

Sept. 12, 1961

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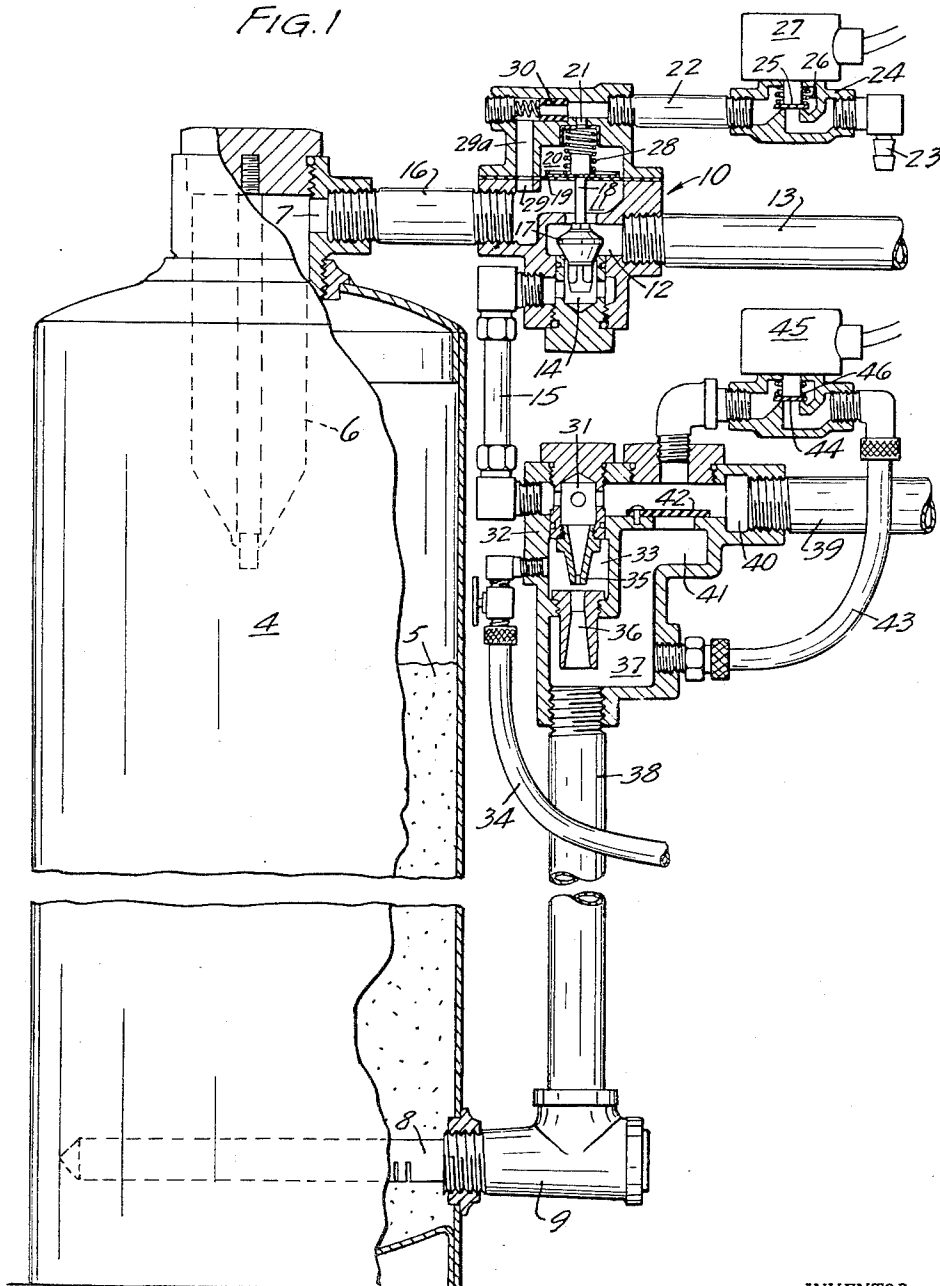
2,999,514

CONTROLS FOR FLUID TREATMENT APPARATUS

Filed June 25, 1958

3 Sheets-Sheet 1

FIG. 1



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FIG. 2

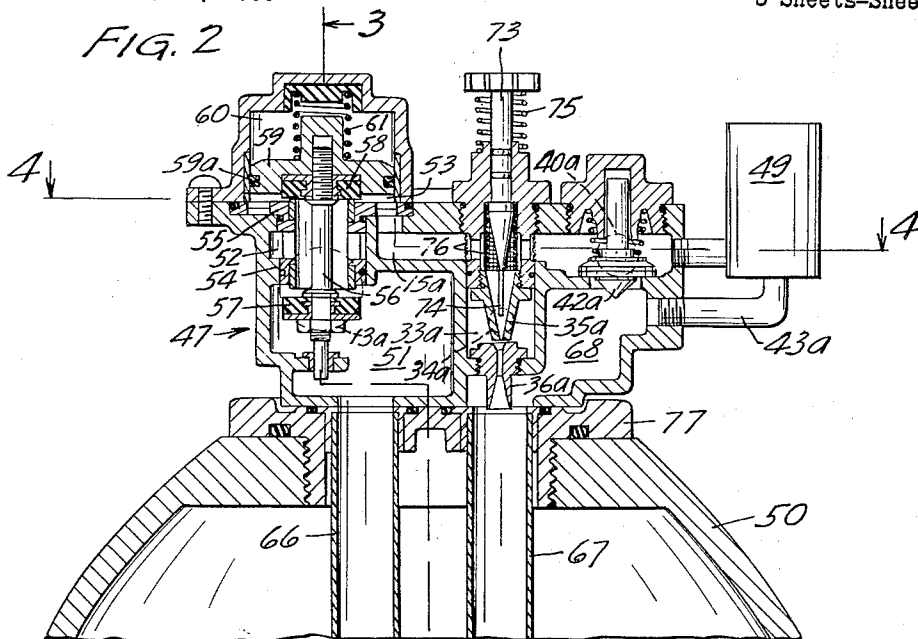
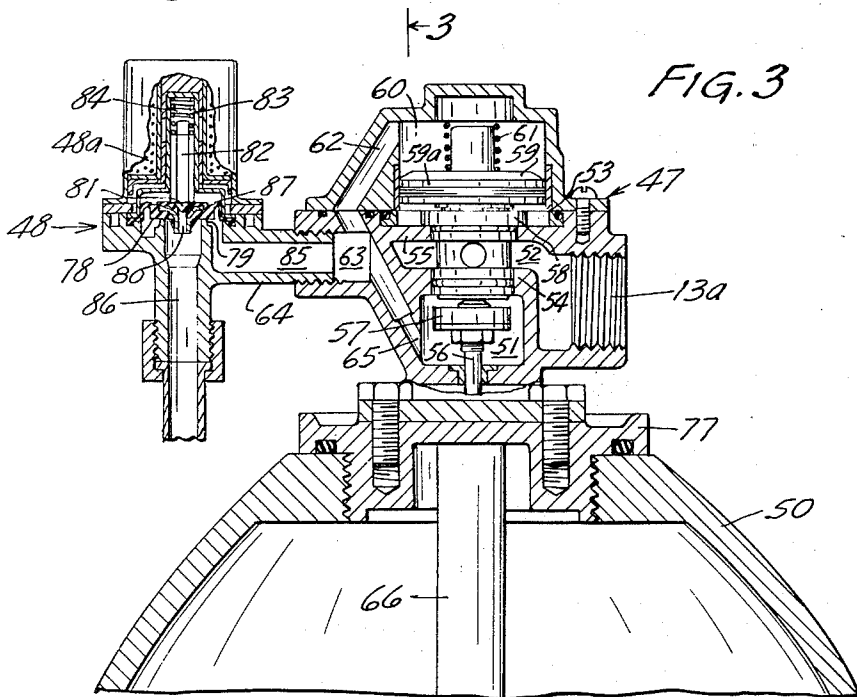


FIG. 3



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CONTROLS FOR FLUID TREATMENT APPARATUS

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FIG. 4

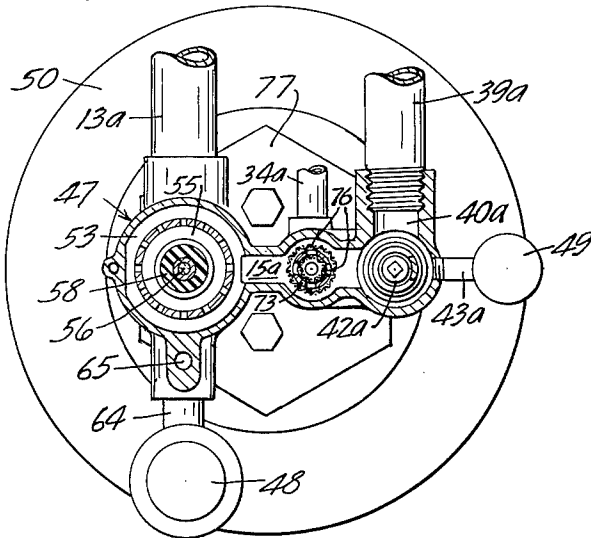


FIG. 6

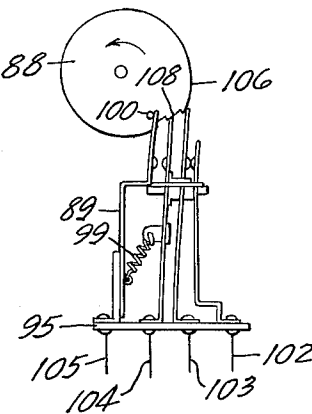


FIG. 7

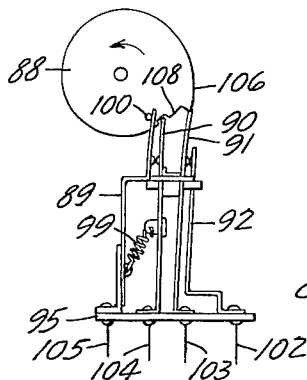


FIG. 8

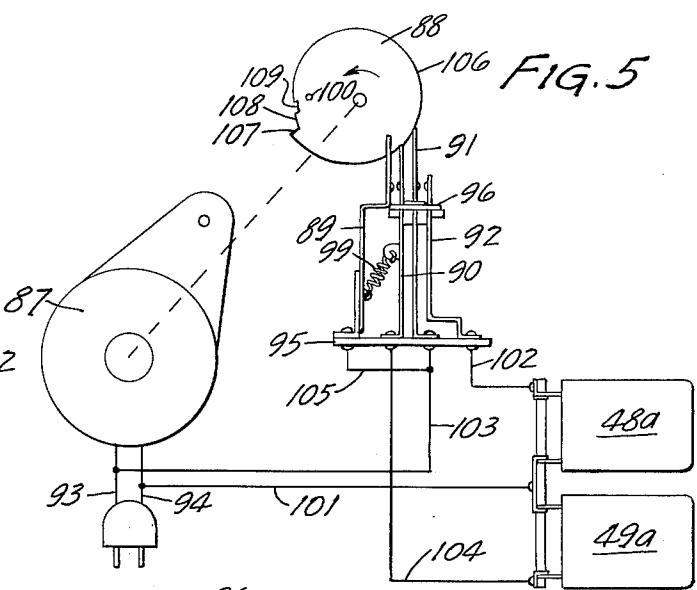
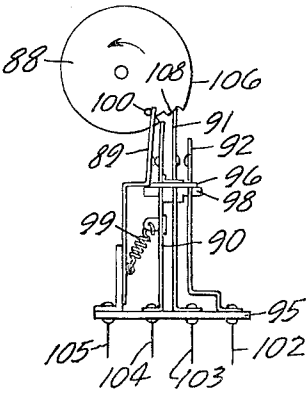
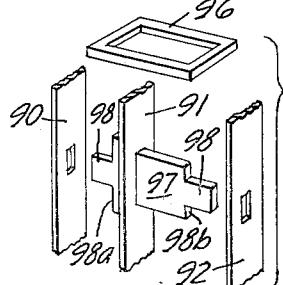


FIG. 9



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CONTROLS FOR FLUID TREATMENT APPARATUS
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Filed June 25, 1958, Ser. No. 744,577
13 Claims. (Cl. 137—624.18)

This invention relates to controls for water softeners and other fluid treatment apparatus and particularly to improved controls of the automatic or semi-automatic type which are adapted to institute and terminate a plurality of treatment operations of predetermined duration. This application is a continuation in part of my application Serial No. 616,232, filed October 16, 1956, now abandoned.

It is an object of my invention to provide novel, simple and reliable automatic controls for treatment apparatus of the class described.

A particular object is to provide controls for apparatus having a treatment tank and a regenerating fluid tank including a main valve activated by time control means, an aspirator for feeding a regenerating fluid to the softener tank for a predetermined period of time and means for by-passing the aspirator and providing increased rate of flow through the treatment tank during the periods of backwashing, the by-passing means including a valve activated by time control means.

A further and particular object is to provide a control for flow through a tank having a main valve actuated by fluid pressure responsive means from a service position in which flow is established in one direction through the tank to a regenerating position in which flow is established in the reverse direction through the tank, and including an aspirator controlling the rate of flow in one direction during regeneration and a valve controlled by-pass for the aspirator which is operative during backwashing operation.

Another object is to provide an automatic water softener control which includes timing means operative at the end of a cycle of regeneration and backwashing to quickly restore normal pressure in the softener tank to thereby insure reliable operation of a pressure responsive main valve and waste control valve even in installations where the available water pressure is low.

My invention also includes certain other novel features of the valves, flow passages, conduits and timing mechanism for apparatus of the class described.

Referring to the accompanying drawings which illustrate, by way of example and not for the purpose of limitation, a preferred and a modified embodiment of my improved controls:

FIGURE 1 is a part side elevational view and part vertical sectional view showing one embodiment of the controls associated with a treatment tank and the connections with the tank;

FIG. 2 is a vertical sectional view through a preferred modification of the main valve, aspirator and associated passages, together with a portion of the treatment tank and the inlet and outlet connections therefor;

FIG. 3 is a fragmentary vertical sectional view taken approximately on the line 3—3 of FIG. 2;

FIG. 4 is a horizontal sectional view taken approximately on the line 4—4 of FIG. 2;

FIG. 5 is a schematic view of the timing mechanism and associated switch blades and circuits with the switch blades and timer cam in the position for water softening operation;

FIG. 6 shows the switch blades and timer cam with these elements in the positions for regenerating operation;

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FIG. 7 is a view similar to FIG. 6 showing the switch blades and cam in positions for backwashing operation;

FIG. 8 shows the switch elements and cam in a fourth position for causing quick restoration of pressure in the tank after backwashing and prior to the return to softening operation, and

FIG. 9 shows details of the switch blades link and spacer on a larger scale.

As shown in FIG. 1, my controls are connected to a tank 4 containing a bed of softening material 5. Extending into the upper portion of the tank is a distributor 6 connected to a tank inlet fitting 7 and a second distributor 8 communicates with the lower portion of the tank and is connected to a tank outlet fitting 9.

The controls shown in FIG. 1 include a main valve indicated generally at 10. This valve has a first chamber 11 communicating with the tank inlet fitting 7, a second chamber 12 in continuous communication with a supply pipe 13 for fluid under pressure, and a third chamber 14 in continuous communication with a conduit 15. A conduit 16 extends from the chamber 11 to the tank inlet 7. Movable in the chamber 12 is a valve head 17 adapted to place this chamber selectively in communication with the chamber 11 or chamber 14. The head 17 is fixed on the lower end of a stem 18 and the latter is connected centrally to a flexible diaphragm 19 adapted to actuate the valve head in response to differences in pressure at opposite sides of the diaphragm. One side of the diaphragm 19 is exposed to fluid pressure in the chamber 11 and the opposite side is exposed to pressure in a chamber 20. A passage 21 connects the chamber 20 with a waste outlet conduit 22 and the flow through the conduit 22 to a waste outlet 23 is under control of a valve indicated generally at 24. The valve 24 is of the solenoid actuated type having a head 25 which is connected to the plunger of the solenoid and biased toward closed position by a coiled spring 26. A solenoid coil in a housing 27 is adapted to be energized as hereinafter described by suitable time control mechanism and an electric circuit.

Confined in the chamber 20 of valve 10 is a coiled spring 28 which biases the head 17 of this valve to the position shown in FIG. 1 wherein the supply pipe 13 is in communication with the tank inlet 7 through the chambers 12 and 11 and conduit 16. When the head 17 is actuated to a second position direct communication between the chambers 11 and 12 is closed and chamber 12 is in communication with chamber 14 and conduit 15.

A waste port 29 is formed in the casing of valve 10 and is connected by a passage 29a to the inlet side of a flow control device 30 which is arranged to discharge into the waste conduit 22. This control device is constructed from resilient compressible material so that its axial passage is restricted in response to progressive increases in pressure in the passage 29a when the waste control valve 24 is open. Flow control device 30 is designed to permit flow to waste at the rate best suited to backwashing of the softening material in the tank 4.

Conduit 15 connects chamber 14 with a chamber 31 in the upper portion of a casing 32 of the aspirator device. This casing is formed with a suction chamber 33 adapted to be supplied with regenerating fluid from a conduit 34 and an aspirator nozzle 35 is arranged in the chamber 33 to discharge into a throat fitting 36 projecting into an outlet chamber 37. Flow from the fitting 36 enters an extension 38 of the conduit 15 connected to the tank outlet fitting 9 at its lower end. Thus the aspirator device is interposed in a conduit that may be referred to as a first conduit connected to the tank outlet. Conduit 34 is connected to a suitable source of regenerating fluid. For example, the conduit 34 may be connected to a float valve and reservoir of the type

described in Whitlock Patent No. 2,716,422, dated August 30, 1955.

A service pipe 39 communicates with a service outlet port 40 formed in the casing 32 and this port is in continuous communication with the chamber 31 of the first conduit. Also formed in the casing 32 is a passage 41 arranged to by-pass the aspirator and permit flow at an increased rate from the conduit extension 38 to the port 40. A check valve 42 of the flap type permits flow from passage 41 to port 40 but prevents reverse flow through the passage 41.

A second by-pass for the aspirator nozzle 35 and throat fitting 36 comprises a conduit 43 having one end in communication with the chamber 37 and the other end in communication with the port 40. Flow through by-pass conduit 43 is under control of a valve 44 adapted to be actuated by a solenoid plunger under control of a solenoid coil in a housing 45. This valve is biased toward closed position by a spring 46 and is open only when the solenoid is energized. The functions of the by-pass conduit 43 and valve 44 are to permit flow from the conduit 15 into the lower portion of the tank 4 at an increased rate during backwashing operation and to quickly restore normal pressure in the tank and flow system at the end of the regenerating and backwashing operations when the solenoid of this valve is energized.

Referring to the modification of the invention shown in FIGS. 2, 3 and 4, the controls include a main valve having a housing, indicated generally at 47, and actuating mechanism of the fluid pressure responsive type for this valve. There is also a second valve 48 (FIG. 3) and a third valve 49 (FIG. 1) both of the solenoid actuated type. These valves are more compactly arranged than those of the form of the invention shown in FIG. 1. The valve assembly is mounted on the top of a tank 50 adapted to contain a bed of softening material similar to that in the tank 4.

Housing 47 for the main valve has a first chamber 51, a second chamber 52 and a third chamber 53 separated by partitions 54 and 55, each formed with a port for the passage of liquid from the chamber 52. Water or other liquid under line pressure substantially above atmospheric pressure is fed to the chamber 52 which constitutes an inlet chamber. The main valve has a stem 56 extending axially through the ports in the partitions 54 and 55. Fixed on this stem below the partition 54 is a washer 57 adapted to open and then close the port in partition 54. Above the partition 55 a second washer 58 is fixed on the stem 56 and arranged to close and then open the port in partition 55. Also fixed on the stem 56 above the partition 55 is a piston 59 which is movable in a chamber 60 above chamber 53, being provided with a peripheral sealing ring 59a. A spring 61 is confined in chamber 60 to bias the piston 59 downwardly to a position in which washer 58 closes the port in partition 55 and washer 57 opens the port in partition 54.

As shown in FIG. 3, a passage 62 connects the chamber 60 to a waste port 63 and a waste conduit 64 extends from the port 63. Flow through this conduit is under control of the valve 48. There is also a more restricted passage 65 extending from the port 63 to the lower valve chamber 51.

Tank 50 has in its upper portion an inlet conduit 66 and a distributor corresponding to the distributor 6 shown in FIG. 1. Conduit 66 opens at its upper end into chamber 51. Extending downwardly in parallel relation to inlet conduit 66 is an outlet conduit 67 having on its lower end a distributor disposed within and near the bottom of the tank 50, as in the case of the distributor 8 in the tank 4. At its upper end conduit 67 communicates with the chamber 68 into which regenerating fluid from the lower end of an aspirator 35a—36a is discharged. This aspirator like the one shown in

FIG. 1 has a nozzle 35a projecting into a chamber 33a and discharging into a throat fitting 36a disposed in axial alignment with the tank outlet conduit 67. Regenerating liquid is supplied to the chamber 33a through a conduit 34a. To supply liquid under pressure to the upper end of nozzle 35a a passage 15a connects with the main valve chamber 53. Suction is created in the chamber 33a by flow from the nozzle 35a into the throat fitting 36a and thence into the tank outlet. Hard water under pressure is supplied to the chamber 52 through a supply pipe 13a and soft water is discharged from the main valve casing through a service port 40a and service pipe 39a.

As indicated in FIG. 2, the chamber 68 is in communication with the tank outlet below the aspirator and is in communication with the service port 40a under control of a check valve 42a so that the aspirator may be by-passed when pressure in the chamber 68 substantially exceeds that in the passage 15a. Check valve 42a is spring biased to prevent by-pass of the aspirator from the passage 15a to the chamber 68 during regeneration. A second passage for by-passing the aspirator is formed by a conduit 43a and flow through this conduit is under control of the solenoid actuated valve 49.

When treating water containing sediment, accumulations of particles sometimes clog the aspirator nozzles. To facilitate removal of sediment from the nozzle 35a and discharge fitting 36a, I provide a plunger 73 carrying on its lower end a pin 74 adapted to be passed through the restricted passages in these aspirator members as often as required and with a minimum of effort. The plunger 73 projects to the exterior of the valve housing 47 through a suitable sealed bearing and a spring 75 biases the plunger and pin 74 toward the retracted position shown. Flow of sediment to the nozzle is minimized by providing concentric screens 76 at the junction of the passage 15a and upper end of the nozzle 35a.

As indicated in FIGS. 3 and 4, the main valve housing is secured by machine screws to a screw threaded cap 77 fitting in a threaded opening in the upper end of the tank 38. This cap has an annular seal at its junction with the tank and is formed with openings to receive inlet conduit 66 and outlet conduit 67.

Details of the solenoid actuated valves 48 and 49 are shown in FIG. 3. Each of these valves has a diaphragm member 78 adapted to close against an annular seat 79 to interrupt flow through the conduit. Extending axially through the member 78 is a restricted passage 80 adapted to be closed by a conical member 81 formed on the lower end of a solenoid plunger 82. This plunger is biased toward closed position by a spring 83 mounted within a chamber 84 in the coil 48a. Valve member 78 is normally held in closed position by fluid pressure on the upper side of this member which is also subject to the bias of spring 83. There is an inlet port 85 disposed to be supplied with fluid under pressure above atmospheric and an outlet port 86 which is normally open to atmospheric pressure. To admit fluid to the upper side of diaphragm member 78 a small perforation 87 is formed in its flexible peripheral portion. This perforation is substantially smaller than the flow passage 80.

When coil 48a is energized, plunger 82 is raised against the bias of spring 83 so that the fluid at the upper side of the diaphragm member 78 escapes through axial passage 80 into outlet port 86. Pressure on the lower side of the peripheral portion of member 78 is thereby caused to actuate this member to open position in relation to its seat 79. It will thus be evident that valve 48 is a modification of valve 24 shown in FIG. 1 and performs the same functions, namely those of controlling flow through the waste conduit and pressure in the chamber at the upper side of the pressure responsive main valve actuating member. The construction of valve 49 controlling flow through by-pass conduit 43a may be similar to that of valve 48 and performs the same functions as

valve 44 controlling flow through by-pass conduit 43 of FIG. 1.

Timing mechanism for both of the controls hereinbefore described is shown diagrammatically in FIGS. 5, 6, 7, 8 and 9. In FIG. 5 the solenoid coil for valve 48 is indicated at 48a and that for valve 49 at 49a. These coils are shown in circuits for energizing them and similar circuits may be provided to energize the solenoids actuating valves 24 and 44 shown in FIG. 1. An electric motor 87 of the synchronous timer type is operatively connected to a cam 88 so that the latter makes one revolution during a predetermined period of time. For example, for an installation where water softening apparatus is designed to be regenerated and placed back in service once in every twenty-four hours gear reduction connections between the motor 87 and cam 88 may be such as to turn the cam one revolution every twenty-four hours.

Cam 88 is adapted to actuate spring switch blades indicated by the numerals 89, 90, 91 and 92 respectively and current may be supplied to the motor 87 by conductors 93 and 94. Switch blades 89-91 are secured to a base 95 of insulating material. Blades 90 and 91 have ends which project to slidably engage the periphery of cam 88. Relative movement of the blades 90 and 92 is limited by a link 96 of insulating material which embraces these blades together with the blade 91 between them and constitutes a stop at the right side of blade 92 and the left side of blade 90. Blade 91 is movable to and from the blade 92. A spacer 97, formed from insulating material, fits loosely in an opening in blade 91 and has reduced end portions 98 that fit loosely in openings in the blades 90 and 92 respectively. A projection 98a on the spacer 97 is adapted to abut against the right side of blade 90 and to constitute a stop for the left side of blade 91. Also formed on the spacer 97 is a shoulder 98b adapted to abut against the left side of blade 92. Connecting the lower portion of the blade 89 with the blade 90 is a spring 99 which biases the blade 90 toward the blade 89. At its free end, the blade 89 is offset laterally from the periphery of cam 88 to coact with a pin 100 projecting from a face of the cam so that the blade 89 is positively actuated to make contact with blade 90 during a predetermined period in the cycle of operation.

Current for energizing coil 48a (or that of the solenoid actuated valve 24) may be supplied by a circuit which includes a branch 101 of the supply wire 94, solenoid coil 48a, a conductor 102, switch blades 92 and 91 and a conductor 103 extending to the supply wire 93. A parallel circuit for energizing solenoid coil 49a includes conductor 101, a conductor 104, switch blades 90 and 89 and a branch 105 of conductor 103 extending to supply wire 93. To control movement of switch blades 90 and 91 the cam 88 is formed with a main peripheral segment 106 terminating in a radial segment 107. From segment 107 a relatively short segment 108 extends to a notch segment 109.

Operation

During water softening operation the several valves are in the positions shown in FIGS. 1-4 inclusive and the electric circuits for energizing the solenoids of the waste and by-pass valves are open, as indicated in FIG. 5. Motor 80 is continuously energized and cam 88 continues to rotate in the direction indicated by arrows in FIGS. 5-8.

Referring to the form of the invention shown in FIG. 1, during water softening operation the valves 24 and 44 are closed and the head 17 of the main valve is in the position shown wherein flow is established from the supply pipe 13 through chambers 12 and 11 to conduit 16 and tank inlet 7. Hard water is thus caused to flow from the top distributor 6 through the bed of softening material 5, and soft water flows through the distributor 8, outlet 9, conduit 38, passage 37, to port 40 and service pipe 39, past check valve 42.

Regeneration is started when switch blade 90 drops from the trailing end of cam segment 106 to segment 108, as indicated in FIG. 6, while the blade 91 remains in contact with the segment 106. Blade 90 is moved to the left by the spring 99 and actuates link 96 to pull switch blade 92 to the left closing contact with the blade 91 and completing the circuit including solenoid coil 48a or the coil of solenoid valve 24 thereby causing this valve to open waste conduit 22. Pressure is thereby reduced substantially to atmospheric pressure in passage 21 and chamber 20. This causes diaphragm 19 to move upwardly under the higher pressure exerted by the fluid in the chamber 11 so that valve head 17 connected to the diaphragm is moved to its upper or second position wherein flow is cut off from chamber 12 to chamber 11 and tank inlet 7, while flow is established from pipe 13 and chamber 12 through chamber 14, conduit 15, aspirator nozzle 35 and throat fitting 36 to conduit 38, tank outlet 9 and distributor 8. This flow causes the fluid pressure in the chamber 33 to be reduced and draws brine through the conduit 34. Brine mixed with water from the nozzle 37 is thus fed into the tank outlet 9 and flows upwardly through the bed 5 to the distributor 6 and tank inlet 7. From the latter the spent brine is discharged through conduit 16, port 29, flow regulating device 30, conduit 22 and valve 24 to the waste outlet 23. The rate of flow of the regenerating fluid through the softening material in the tank 4 is determined by the cross sectional areas of the nozzle 35 and throat 36 for liquid supplied at any particular pressure. These flow controls are designed to provide a slower rate of flow than that permitted by the flow control device 30 which limits the rate of flow to waste during backwashing. During regeneration hard water is supplied to the service outlet pipe 39, through the conduit 13, chamber 31 and port 40. Also during regeneration, the coil of solenoid valve 44 remains deenergized so that by-pass conduit 43 is closed and the aspirator is operative.

At the end of the predetermined period for regeneration, flow of brine is cut off by the brine valve (not shown) but hard water continues to flow through the aspirator into the lower portion of the tank and from the upper portion of the tank to the waste outlet. This relatively low rate of flow is increased for backwashing when switch blade 90 drops into notch segment 108 of cam 88, as indicated in FIG. 7, and pin 100 on cam 88 holds switch blade 89 against movement to the left. The circuit is thereby closed between the blades 89 and 90. This circuit energizes solenoid coil 49a or the coil of solenoid valve 44. Switch blade 91 remains in contact with cam segment 106 during backwashing, as indicated in FIG. 7, and link 96 holds blade 92 in its contact closing position. Thus the coils of both solenoid valves are energized during backwashing. During backwashing, upward flow through the tank 4 to waste outlet 23 is increased by flow through conduit 43, valve 44 and conduit 38. The rate of this backwash flow is regulated by the device 30 which discharges into the waste conduit 22. The time required for backwashing is ordinarily considerably shorter than that required for regeneration.

At the end of the backwashing period, switch blade 91 drops off of cam segment 106 to segment 108, as indicated in FIG. 8, so that blade 91 springs away from blade 92 and causes the circuit including solenoid coil 48a or the coil of solenoid valve 24 to be deenergized. Blade 92 is held back by the spacer 97. For a further short period, contact between the blades 89 and 90 is maintained, the blade 89 being confined against movement to the left by pin 100 and contact between these blades is maintained by spring 99. Energization of the by-pass control valves 44 or 49 is thus continued for a short period after the waste valve solenoid has been deenergized.

By retaining by-pass valve 44 in open position after the solenoid of waste valve 24 has been deenergized, I insure rapid return of the main valve to the water softening

ing position. This is advantageous because at the end of the regenerating and backwashing operations the pressure in the tank 4 may be too low to move the diaphragm actuated main valve head to its water softening position. With valve head 17 in its upper closed position, it is necessary to build up pressure above diaphragm 19 in order to close head 17 at its lower seat. Low pressure approaching atmospheric pressure may extend from chamber 20 through passages 21, 29a and the tank 4. In the absence of an open by-pass 43, pressure in the tank could build up only by flow through the aspirator nozzle. The resulting slow build-up of pressure makes the operation of the main valve unreliable, particularly in installations where the available water pressure is low. When the by-pass 43 is held open, pressure in the tank and diaphragm chamber 20 is built up rapidly by flow through the conduits 15 and 38, and the valve head 17 is moved to its regenerating position quickly. As a further result of the rapid return to normal pressure in the tank, soft water is caused to flow from chamber 33 through conduit 34 to replace brine that has been removed from the brine tank during the regenerating period.

A relatively short time, on the order of five minutes, is sufficient for the restoration of normal pressure in the tank and return of the main valve to its water softening position. The period for restoration of pressure is terminated when the pin 100 releases switch blade 89 so that this blade springs away from the blade 90 and the latter is held in its open position by engagement with the leading end of the segment 106. The circuit including solenoid coil 49a or the coil of solenoid valve 44 is thereby deenergized and the apparatus is returned to water softening operation.

Operation of the modification of the invention shown in FIGS. 2, 3 and 4 is similar to that described with reference to the form shown in FIG. 1. During water softening, hard water entering through the pipe 13a and chamber 52 flows past the washer 57, through chamber 51, inlet conduit 16, downwardly through the water softening material in the tank 50, up through outlet conduit 67 to chamber 68 and thence past check valve 42a to the soft water port 40a and service pipe 39a.

Regeneration is started by the closing of the circuit (FIG. 5) energizing solenoid coil 48a of valve 48. This circuit is closed when the switch blades spring to the positions shown in FIG. 6. When valve 48 opens the pressure in chamber 60 is reduced by flow through the passage 62, port 63 and waste conduit 64. Thereupon, fluid pressure in inlet chamber 52 and chamber 53 at the lower side of the piston 59 moves the piston upwardly against the bias of spring 61 to open the port between chamber 52 and chamber 53, and close the port between chamber 51 and chamber 52 by operation of the washers 55 and 57. Liquid flowing from chamber 53 through passage 15a and the aspirator nozzle 35a now creates suction in chamber 33a and conduit 34a to draw brine from the brine supply tank. The aspirator thus operates to cause a mixture of concentrated brine and water to flow from the fitting 36a through outlet conduit 67 to the bottom tank distributor. Brine flows upwardly through the body of water softening material, and the spent brine passes out to waste through conduit 66, chamber 51, passage 65, port 63 and conduit 64.

At the end of the predetermined regenerating period valve 48 remains open and the by-pass control valve 49 is caused to open by energizing its solenoid coil 49a which is included in the circuits hereinbefore described. Switch blades 89—90 and 91—92 are then in the closed positions indicated in FIG. 7 for the duration of the backwashing period. Water flows from inlet chamber 52 through the port in partition 55 to chamber 53 and through passage 15a, by-pass conduit 43a, chamber 68, and conduit 67 to the bottom distributor, then upwardly through the softening material to the top distributor and

through conduit 66, chamber 51, passage 65, port 63 and conduit 64 to waste.

Timer cam 88 retains the switch blades in their backwash positions for a suitable time and then reaches a position wherein blades 91 and 92 spring apart to open the circuit including solenoid 48a while the circuit including coil 49a remains closed, the switch blades being in the positions indicated in FIG. 8. When the controls are in these positions, the pressure in the tank and flow system is quickly returned to the normal line pressure. As a result, the waste valve 48 is moved quickly to its closed position and the main valve moved quickly from its regenerating position to its water softening position.

Both of these valves, being operated by pressure-responsive means, depend for efficient operation on restoration of normal operating pressure after the regenerating operation.

More specifically, in order to return piston 59 to its water softening position, indicated in FIGS. 2 and 3, and to cause solenoid valve 48 to close, it is necessary to build up the pressure in the chamber 60 of the main valve and in the chamber above the waste valve member 78. With reduced pressure in the port 85, and in the chamber below member 78, a short period of time is required for sufficient fluid to pass through the opening 87 to build up normal operating pressure above member 78. This valve member closes promptly when the pressure in the system is built up to normal line pressure as is the case when valve 49 is retained in its open position after the solenoid 48a has been deenergized.

Accordingly, an important feature of my invention is the provision of a control valve in the by-pass conduit 43 or 43a and means for retaining the by-pass open for a substantial period of time, e.g., five minutes, after the drain valve solenoid has been deenergized. Typically, the cam 88 is designed to actuate the switch blades 89—92 through a cycle providing water softening for approximately 22 hours and 20 minutes, automatic regeneration for approximately 60 minutes, backwashing for about 15 minutes and then about 5 minutes for restoration of normal pressure in the flow system.

By simple modification of the cam 88 and its connections with the motor 87, and by providing a switch or switches for starting and stopping the motor, my controls may be made semi-automatic. With such controls the operator merely operates a starter switch which initiates the cycle required for regeneration and/or backwashing of predetermined duration followed by automatic return of the apparatus to water softening operation. For installations where backwashing at an increased rate of flow is not required, the by-pass conduit 43 (or 43a) and its control valve, solenoid and activating circuit including switch blades 89 and 90 may be eliminated.

As in other automatic softeners my timing mechanism may be set so that regeneration is effected at an hour when there is little or no demand for water. Thus the service outlets connected to the pipe 39 are ordinarily closed during regeneration and backwashing.

I claim:

1. A control for fluid treatment apparatus comprising casing means having first and second tank connecting ports, a main valve having a first chamber, a second chamber and a third chamber; partitions separating said second chamber from the first and third chambers respectively and having ports for flow from the second chamber to the first and third chambers; said first tank connecting port communicating with said first chamber; a supply pipe for fluid under pressure connected to said second chamber; a first passage connecting said third chamber to said second tank connecting port; a service outlet port communicating with said first passage; closure means movable to selectively close the ports in said partitions, said closure means being movable to a first position closing the port in the partition between the third and second chambers and opening the port in the partition between

the first and second chambers, and said closure means being movable to a second position opening the port in the partition between the second and third chambers and closing the port in the partition between the first and second chambers, a waste outlet port communicating with said first tank connecting port; a waste conduit vented to atmospheric pressure and connected to said waste outlet port; a second valve which is operative independently of said closure means controlling flow from said waste outlet port to said waste conduit; an aspirator interposed in said first passage to direct fluid to said second tank connecting port; means for conducting a regenerating fluid to said aspirator; a second passage having ends connected to said first passage near the inlet and outlet sides respectively of said aspirator and disposed to by-pass said aspirator; a third valve which is operable independently of said second valve, interposed in said second passage to control flow through said passage; fluid pressure responsive means operatively connected to said closure means; one side of said fluid pressure responsive means being subject to the pressure in said first tank connecting port and the other side being subject to the pressure in said waste conduit; and automatic timing means operatively connected to said second and third valves for activating them successively to open positions and then to closed positions at predetermined time intervals.

2. A control in accordance with claim 1 in which electro-magnetic means are provided to actuate said second and third valves to open said waste conduit and second passage respectively.

3. A control in accordance with claim 1 in which said automatic timing means comprise means for opening said third valve subsequently to the opening of the second valve and for closing the second valve prior to the closing of the third valve whereby normal pressure is restored in said second tank connecting port by flow through said second passage in the interval between the closing of said second and third valves.

4. A control in accordance with claim 1 in which said service outlet port communicates with said first passage at the inlet side of said aspirator, including a third passage extending from the first passage at the outlet side of said aspirator to said service outlet port to by-pass said aspirator; and a check valve in said third passage permitting relatively unrestricted flow from said second tank connecting port past the aspirator to the service outlet port.

5. A control in accordance with claim 1 in which said closure means comprise a stem operatively connected to said fluid pressure responsive means and extending through the ports in said partitions, and washers fixed on said stem and movable in said first and third chambers respectively to and from said first and second positions.

6. A control in accordance with claim 1 in which said closure means comprise a head movable in said second chamber, operatively connected to said fluid pressure responsive means and movable to and from said first and second positions.

7. A control in accordance with claim 1 in which electro-magnetic means are provided to actuate said second and third valves respectively, and in which said timing means comprise a cam, a motor operatively connected to said cam, electric switches disposed to be actuated by said cam, and electric circuits under control of said switches including said electro-magnetic actuating means for the second and third valves respectively whereby said valves are caused to open and close at predetermined times.

8. A multiport valve comprising a casing having first, second and third chambers therein, a fluid inlet passage communicating with said first chamber, said casing having first and second parts therein providing communication between said first chamber and said second chamber and between said first chamber and said third chamber, respectively, valve means movable from a position

blocking flow through said second port to a position blocking flow through said first port, a raw water outlet passage communicating with said second chamber, a service passage communicating with said third chamber, a treated fluid passage in said casing, an ejector including a raw fluid inlet communicating with said third chamber; a regenerant fluid inlet; and an outlet communicating with said treated fluid passage and operative to pass a restricted flow of fluid from said third chamber to said treated fluid passage, a first by-pass means communicating with said third chamber and said treated fluid passage for passing a flow of fluid from said third chamber to said treated fluid passage, selectively operable valve means for controlling the flow of fluid through said first by-pass means, and a second by-pass means communicating with said third chamber and said treated fluid passage and including a check valve operable to open and permit flow from the treated fluid passage to said third chamber and to close to prevent return flow therethrough from said third chamber to said treated fluid passage.

9. A multiport valve comprising a casing having first, second and third chambers therein, a fluid inlet passage communicating with said first chamber, said casing having first and second ports therein providing communication between said first chamber and said second chamber and between said first chamber and said third chamber, respectively, valve means movable between a position blocking flow through said second port and a position blocking flow through said first port, a raw water outlet passage communicating with said second chamber, said casing having a treated fluid passage therein, an ejector mounted in said casing and including a nozzle having the inlet thereof communicating with said third chamber and a throat having the discharge end thereof communicating with said treated fluid passage, by-pass means communicating with said third chamber and with said treated fluid passage, valve means for controlling the flow of fluid through said by-pass means normally positioned to close said by-pass means, a drain passage communicating with said second chamber for passing fluid therefrom to drain, drain valve means controlling flow through said drain passage normally positioned to close said drain passage, a first electro-responsive means for opening said drain valve means, means connected to said valve means and responsive to the opening of said drain valve means for moving said valve member from a position blocking flow through said second port to a position blocking flow through said first port and opening said second port to supply water from said inlet to said third chamber, a second electro-responsive means for opening said valve means in said by-pass means, and timer means for sequentially energizing said first electro-responsive means to open said drain valve means and for energizing said second electro-responsive means to open said valve means in said by-pass means.

10. A multiport valve comprising, casing means having first, second and third chambers therein, a fluid inlet passage communicating with said first chamber, said casing means having first and second ports therein providing communication between said first chamber and said second chamber and between said first chamber and said third chamber, respectively, a valve member in said first chamber movable from a position blocking flow through said second port to a position blocking flow through said first port, a raw water outlet passage communicating with said second chamber, a service passage communicating with said third chamber, a treated fluid passage in said casing means, an ejector including a raw fluid inlet communicating with said third chamber; a regenerant fluid inlet; and an outlet communicating with said treated fluid passage and operative to pass a restricted flow of fluid from said third chamber to said treated fluid passage, a first by-pass means communicating with said third chamber and said treated fluid passage for passing a flow of fluid from said third chamber to said treated fluid pas-

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sage, selectively operable valve means for controlling the flow of fluid through said by-pass means, and a second by-pass means communicating with said third chamber and said treated fluid passage and including a check valve operable to open and permit flow from the treated fluid passage to said third chamber and to close to prevent return flow therethrough from said third chamber to said treated fluid passage.

11. A multiport valve comprising casing means having first, second and third chambers therein, a fluid inlet passage communicating with said first chamber, said casing means having first and second ports therein providing communication between said first chamber and said second chamber and between said first chamber and said third chamber, respectively, a valve member in said first chamber movable between a position blocking flow through said second port and a position blocking flow through said first port, a raw water outlet passage communicating with said second chamber, a service passage communicating with said third chamber, said casing means having a treated fluid passage with one end thereof disposed adjacent said third chamber, an ejector mounted in said casing means, and including a nozzle having the inlet thereof communicating with said third chamber and a throat having the discharge end thereof communicating with said treated fluid passage, a first by-pass means communicating with said third chamber and said treated fluid passage, a first valve means including a movable valve member for controlling the flow of fluid through said first by-pass means, an electro-responsive means mounted on said casing means for operating said first valve means, a second by-pass means communicating with said third chamber and said treated fluid passage, and a second valve means in said second by-pass means operable to close to prevent flow therethrough from said third chamber to said treated fluid passage and to open to permit flow therethrough from said treated fluid passage to said third chamber.

12. The combination of claim 11 including means yieldably urging said first valve means to a position blocking flow through said first by-pass means to normally prevent flow therethrough, said electro-responsive means being operative when energized to open said first valve means.

13. A multiport valve comprising casing means having

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first, second and third chambers therein, a fluid inlet passage communicating with said first chamber, said casing means having first and second ports therein providing communication between said first chamber and said second chamber and between said first chamber and said third chamber, respectively, a valve member in said first chamber movable between a position blocking flow through said second port and a position blocking flow through said first port, a raw water outlet passage communicating with said second chamber, said casing means having a treated fluid passage therein, an ejector mounted in said casing means and including a nozzle having the inlet thereof communicating with said third chamber and a throat having the discharge end thereof communicating with said treated fluid passage, by-pass means communicating with said third chamber and with said treated fluid passage, valve means for controlling the flow of fluid through said by-pass means normally positioned to close said by-pass means, a drain passage communicating with said second chamber for passing fluid therefrom to drain, drain valve means controlling flow through said drain passage normally positioned to close said drain passage, a first electro-responsive means for opening said drain valve means, means connected to said valve member and responsive to the opening of said drain valve means for moving said valve member from a position blocking flow through said second port to a position blocking flow through said first port and opening said second port to supply water from said inlet to said third chamber, a second electro-responsive means for opening said valve means in said by-pass means, and timer means for sequentially energizing said first electro-responsive means to open said drain valve means and for energizing said second electro-responsive means to open said valve means in said by-pass means.

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