

May 28, 1968

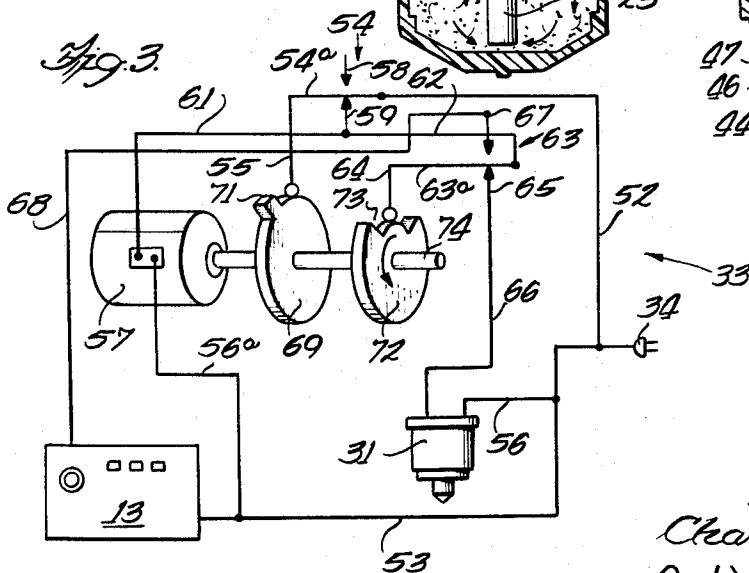
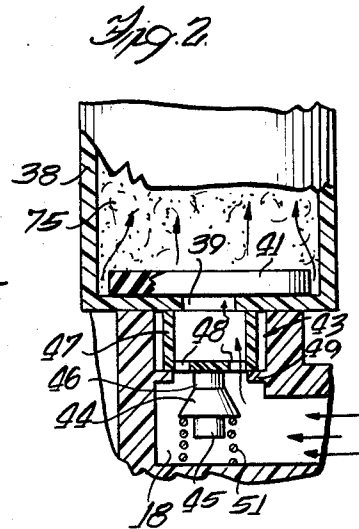
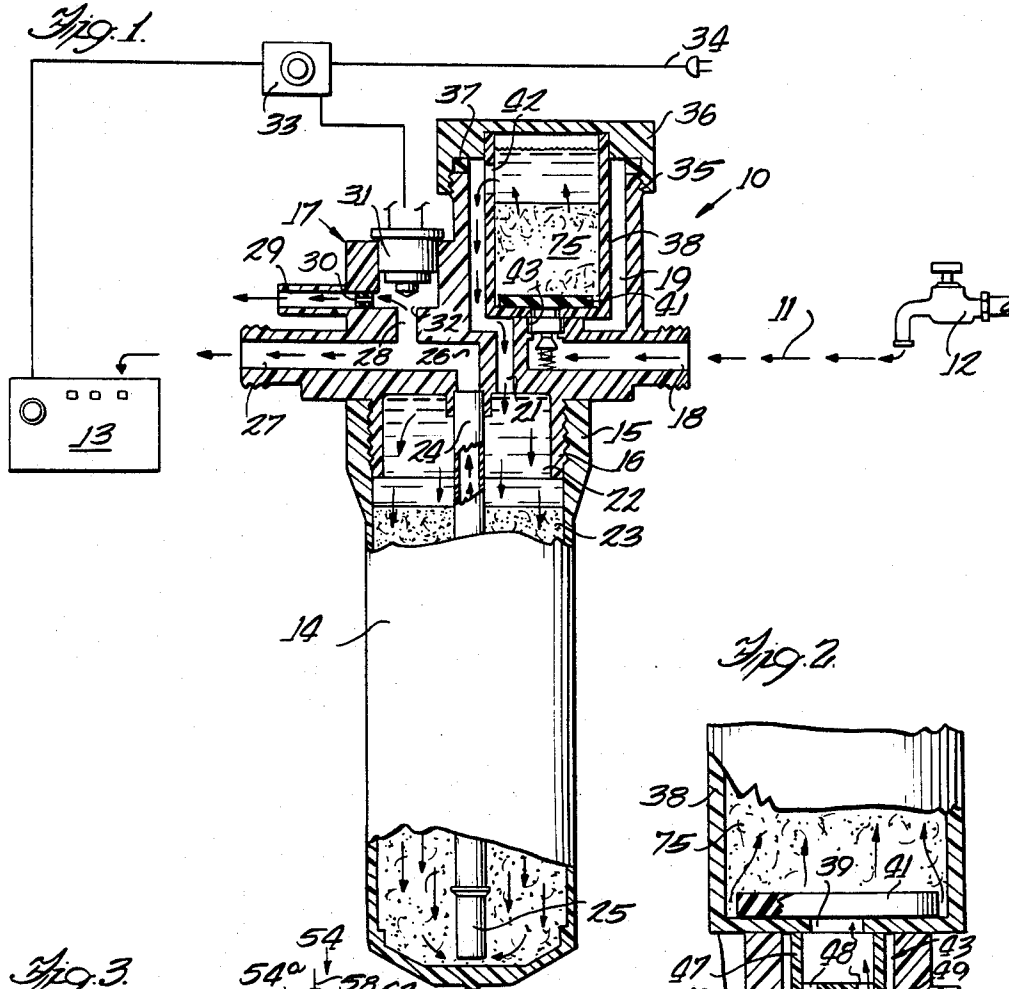
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3,385,441

COMPACT WATER SOFTENER

Filed Feb. 8, 1966

2 Sheets-Sheet 1



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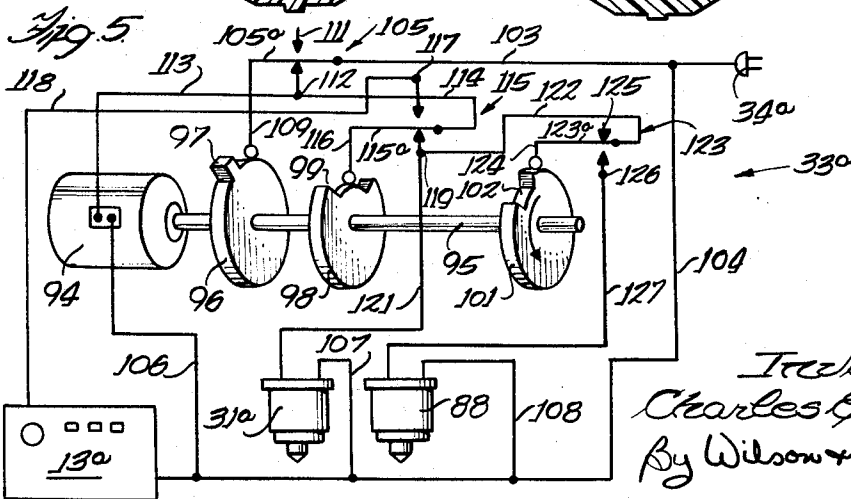
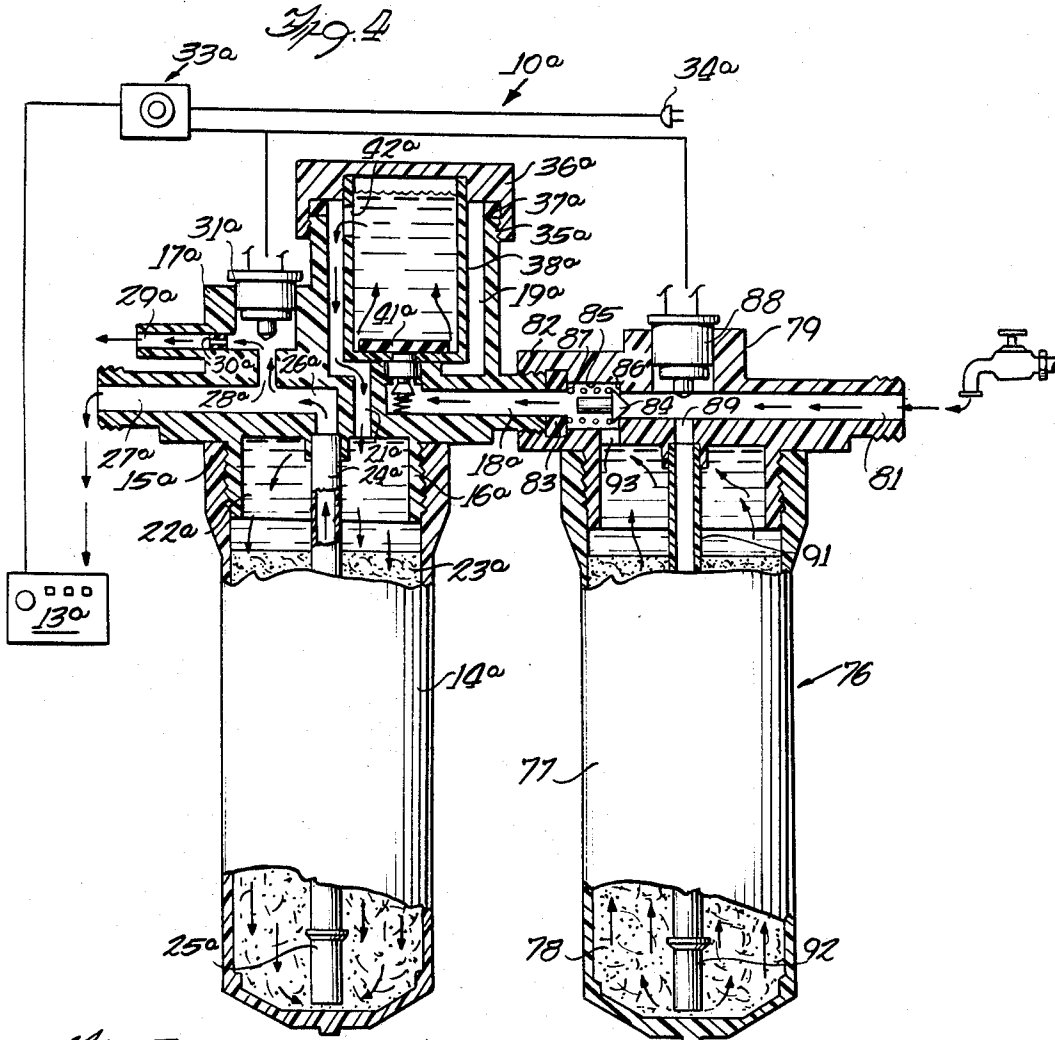
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2 Sheets-Sheet 2



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COMPACT WATER SOFTENER

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11 Claims. (Cl. 210-134)

ABSTRACT OF THE DISCLOSURE

A compact water softener for an appliance having a head with a removable salt cup and inlet and outlet passages therein, all flow passing through the cup and regenerating fluid passing from the outlet passage to a solenoid valve controlled drain passage; a second embodiment having a brine reservoir communicating with the structure of the first embodiment, the reservoir having an inlet and outlet with a check valve containing bypass therebetween, and a solenoid valve controlling flow to the bypass or to the reservoir with the brine passing to the outlet through a separate part.

The present invention relates to a novel small or compact water softener and more particularly to a water softener of a size which will treat sufficient water for and supply water to a household appliance such as an automatic dishwasher or clothes washing machine.

Among the objects of the present invention is the provision of a compact water softener which is connected to and controls the cycle of an appliance commonly used in the home such as an automatic dishwasher or clothes washing machine. The softener is of a size to provide sufficient softened or treated water for a single cycle of the appliance utilizing influent water of substantial hardness. The softener can be easily installed in a water line leading to the appliance without any substantial changes to the line, and the softener includes a timer actuated by the user which controls the regeneration of the softener and the cycle of the appliance. Thus, the appliance can be made ready for operation and turned on, but the appliance will not operate until the timer for the softener is manually actuated.

Another object of the present invention is the provision of a compact water softener having a salt-in-head operation for regeneration. The top of the softener is threadedly secured to the resin container and contains a hard water inlet, a soft water outlet and a drain outlet. An outlet manifold depends into the tank and communicates with the soft water and drain outlets, and the hard water inlet communicates with a chamber leading to the resin and housing a removable salt storage reservoir. The reservoir is generally cylindrical or cup-shaped with an opening at its lower end covered by a flap check valve to prevent loss of the salt and one or more radial openings in the side thereof adjacent the top. Water entering the softener through the inlet passes up through the bottom of the salt storage reservoir past the flap valve to dissolve the salt, and the brine formed passes through the radial openings and down through the resin bed.

A further object of the present invention is the provision of a compact water softener having a removable salt storage reservoir or cup in the head of the softener and a resiliently-biased check valve below and actuated by the salt cup to allow the cup to be removed from the head while the softener is under line pressure at the inlet. A threaded cap opens the top of the chamber housing the salt cup so it can be removed and filled with salt, the valve being biased to closed position when the salt cup is removed to prevent the escape of influent water under pressure.

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The present invention also comprehends the provision of a compact water softener having a separate and substantially identical tank attached thereto at the hard water inlet, the second tank providing a salt reservoir with sufficient salt storage for multiple regenerations. The second tank has a head provided with suitable valving to control, along with the control valve on the softener, the regeneration and rinse operations, and a by-pass check valve to allow influent hard water to bypass the salt storage tank and proceed directly to the softener.

The present invention also comprehends the provision of a compact softener having a timer control system to control the valve actuation for regeneration and rinsing of the softener and to actuate the appliance receiving treated water for the full operational cycle of the appliance.

Further objects are to provide a construction of maximum simplicity, efficiency, economy and ease of assembly and operation and such further objects, advantages and capabilities as will later more fully appear and are inherently possessed thereby.

In the drawings:

FIGURE 1 is a vertical cross sectional view through a compact softener assembly having a salt-in-head regeneration unit and connected to an appliance receiving the treated water.

FIG. 2 is an enlarged cross sectional view of the check valve utilized below the salt storage reservoir or cup of the softener of FIG. 1.

FIG. 3 is a schematic showing of the timer control circuit for the softener of FIG. 1.

FIG. 4 is a vertical cross sectional view of a modified compact softener assembly having a separate salt storage unit.

FIG. 5 is a schematic showing of the timer control circuit of the softener of FIG. 4.

Referring more particularly to the disclosure in the drawings wherein are shown illustrative embodiments of the present invention, FIG. 1 discloses a compact softener 10 adapted to be mounted in a water supply line 11 from a source of hard water 12 to supply treated water to an appliance 13 such as an automatic dishwasher, clothes washing machine, etc.

The compact softener 10 has a generally cylindrical body or housing 14 receiving sufficient water softening and/or treating material to provide sufficient soft water for a complete cycle of the appliance 13. Specifically, this unit is sized to produce approximately 10 to 20 gallons of soft water starting with an influent hardness of approximately 20 grains per gallon. The ion exchange resin charge is approximately $\frac{1}{20}$ of a cubic foot; although these sizes are not meant to be limiting.

The housing has an internally threaded upper end 15 to receive the externally threaded annular flange 16 of a head 17 for the unit having the fluid passages therein. The head is provided with a hard water inlet 18 which extends inwardly and upwardly to an enlarged salt-in-head chamber 19, and a short passage 21 communicates between the chamber 19 and the interior 22 of the housing 14 containing the ion exchange resin 23. An outlet manifold 24 having a strainer 25 at the lower end depends from the head 17 into the resin 23 terminating adjacent the bottom of the housing.

The outlet manifold 24 communicates with a passage 26 leading to the soft water outlet 27 which is connected with the appliance 13. A branch passage 28 extends from the passage 26 to a drain outlet 29, and a solenoid valve 31 is positioned to seat at 32 and close the drain line. The solenoid valve 31 is also provided with a flow control orifice 30 of approximately $\frac{1}{8}$ gallon per minute to control the flow rate during regeneration and rinsing opera-

tions. A timer 33, connected to the appliance 13 and with a suitable power source 34, controls actuation of the solenoid valve 31 in a manner to be later described.

The salt-in-head chamber 19 has an open externally threaded upper end 35 which is closed by an internally threaded cap 36 having suitable sealing means 37. A generally cylindrical salt reservoir or cup 38 is positioned in the chamber 19 with the lower end of the cup seated on a seat in the vertical portion of the inlet passage 18 and the upper open end of the cup is conformably received in a recess and abuts the interior surface of the cap 36. The salt cup 38 has a central opening 39 in the base or lower end (see FIG. 2) with a flap check valve 41 therein covering the opening 39. One or more radial openings 42 are formed in the wall of the salt cup 38 adjacent the upper end to allow flow of liquid from the salt cup to the chamber 19.

If the softener 10 is permanently piped to the hard water supply 12 with unit constantly under pressure, a check valve 43 is located in the vertical portion of inlet 18 below the seat for the salt cup 38 to prevent any undesirable flow of water when the salt cup 38 is removed for refilling with salt. This valve 43 is shown in FIG. 2 and includes a downwardly flared or tapered body 44 with a lower depending stem or projection 45 and an upper stem 46 connected to an open-topped enlarged cup member 47. The cup member 47 has a plurality of openings 48 in the bottom thereof to allow flow there-through from the passage 18 around the tapered body 44 to and through the opening 39 in the salt cup 38. A radially inwardly extending flange 49 is formed in the vertical portion of inlet 18 and cooperates with the lower surface of cup member 47 and the spaced tapered body 44. A compression spring 51 is positioned below the valve 43 and encompasses the stem 45 to abut the lower surface or shoulder of the tapered body 44.

Referring to FIG. 3, the timer 33 actuating the solenoid valve 31 and controlling the appliance 13 is shown. A pair of conductors or lines 52, 53 communicate with the power source 34; the line 52 leading to a single-pole double-throw switch 54 having a contact arm 54^a actuated by a cam follower 55, and the line 53 leading to the appliance 13. The line 53 has branch conductors or lines 56, 56^a leading to the solenoid valve 31 and a motor 57, respectively. The switch 54 has an inactive contact 58 and a contact 59 having a branch line 61 leading to the motor 57 and a second branch 62 leading to a single-pole double-throw switch 63 having a contact arm 63^a actuated by a cam follower 64. Contact 65 of the switch 63 leads to the solenoid 31 through line 66, and line 68 of contact 67 of the switch 63 leads to the appliance 13.

In operation, the appliance 13 is filled with dishes or clothes, soap added and its cycle timer is turned to the "on" position. As the timer 33 has not been actuated, the appliance does not have any power for operation. Then the cap 36 and salt cup 38 are removed allowing the spring 51 to bias the tapered body 44 against the flange 49 and prevent undesirable liquid flow as the inlet 18 is under fluid pressure from the source of hard water 12. The water in the cup 38 is dumped out and replaced with a predetermined quantity of salt; for example, 3 ounces of salt. The cup 38 and cap 36 are then reassembled opening the check valve 43. The flap valve 41 in the cup 38 retains the liquid therein when the cup is removed; this procedure being necessary as the water must be displaced to make room for the salt to be added.

The timer 33 in the inactive position has the cam follower 55 lifted by the projection 71 of cam 69 to open contact 59 of switch 54, and the follower 64 is adjacent the recess 73 in the cam 72; both cams being rotated on a shaft 74 of the motor 57. The operator manually turns the shaft 74 in the direction of the arrow so that the follower 55 drops off of projection 71 and follower 64 drops in recess 73. The switch arm 54^a contacts contact

59 and switch arm 63^a engages contact 65 so that a circuit is established to operate the motor 57 through line 52, switch arm 54^a, contact 59, line 61, motor 57, line 56^a and line 53, and a circuit is established actuating solenoid 31 through line 52, switch arm 54^a, contact 59, line 62, switch arm 63^a, contact 65, line 66, solenoid 31, line 56 and line 53.

When the solenoid valve 31 is actuated, it opens branch passage 28 so that hard water from line 11 enters inlet 18 and flows around the tapered body 44 and up through the openings 48 and the cup member 47 into opening 39 of the salt cup 38. Liquid flows around the flap valve 41 and enters and dissolves the salt 75 in the cup 38 to form brine. The brine passes out through openings 42 into the chamber 19, down through passage 21 and into the resin bed 23 to cause regeneration thereof. The waste effluent passes up through the outlet manifold 24 into passage 26 and branch passage 28 to the drain outlet 29. As the timer 33 has not energized the appliance 13, liquid cannot pass through the outlet 27 to the appliance.

Approximately 2 to 3 ounces of salt will all be dissolved in approximately two to three minutes and the softener enters the rinse portion of its cycle. The cams 69 and 72 are being rotated by the motor 57, but the switches 54 and 63 remain in the same positions. The water flow through the chamber 19 from inlet 18 and through the softener to the drain outlet 29 is the same as above described except that the hard water rinses any remaining salt from the bed 23. The rinse cycle continues for approximately fifteen minutes, but the time interval can be adjusted for the requirements of the regeneration cycle.

At the end of the rinse cycle, the cam follower 64 will be lifted out of the recess 73 onto the periphery of the cam 72 so that the switch arm 63^a disengages from contact 65 to deenergize the solenoid valve 31 and engages contact 67 to energize the appliance through the circuit of line 52, switch arm 54^a, contact 59, line 62, switch arm 63^a, contact 67, line 63, appliance 13 and line 53. The motor remains energized to rotate the cams 69 and 72 with the remaining time of rotation sufficient to fully complete the cycle of the appliance 13.

When the solenoid valve 31 closes and the appliance 13 is energized, the flow of liquid as demanded by the appliance proceeds through inlet 18, empty cup 38, chamber 19 and passage 21 into the housing 14. The hard water passing down through the regenerated resin bed 23 is filtered and softened with the soft water passing through the strainer 25 and up through the outlet manifold 24, passage 26 and outlet 27 to the appliance 13. The resin bed 23 will soften sufficient water for the complete cycle of the appliance. The timer 33 continues operation until the appliance cycle is completed and then the cam follower 55 is lifted by the projection 71 on the cam 69 to disengage the switch arm 54^a from contact 59 to shut off the timer.

FIGS. 4 and 5 disclose a second embodiment of the present invention with identical parts of the softener 10^a having the same numerals as in FIGS. 1 to 3 with a superscript "a." This embodiment utilizes an identical softener structure to that shown in FIG. 1, but does not use the salt cup 38^a to provide the measured quantity of salt for a regeneration operation. Instead, a salt reservoir 76 containing sufficient salt for multiple regeneration operations is attached to the inlet 18^a for the softener. This reservoir 76 includes a housing 77 similar to the housing 14^a, but containing sufficient salt 78 for approximately 20 to 30 regeneration operations, and a header 79 having a hard water inlet 81 directly communicating through a by-pass with an outlet 82 threadingly connected to the inlet 18^a of the head 17^a and having a sealing ring 83. A check valve 84 is mounted in an enlarged by-pass portion 85 adjacent the outlet 82 and is biased against a seat 86 by a spring 87.

A second solenoid valve 88 controls communication of a passage 89 leading to manifold 91 with the inlet 81;

the manifold 91 also having a strainer 92 at the lower end thereof. The armature of the solenoid valve 88 engages a seat at the junction of the inlet 81 and passage 89; the inlet passage 81 being greater in diameter than the diameter of the solenoid armature to allow flow therearound when the armature closes passage 89. Further, a short passage 93 communicates between the salt chamber 77 of the housing and the enlarged by-pass portion 85 adjacent the outlet 82 behind the enlarged head of the check valve 84.

FIG. 5 discloses a modified control circuit for the timer 33^a to control the solenoid valves 31^a and 88. The timer has a motor 94 rotating shaft 95 on which are mounted three cams 96, 98 and 101; cam 96 having a projection 97, cam 98 an arcuate recess 99, and cam 101 having a relatively shorter arcuate recess 102. From the power source 34^a extends a pair of conductors or lines 103, 104; line 103 extending to a single-pole double-throw switch 105, and line 104 extending to the appliance 13^a. Line 104 has branches 106, 107 and 108; branch line 106 extending to the motor 94, line 107 extending to solenoid valve 31^a and line 108 extending to solenoid valve 88.

The switch 105 has an arm 105^a actuated by a cam follower 109 and has an inactive contact 111 and a contact 112 connected to a line 113 leading to the motor 94. A line 114 from contact 112 leads to a single-pole double-throw switch 115 having an arm 115^a actuated by a cam follower 116 for cam 98. A contact 117 of the switch 115 has a line 118 leading to the appliance 13^a, and a contact 119 has one line 121 leading to solenoid 31^a and a second line 122 leading to another single-pole double-throw switch 123 having an arm 123^a actuated by a cam follower 124 cooperating with the cam 101. The switch 123 has an inactive contact 125 and a contact 126 connected to solenoid 88 through line 127.

The softener 10^a in FIG. 4 is shown in the regeneration position while the timer 33^a of FIG. 5 is shown in the rinse position. The timer 33^a is initially positioned with the cam follower 109 on the lug or projection 97 of cam 96 so that the switch arm 105^a does not engage contact 112 but engages inactive contact 111. Thus power is shut off to the entire circuit. Then the appliance is filled or otherwise prepared and turned on, but nothing happens until the operator turns on timer 33^a by turning shaft 95 in the direction of the arrow so that the follower 109 comes off the lug 97, the follower 116 falls into recess 99 of cam 98, and follower 124 falls into recess 102 of cam 101. The switch arm 105^a engages contact 112 to complete the circuit to the motor 94 through line 103, switch arm 105^a, contact 112, line 113, motor 94, line 106 and line 104; the motor 94 rotating the shaft 95 and cams 96, 98 and 101.

Also a circuit is completed energizing solenoid valve 31^a through line 103, switch arm 105^a, contact 112, line 114, switch arm 115^a, contact 119, line 121, solenoid 31^a, line 107 and line 104; and a circuit is completed to solenoid valve 88 through line 103, switch arm 105^a, contact 112, line 114, switch arm 115^a, contact 119, line 122, switch arm 123^a, contact 126, line 127, solenoid 88, line 108 and line 104. Thus both solenoid valves 31^a and 88 are opened and liquid under pressure from source 12^a enters the inlet 81 and passes down through passage 89 opened by solenoid valve 88 and manifold 91 into the salt bed 78 to dissolve the salt forming concentrated brine.

The brine thus formed passes through passage 93, chamber 85, inlet 18^a, cup 38^a and chamber 19^a to the passage 21^a and into the resin bed 23^a. When the salt solenoid valve 88 is energized, the flow of hard water is through this solenoid valve and passage 89 and not across the spring-loaded check valve 84 because the pressure drop through the salt chamber 77 is less than the pressure drop across the spring-loaded check valve. The brine passes downward through the resin bed 23^a and the waste effluent passes up through the outlet manifold 24^a into the passage 26^a and then through the branch passage 28^a opened by the solenoid valve 31^a to

the drain outlet 29^a. As in the previous embodiment, the solenoid valve 31^a or the passage 28^a contains a flow control orifice 30^a of approximately 1/4 gallon per minute to control flow during the regeneration cycle.

After approximately one minute, the cam follower 124 will be lifted out of the recess 102 by rotation of cam 101 to disengage switch arm 123^a from contact 126 and deenergize the solenoid valve 88 (see FIG. 5). The solenoid valve 88 will close passage 89 preventing any flow of liquid through the salt chamber 76, and liquid in inlet 81 flows around the solenoid armature and biases the valve 84 to allow flow of hard water therearound and to the resin bed 23^a to rinse any remaining brine or waste liquid therefrom through drain outlet 29^a.

The rinse period extends over an interval of approximately eighteen minutes. Then the cam follower 116 is lifted out of the recess 99 in cam 98 to disengage switch arm 115^a from contact 119 deenergizing solenoid valve 31^a to close branch passage 28^a and engage switch arm 115^a with contact 117. This change completes a circuit to energize the appliance 13^a through line 103, switch arm 105^a, contact 112, line 114, switch arm 115^a, contact 117, line 118, appliance 13^a and line 104.

Flow of hard water will now proceed through inlet 81, past check valve 84, through inlet 18^a, chamber 19^a and passage 21^a to flow down through the regenerated resin bed 23^a. Softened water passes up through the outlet manifold 24^a and passage 26^a to the soft water outlet 27^a leading to the appliance 13^a now energized by the timer 33^a. The appliance 13^a operates through its cycle and shuts off, and the cam 96 provides sufficient time after completion of the regeneration cycle to allow completion of the cycle for the appliance and then the follower 109 is lifted by the lug 97 so that the switch arm 105^a is disengaged from contact 112 opening the circuit to the appliance 13^a and the motor 94 and engages the inactive contact 111 until the timer is again actuated.

It is obvious that the appliance 13 or 13^a could be an automatic dishwasher, clothes washer, espresso coffee maker or other suitable appliance requiring both a source of soft water and a source of power, and the nature of the appliance is not meant to be limiting on the scope of the invention. Obviously, the compact softener can also be used to provide soft or treated water where no appliance is involved, and the circuit for the appliance would be omitted.

Having thus disclosed the invention, I claim:

1. A compact water softener comprising a generally cylindrical housing having an open upper end and containing the treating material, a head sealingly engaging the open end of the housing, a soft water inlet and an outlet in said head, a drain outlet in said head communicating with said outlet, a solenoid valve in said head controlling access to the drain outlet, an outlet manifold in said head and depending into the housing and treating material and communicating with said outlet, said head having a chamber interposed between said inlet and said housing and having a passage therefrom leading to the interior of said housing, and a cup in said chamber constructed and arranged relative to said chamber for receiving all flow of fluid from said inlet to said housing and adapted to receive a quantity of salt for regeneration of the treating material in the housing.

2. A compact softener as set forth in claim 1, including means to close the soft water outlet to the point of consumption while the solenoid valve is open so that all liquid flow will be to drain during the regeneration cycle.

3. A compact softener as set forth in claim 1, including a timer controlling operation of the solenoid valve, and an appliance requiring soft water and a source of power is connected to the soft water outlet and the timer, said timer preventing operation of the appliance while the solenoid valve is open.

4. A compact water softener comprising a generally cylindrical housing having an open upper end and containing the treating material, a head sealingly engaging

the open end of the housing, an inlet and an outlet in said head, a drain outlet communicating with said outlet, a solenoid valve in said head controlling access to the drain outlet, an outlet manifold communicating with said outlet, said head having a chamber communicating with said inlet and having a passage therefrom leading to the interior of said housing, a cup in said chamber receiving all flow of fluid from said inlet and adapted to receive a quantity of salt for regeneration of the treating material in the housing, said chamber having an open top, a cap for said chamber threadingly engaging the head, said cup being mounted between a seat in said chamber and said cap, said cup having an opening in the bottom surface communicating with said inlet and at least one radial opening adjacent the upper end of the cup communicating with the chamber, and a flap check valve in the bottom of the cup covering the opening therein.

5. A compact softener as set forth in claim 4, including a spring-biased check valve in said inlet biased against the bottom of the cup to prevent undesirable flow of water under pressure when the cup is removed from the head.

6. A compact softener as set forth in claim 5, in which said inlet has a vertical portion leading to said chamber and a radially inwardly extending flange in said vertical portion, said spring-biased check valve cooperating with said flange to prevent flow of water therearound when the salt cup is removed.

7. A compact softener as set forth in claim 6, in which said spring-biased check valve includes a tapered body portion below said flange, a depending projection on said tapered body portion, a projection on the opposite end of said tapered body portion, and a cup-shaped member integral with said upper projection above said flange and of a diameter greater than the inner peripheral diameter of the flange, said cup-shaped member having at least one opening in the bottom thereof.

8. A compact softener as set forth in claim 7, including a compression spring encompassing said depending projection and abutting said tapered body portion to urge said check valve against said cup.

9. A compact water softener comprising a generally

cylindrical housing having an open upper end and containing the treating material, a head sealingly engaging the open end of the housing, an inlet and an outlet in said head, a drain outlet communicating with said outlet, a solenoid valve in said head controlling access to the drain outlet, an outlet manifold communicating with said outlet, said head having a chamber communicating with said inlet and having a passage therefrom leading to the interior of said housing, a cup in said chamber, a salt reservoir connected to the inlet of the softener, said salt reservoir including a housing containing the salt and having an upper open end, a head sealingly engaging the upper open end of the reservoir housing, an inlet and an outlet in said reservoir head communicating with the reservoir housing, a salt solenoid valve in said reservoir head, a passage communicating with said last mentioned inlet controlled by the salt solenoid valve, a manifold leading from said last mentioned passage to adjacent the lower end of the reservoir housing, and by-pass means from said inlet to said outlet in the salt reservoir head.

10. A compact softener as set forth in claim 9, in which said by-pass means includes a passage directly connecting the inlet and the outlet in the head of the salt reservoir, a spring-biased check valve in said passage, and a passage communicating between the interior of the reservoir and the outlet downstream behind the check valve.

11. A compact softener as set forth in claim 10, in which fluid flow will be diverted through the salt reservoir when said second solenoid valve is opened as the pressure drop through the salt bed is less than the pressure drop across the by-pass check valve.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,385,441

May 28, 1968

Charles E. Lyall

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 48, "contanier" should read -- container --.
Column 3, line 65, "wehn" should read -- when --. Column 6, line 28, "manfold" should read -- manifold --; lines 50 and 51, "a sof water inlet and an outlet" should read -- an inlet and a soft water outlet --. Column 7, line 6, "thereform" should read -- therefrom --.

Signed and sealed this 9th day of December 1969.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents