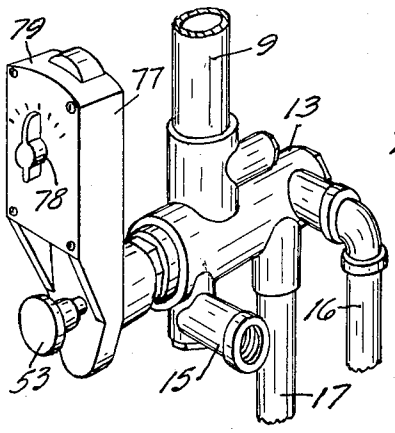
Jan. 22, 1957 L. G. LINDSAY 2,778,799

WATER SOFTENING APPARATUS

Filed July 17, 1953 2 Sheets-Sheet 1

FIG. 4



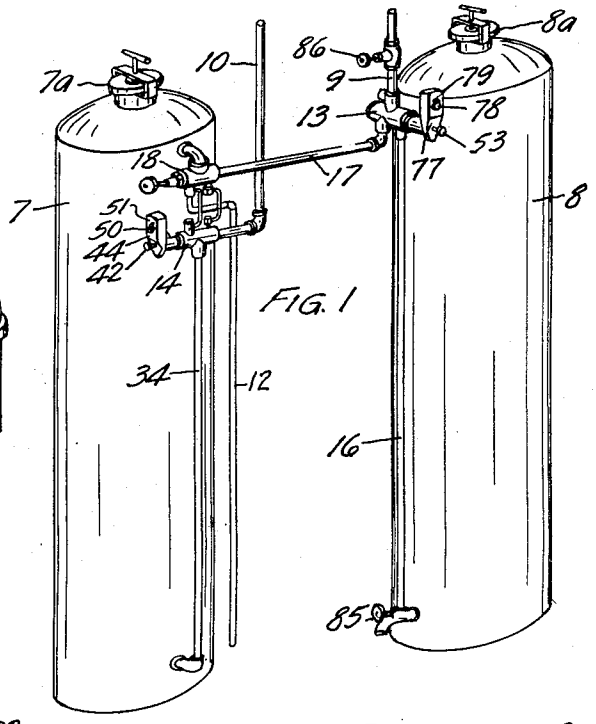




FIG. 1

FIG. 2

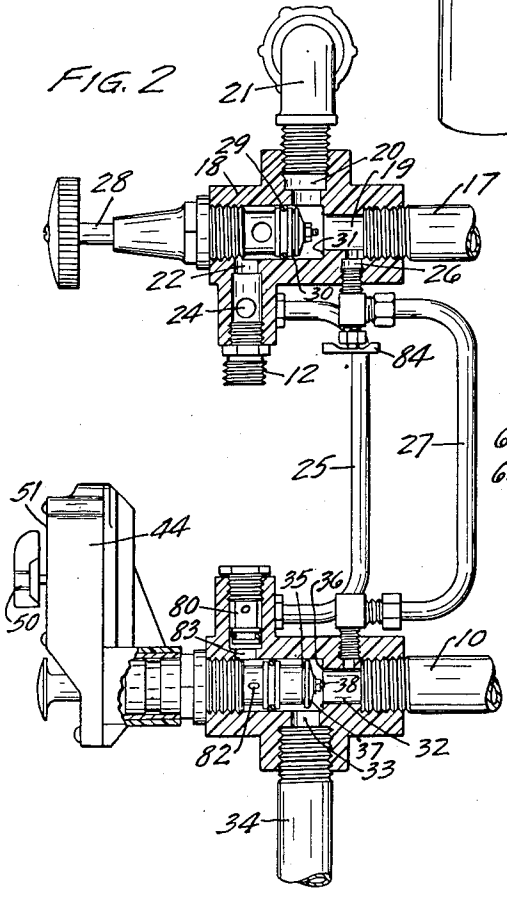
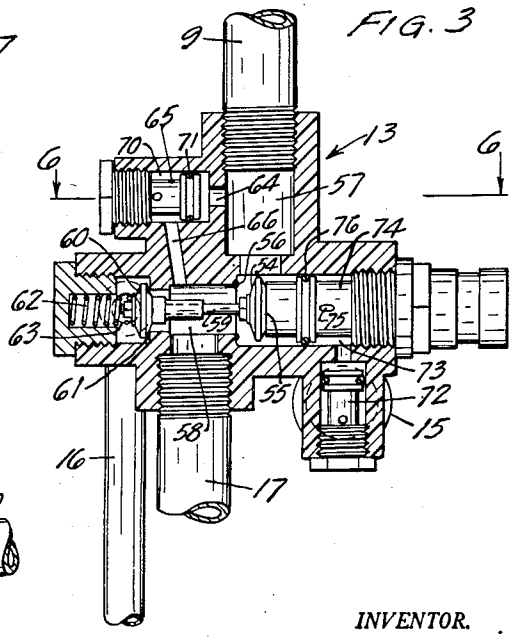



FIG. 3




INVENTOR.
LYNN G. LINDSAY
BY
John E. Mitchell
ATTORNEY

Jan. 22, 1957 L. G. LINDSAY 2,778,799

WATER SOFTENING APPARATUS

Filed July 17, 1953 2 Sheets-Sheet 2

FIG. 5

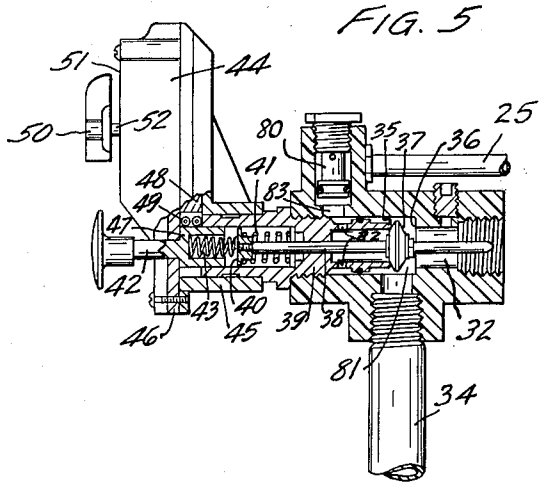
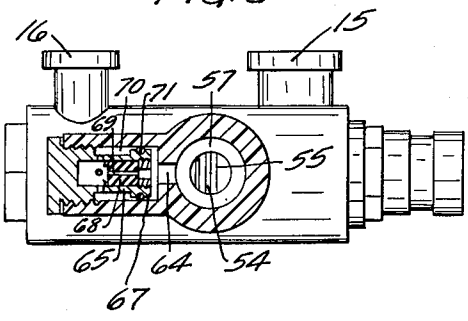



FIG. 6




INVENTOR
LYNN G. LINDSAY
BY John E. Thyken
ATTORNEY

United States Patent Office 2,778,799 Patented Jan. 22, 1957



2,778,799

# WATER SOFTENING APPARATUS

Lynn G. Lindsay, St. Paul, Minn., assignor to The Lindsay Company, St. Paul, Minn., a corporation of Minnesota

Application July 17, 1953, Serial No. 368,739

7 Claims. (Cl. 210—24)

This invention relates to water softening apparatus of the type wherein the water to be softened is passed through a body of softening material which requires periodic regeneration and has for an object to provide apparatus of this class having semi-automatic valves and timing mechanism including manual controls for initiating and selecting independently one of the other suitable periods for regenerating the softening material and for flushing it and means for automatically returning the apparatus to water softening operation at the end of the flushing period.

A particular object is to provide for water softening apparatus of the class described, improved regenerating, flushing and control means comprising a plurality of semi-automatic time control valves adapted to be severally set to initiate the regenerating and flushing operations and whereby the regenerating operation is automatically terminated at a controlled time prior to the termination of the flushing operation and return of the apparatus to softening operation automatically.

A further object is to provide in apparatus of the class described orifice devices which are so arranged as to cause the mixing of concentrated brine from the brine tank with correct proportions of clear water during regeneration and to regulate the rate of flow of the resulting dilute brine and flushing water to the drain outlet after these liquids have passed through the softening material.

Other objects will appear and be more fully pointed out in the following specification and claims.

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

Figure 1 is a perspective view showing my improved water softening apparatus;

Fig. 2 is a part vertical sectional view and part elevational view showing the first semi-automatic time control valve and adjacent valve mechanism and conduits;

Fig. 3 is a fragmentary vertical sectional view through the second time control valve;

Fig. 4 is a perspective view showing the second time control valve and connecting conduits;

Fig. 5 is a fragmentary sectional view showing particularly the latch mechanism for one of the semi-automatic control valves; and

Fig. 6 is a longitudinal sectional view through one of the automatic flow regulating devices taken on the line 6—6 of Fig. 3.

In the drawings the numeral 7 indicates a tank containing granular zeolite or other water softening material through which the water to be softened is circulated and the numeral 8 indicates a tank containing common salt or other regenerating material. These tanks are of the pressure type, provided with top manholes and having covers therefor, indicated at 7a and 8a respectively, and suitable clamps for holding the covers in closed and sealed relation to the respective tanks. Water to be softened is supplied under pressure through a pipe 9 and softened water is delivered from the softener through a



pipe 10 extending to the service outlets. The spent brine and flush water may be discharged through a waste pipe 12 or other waste outlet or hose. Suitable conduits are also provided for circulating water from the pipe 9 through the tank 7 to the service pipe 10 and for circulating the liquid successively through the tanks 8 and 7 to the waste pipe 12 during regenerating and flushing under control of a plurality of semi-automatic valves indicated generally by the numerals 13 and 14. These valves hereinafter referred to as the first and second semi-automatic valves respectively are preferably of the multiple port two-way type. The ports of the valve 13 are respectively a hard water port 57 connected to the supply pipe 9, a conduit 15 forming an upper brine tank port extending to the upper portion of the tank 8, a lower brine tank port 63 communicating with a conduit 16 extending to the lower portion of the tank 8 and an outlet port 58 communicating with a conduit 17 extending to a valve 18 normally connecting the conduit 17 to the upper portion of the tank 7.

As shown in Fig. 2, the valve 18 has a port 19 communicating with the conduit 17, a second port 20 connected by a conduit 21 with the upper portion of the tank 7, a third port 22 communicating with the drain pipe 12, a port 24 connected by a pipe 25 to the valve 14 and a port 26 connected by a pipe 27 to the valve 14. The valve 18 has a handle 28 operatively connected to a head 29. By operating the handle 28, the head 29 may be closed against a seat 30 or against a seat 31. The seat 30 is formed on an end of a tubular member formed with passages in continuous communication with the port 22. A similar tubular member is shown in section in Fig. 5 and is hereinafter described. During the water softening, regenerating and flushing operations the head 29 is in closed position against the seat 30 so that communication is established between the ports 19 and 20 and direct communication between the ports 20 and 22 is cut off by the head 29.

As shown in detail in Figs. 2 and 5, the valve 14 constituting the second semi-automatic valve, has a service outlet port 32 communicating with the service pipe 10 and a port 33 which is in continuous communication with a conduit 34 extending to the lower portion of the tank 7. Port 33 may be referred to as the second port of valve 14. Annular seats 35 and 36 are formed in the casing of valve 14 at opposite sides of the port 33 for engagement with a valve head 37 which is mounted on a stem 38 and adapted to be actuated to close selectively against either the seat 35 or seat 36. The stem 38 is movable longitudinally in a bearing 39 in the valve 14 and has rigidly fixed on its outer end a head 40. As shown in Fig. 5, the seat 35 is formed on an end of a tubular member projecting from the bearing 39 and this tubular member is formed with passages 82 communicating with a chamber 83. Confined between the head 40 and the bearing 39 is a spring 41 arranged to bias the head 37 toward closed position against the seat 35. A manually operable plunger 42 is mounted in axial continuation of the valve stem 38 and is formed with a recess in its inner end to receive and confine a coiled spring 43 which projects to engage the outer end of the head 40. This spring 43 is stiffer than the spring 41 and is designed to permit limited inward movement of the plunger 42 after the head 37 has been closed against the seat 36.

Latch and timing devices for the valve 14 are mounted in a housing 44 which is carried by an extension of the casing for valve 14, the housing being formed with a cylindrical end portion 45 fitting the valve casing and held in place by suitable set screws. The latch and timing devices shown herein are more fully described and claimed in the application of Lynn G. Lindsay Serial

No. 210,273, filed February 6, 1951, now United States Patent No. 2,689,006. The plunger 42 projects through an opening in a member 46 of the housing 44 and is provided with a suitable knob adapted to be manipulated to set the head 37 in its closed position against the seat 36.

An annular shoulder 47 extends radially on the plunger 42 for engagement with a latch member indicated generally by the numeral 48. This latch member is movable substantially radially of the plunger, to and from engagement with the shoulder 47 and is guided between radially extending surfaces formed in the housing 44, which surfaces are substantially perpendicular to the axis and direction of movement of the plunger 42. Anti-friction rollers 49 are carried by the latch member 48 to make rolling contact with the shoulder 47 and radial guide surfaces of the housing.

As more fully described in my United States Patent No. 2,689,006 above referred to, the timing mechanism is of the spring actuated clock type having a cam disposed to release the latch member 48 so that it is retracted out of the path of the plunger 42 at the end of a period of time which is determined by the setting of a knob 50 in relation to a graduated dial 51 on the front face of the housing 44. The knob 50 is fixed on an end of a spindle 52 and is operatively connected to the main spring of the clock mechanism. Thus the clock spring may be wound by turning the knob 50 clockwise. The dial 51 is graduated to indicate the period of time in minutes during which the valve mechanism is to be held in predetermined position. When the pointer carried by the knob 50 has been set manually for a selected period, the clock mechanism turns the spindle 52 in counterclockwise direction and returns the pointer to the starting or zero position at a uniform, predetermined rate. At or near the end of the selected period, the clock operated mechanism releases the latch member 40 so that it is retracted from engagement with the shoulder 47 on the plunger 42. The spring 41 is thereby released and operates to move the head 37 away from the seat 36 and to closed position against the seat 35.

A similar clock operated control and manually operable setting mechanism therefor is provided for the valve 13. As shown in Figs. 1 and 3, this valve has a manually operable plunger 53 which is connected to a head 54 and is spring biased so that the head is normally closed against an annular seat 55. This seat is formed on an end of a tubular member 73 formed with radial passages communicating with a chamber 73. An oppositely disposed seat 56 is provided for the head 54 which is adapted to be manually set in closed relation to the seat 56. When in its normal position the head 54 opens communication between the port 57 communicating with the pipe 9 and port 58 communicating with the pipe 17.

Projecting from and in axial alignment with the head 54 is a pin 59 adapted to actuate a third valve 60 to open position. This valve is biased toward closed relation to a seat 61 by a spring 62 and a port 63 communicates with the conduit 16 at one side of the valve 60 so that communication between the port 63 and port 58 is cut off when the valve 60 is in one position and is opened when the valve is in a second position.

Formed in the casing of the valve 13 is a passage 64 extending to an orifice device 65 of the automatic pressure responsive type and a passage 66 connecting the outlet of the orifice device to the port 58. This orifice device is designed to maintain a substantially uniform predetermined rate of flow of water through the passage 66 during regeneration and flushing irrespective of the pressure of the water in the port 57. As best shown in Fig. 6, the orifice device 65 comprises a rigid cylindrical member 67 containing a core 68 of soft rubber or like compressible material having an axial passage 69 for liquid which communicates at one end with the passage 64 and at the other end with an annular chamber 70. This chamber is separated from the chamber 64 by a suitable sealing ring 71. Increases in pressure cause approximately proportional compression of the core 68 and corresponding restriction of the axial passage 69. The chamber 70 is in communication with the passage 66 so that during regeneration water will flow at a controlled rate, determined by the size of the axial passage 69, from the pipe 9 to the port 58 and pipe 17.

A second orifice device indicated generally by the numeral 72 (Fig. 3) is provided to control the flow from a chamber 73 in the casing for the valve 13 to the conduit 15 communicating with the upper portion of the brine tank 8. This device 72 is like the orifice device 65, and has an axial passage in its compressible core of such diameter as to permit flow of water to the upper portion of the tank during regeneration at a desirable rate which is predetermined to cause flow of concentrated brine from the tank 8 in proper proportion to the flow of clear water through the device 65. Thus when the head 54 of the valve is closed at its seat 56 water flows past the seat 55 to the interior of a tubular valve member 74, thence through passages 75 to the chamber 73 which is separated from the port 58 by a sealing ring 76.

A semi-automatic time control device is provided for the valve 13 which is a duplicate of that hereinbefore described for the valve 14. As shown in Fig. 1, the valve 13 is provided with a timer indicated generally by the numeral 77, having a manually operable knob 78 and pointer adapted to be set by reference to a dial 79 to determine the regenerating period independently of the flushing period.

Flow of water to waste from the valve 14 is under control of an orifice device 80 which is like the orifice devices 65 and 72, except for the size of the axial passage through the rubber core. The device 80 correlates the flow to waste to the setting of the timer for the valve 14 and is effective to secure efficient and complete regeneration and flushing out of the brine from the tank 7. During the flushing water flows past the valve seat 35, through passages 81 and 82 (Fig. 5) to a waste outlet port 83, thence through the orifice device 80 and conduit 25 to the port 24 and drain pipe 12.

Periodic backwashing of the bed of water softening material in the tank 7 is desirable with many installations. To provide for this, a manually operable needle valve 84 is disposed to control the passage of water from the port 26 to and through the pipe 27 to the port 32 in the valve 14. When the valve head 29 is closed at the seat 31 and the head 39 is closed at seat 35, hard water may be caused to flow to the lower portion of the softening tank by opening the needle valve 84. Service outlets connected to the conduit 10 are normally closed but if one of them should be opened during backwashing this would merely retard backwashing. To permit lowering of the level of liquid in the tank 8 when the latter is to be recharged with regenerating material, the conduit 16 is provided with a drain valve 85. Another manual valve 86 is provided in the hard water supply pipe 9, as shown in Fig. 1.

### *Operation*

My improved apparatus is ready for operation when the tank 7 contains a charge of water softening material, the tank 8 a charge of common salt or other regenerating material for the water softening material and the pipes 9, 10 and 12 are connected respectively to a source of water under pressure, to the service outlets and to a waste outlet. During the normal water softening operation the head 54 of the valve 13 is closed against its seat 55, the head 37 of the valve 14 is closed against its seat 35 and the head 29 of the valve 18 is closed against its seat 30. Water is thereby caused to flow from the pipe 9 through the port 57, chamber 58, conduit 17, valve 18, port 20 and conduit 21, into the top of the softener tank 7, thence downward through the softening material and out through the conduit 34, ports 33 and 32 to the

service pipe 10. During this operation brine from the tank 8 is shut off from the conduit 17 by operation of the valve 60 which closes the passage between the pipes 16 and 17 through the port 63 and chamber 58.

To regenerate and flush out the brine and hardening salts deposited in the softening bed, the operator merely actuates the manual controls of the valves 13 and 14 and sets the timing mechanism for the periods required respectively for regeneration and flushing. The plungers 42 and 53 are thrust inward and the knobs 50 and 78 of the time controls are turned to suitable positions with reference to the graduations and legends on the dials. Thus the plunger 53 is thrust inward to close the valve head 54 against its seat 56 and the knob 78 is turned to wind the clock mechanism of the timer 77 and set it for the period required for regeneration. The plunger 53 is locked by its latch mechanism in this regenerating position. By similar operation of the valve 14, the head 37 is seated and locked in closed position relative to the seat 36 and the clock mechanism in the casing 44 is set for the total period of time required for regeneration and flushing.

For example, the valve 13 may be set for a regenerating period of thirty minutes and the valve 14 for a longer period of say forty-five minutes to thereby cause the flushing operation to continue for fifteen minutes after the flow of brine from the tank 8 has been cut off by the operation of the timing mechanism for the valve 13. With the timing control valves 13 and 14 set, as described for regeneration and flushing, water flows from the pipe 9 through port 57, member 74, passages 75 and 73, orifice device 72 and conduit 15 to the upper portion of the tank 8, thereby forcing brine from the bottom of said tank through the conduit 16, port 63, chamber 58, conduit 17, ports 19 and 20 of valve 18 and conduit 21 into the upper portion of tank 7. The brine so conducted into the upper portion of the tank 7 is diluted to a controlled degree by water from the pipe 9 which flows through the orifice device 65, passage 66 and chamber 58 where the mixing of the concentrated brine and added water takes place. Orifice device 72 operates to properly proportion the concentrated brine to the water supplied through the device 65. The brine or other regenerating fluid passes downward through the body of water softening material in the tank 7 and out through the conduit 34, port 33, passages 81 and 82, chamber 83, orifice device 80, pipe 25 and port 24 to drain pipe 12. This operation continues until the time control for the valve 13 releases the plunger 53 and allows the plunger spring to actuate the head 54 to closed position against the seat 55 and to close the valve 60, thereby cutting off the supply of water to the salt tank 8. Flush water now flows from pipe 9 through the port 57, past head 54, open seat 56 to chamber 58 and also through passage 64, orifice device 65, passage 66 to chamber 58, thence through conduit 17 to valve 18 and downward through the softening material in the tank 7, carrying out the brine and impurities through the conduit 34, port 33, passages 81, 82 and 83, orifice device 80, conduit 25 and port 24 to the waste pipe 12. This flushing operation continues until the clock control for the valve 14 releases the plunger 42 and allows the spring 41 to actuate the valve head 37 to closed position at the seat 35, thereby returning the softener to water softening operation automatically.

When the supply of salt in the tank 8 has been exhausted, the tank may be recharged through the manhole having the closure cap 8*a*. To shut off the supply of water to the tank 8 the valve 86 in the pipe 9 is closed and then the valve 85 may be opened and a quantity of water drawn off from the tank 8 sufficient to allow space therein for the new charge of salt.

To backwash, assuming that the valve head 37 is closed at seat 35, the softening material in the tank 7, the stem 28 of the valve 18 is operated to close the head 29 against the seat 31 and the valve 84 is opened to allow wash water to flow through the conduits 17 and 27 to the ports 32 and 33 of the valve 14, thence through pipe 34 to the lower portion of the tank 7, up through the bed of water softening material and out through conduit 21, port 20 and passages communicating with the waste pipe 12. After a suitable period of backwashing the valve 84 is closed and the head 29 of valve 18 is returned to its normally closed position at its seat 30, to thereby return the apparatus to water softening operation.



Unusually thorough and efficient regenerating and flushing is obtained by reason of my controls comprising the independently operating, semi-automatic valves severally controlling the duration of the flushing treatment and total regeneration and flushing time. My orifice devices regulate the rate of flow to waste during regenerating and flushing periods and also the proportions of concentrated brine to added water in the regenerating fluid. The manual setting of my controls requires a minimum of skill and the servicing of the water softening apparatus is further greatly facilitated by the provision of a large salt tank which requires no attention for long periods of time.

Instead of the semi-automatic valve control mechanism herein described in detail, other suitable time controls may be provided. Examples of suitable substitutes for the specific controls described herein are described and claimed in my Patents No. 2,347,201, 2,347,202, 2,374,203, 2,347,204, 2,507,343, 2,551,445 and 2,625,166.

The present application is a continuation-in-part of my application Serial No. 15,397, filed March 17, 1948, for Water Softening Apparatus which has been abandoned.

Having described my invention, what I claim as new and desire to protect by Letters Patent is:

1. For water softening apparatus having a softener tank and a brine tank, the improved control which comprises; a first semi-automatic valve having an upper brine tank port, a lower brine tank port, a hard water port and an outlet port connected to said softening tank, a second semi-automatic valve having a service outlet port, a waste outlet port and a port connected to said softener tank, manually actuatable means for severally setting said valves in a first position to cause the flow of liquid from said hard water port through said valves and through said brine and softener tanks to the waste pipe for regenerating and flushing operations, means for actuating said valves to a second position to cause flow of liquid from said hard water port through said valves and through the softener tank to the service outlet port, and separate and independently operable time control means operatively connected to said first and second valves respectively and adapted to be manually set independently one of the other to terminate the regenerating and flushing operations respectively at selected different times and to initiate the softening operation automatically.

2. Water softening control apparatus according to claim 1 wherein a third valve is operatively connected to said first valve and disposed to cut off the flow of regenerating material to said softener tank during the softening operation.

3. Water softening control apparatus according to claim 1 wherein an orifice device is disposed to control the rate of flow of concentrated regenerating fluid from said brine tank to said first valve and another orifice device is disposed to control the addition of water to concentrated regenerating fluid flowing from said brine tank in predetermined proportions during the regenerating operation.

4. Water softening control apparatus according to claim 1 wherein an orifice device is disposed to control the flow of liquid to said waste outlet port during the regenerating and flushing operations, a second orifice device is disposed to control the rate of flow of concen-

trated regenerating fluid from said brine tank to said first valve and a third orifice device is disposed to control the addition of water to concentrated regenerating fluid flowing from said brine tank in predetermined proportions during the regenerating operation.

5. For water softening apparatus having a softener tank and a brine tank, an improved control comprising; a first semi-automatic valve having an upper brine tank port, a lower brine tank port, a hard water port and an outlet port adapted to be connected to said softening tank, a second semi-automatic valve having a service outlet port, a waste outlet port and a port adapted to be connected to said softener tank, said valves being movable to a first position in which flow of liquid from said hard water port through said brine and softener tanks to said waste outlet port is established and being movable to a second position in which flow from said hard water supply port through the softener tank to said service outlet port is established, manually actuatable means for setting said semi-automatic valves in said first position, means severally biasing said valves toward said second position, separate and independently operable time control means each having a dial and a manually operable hand adapted to be set by reference to said dial, and means operatively connecting said time control means to said first and second valves resepctively whereby said valves may be actuated to said second position successively and at predetermined different times as determined by the setting of the respective time control means.

6. A control in accordance with claim 5 wherein said means operatively connecting said time control means to the first and second valves respectively comprise; latches adapted to retain said valves in said first position against the action of said biasing means, said latches being operative to release said valves to said second position, and means operatively connecting said time control means to said latches whereby said latches are actuated at said predetermined selected times.

7. For water softening apparatus having a softener



tank and a brine tank, an improved control comprising; a first semi-automatic valve having an upper brine tank port, a lower brine tank port, a hard water port and an outlet port, conduit means connecting said outlet port to a second semi-automatic valve and to one end of said softener tank respectively, a second semi-automatic valve having a service outlet port, a waste outlet, a second port connected to the opposite end of said softener tank, and an inlet port connected by said conduit means to the outlet port of said first semi-automatic valve, manually actuatable means controlling flow through said conduit means to said softener tank and to said inlet port of the second valve and from the first mentioned end of the softener tank to said waste outlet, manual control means operatively connected to each of said semi-automatic valves to set them in a first position causing flow from said hard water port through said brine and softener tanks to said waste outlet for regenerating and flushing operations, said semi-automatic valves being movable to a second position to cause flow of liquid from said hard water port through the softener tank to the service pipe for water softening operation, and separate and independently operable time control means severally connected to said semi-automatic valves and operative to terminate the regenerating and flushing operations respectively at predetermined different times.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 1,905,221 | Dunkelberg | Apr. 25, 1933 |
| 1,938,628 | Huppertz | Dec. 12, 1933 |
| 2,050,966 | Eisenhauer | Aug. 11, 1936 |
| 2,068,814 | Mousley | Jan. 26, 1937 |
| 2,102,856 | Russell | Dec. 21, 1937 |
| 2,347,201 | Lindsay | Apr. 25, 1944 |
| 2,545,425 | Fischer | Mar. 13, 1951 |
| 2,610,147 | Lindsay | Sept. 9, 1952 |
| 2,610,945 | Purcell et al. | Sept. 16, 1952 |