through which at least a portion of the water entering the dishwasher will pass,
(d) a regenerating system to regenerate said water softener by admitting a regenerating solution thereto,
(e) means within said sequence control means to energize said regenerating system at approximately the same time that said drying cycle begins, and
(f) said means within said sequence control means further energizing said regenerating system at approximately the same time the said drying cycle terminates.

7. The invention of claim 6 wherein each energization of said regenerating system lasts for approximately one minute and said drying cycle lasts for approximately twenty minutes.

8. The invention of claim 6 wherein said water softener includes a resin chamber containing ion-exchange media and said energization of said regenerating system admits a quantity of regenerating solution to said resin chamber sufficient, when added to said ion-exchange media, to substantially fill said resin chamber.

9. The invention of claim 8 wherein a reservoir is disposed downstream from said resin chamber and receives all liquid leaving said resin chamber, said reservoir having a capacity sufficient to contain a quantity of liquid approximately equal to the quantity of regenerating solution admitted by each energization of said regenerating system.

10. The invention of claim 9 wherein said reservoir has means therein to provide a tortuous path for any liquid passing therethrough.

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