Oct. 8, 1957 M. H. AUKERMAN ET AL 2,808,882

MULTIPLE VALVE

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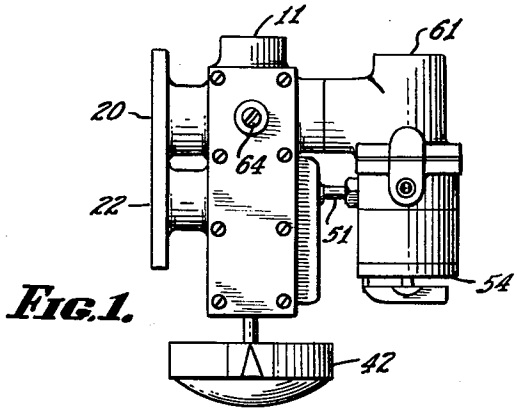


FIG. 1.

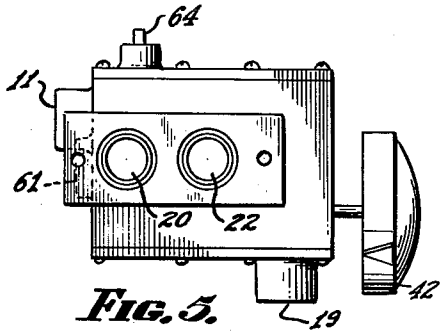


FIG. 5.

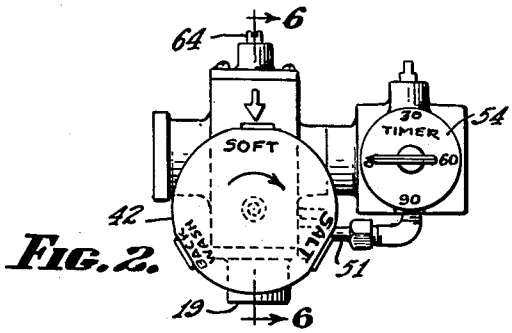


FIG. 2.

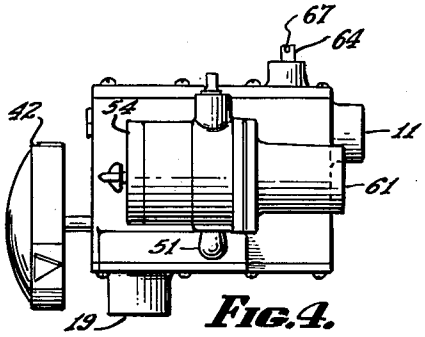


FIG. 4.

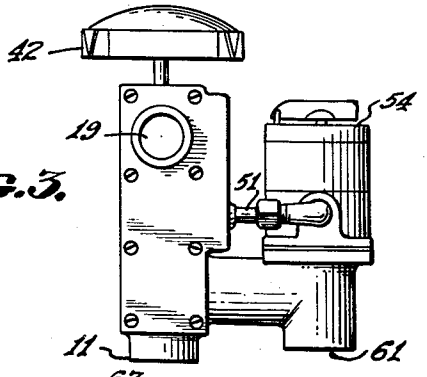


FIG. 3.

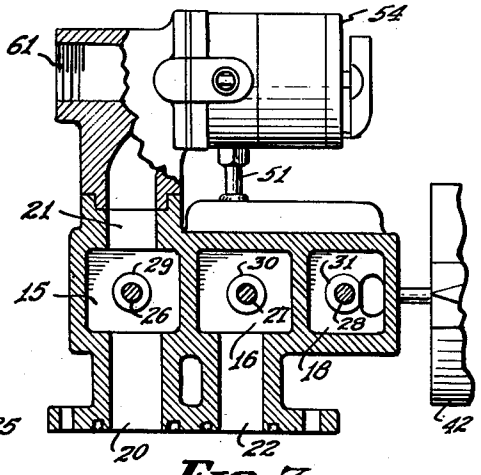


FIG. 7.

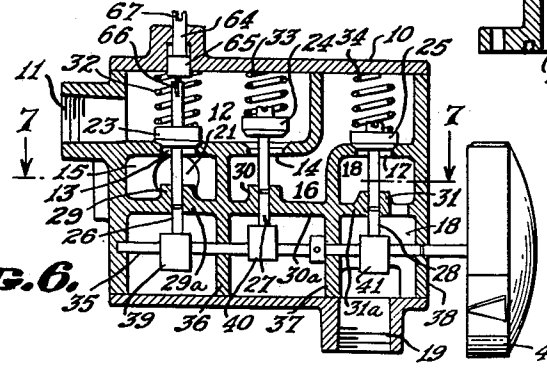


FIG. 6.

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MULTIPLE VALVE

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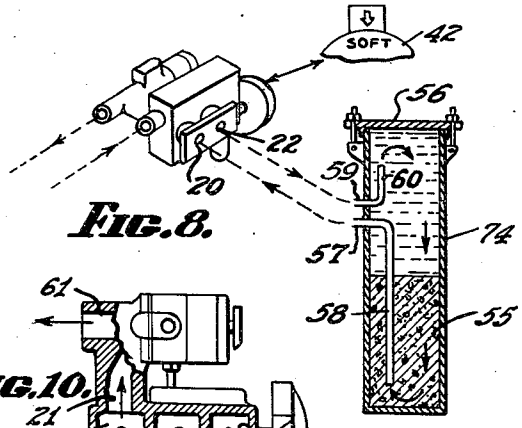


FIG. 8.

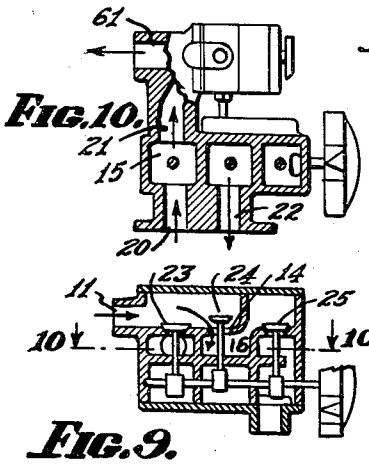


FIG. 10.

FIG. 9.

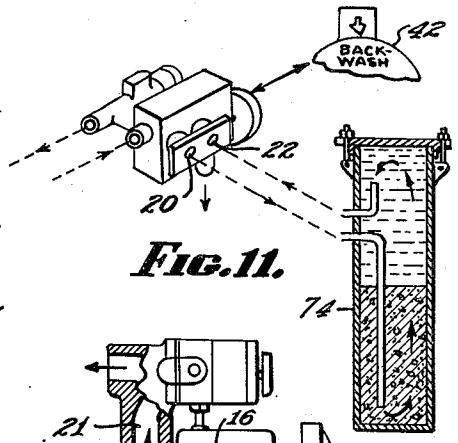


FIG. 11.

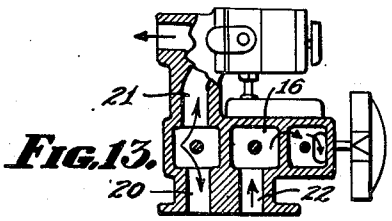


FIG. 13.

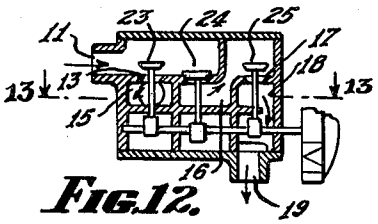


FIG. 12.

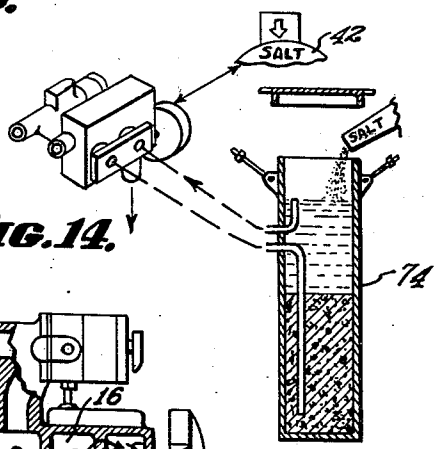


FIG. 14.

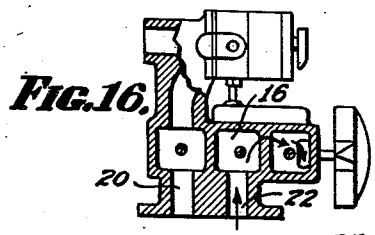


FIG. 16.

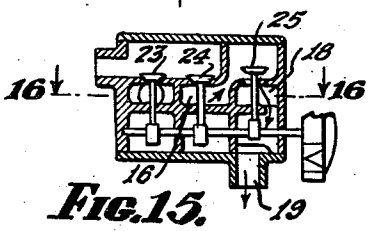


FIG. 15.

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MULTIPLE VALVE

Filed Dec. 1, 1953 3 Sheets-Sheet 3

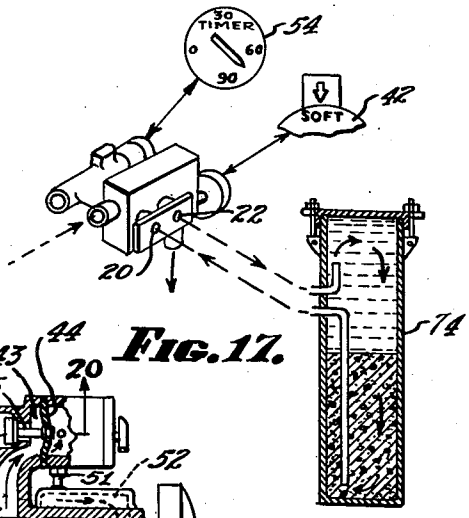


FIG. 17.

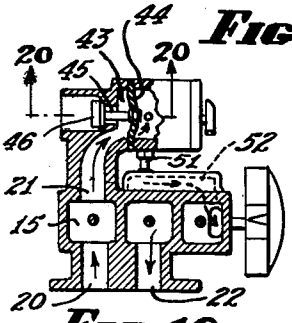


FIG. 19.

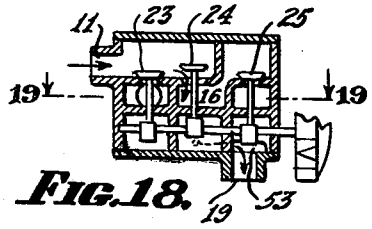


FIG. 18.

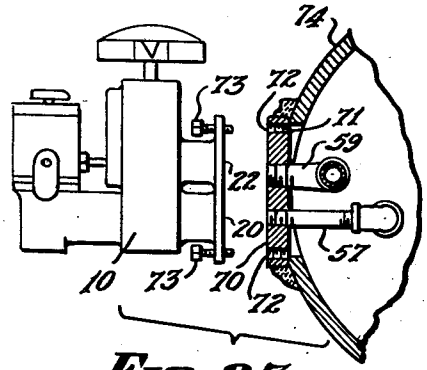


FIG. 23.

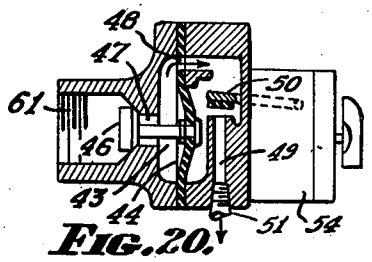


FIG. 20.

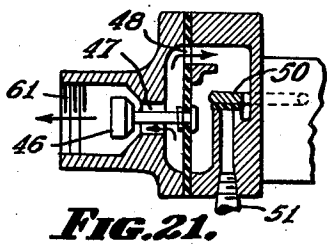


FIG. 21.

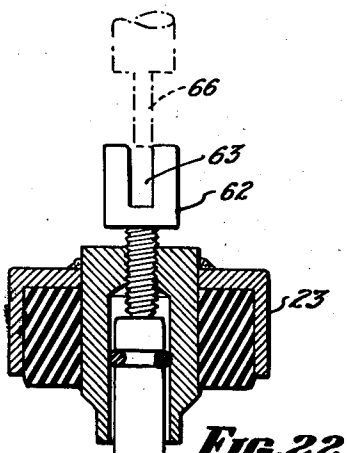


FIG. 22.

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United States Patent Office 2,808,882 Patented Oct. 8, 1957

2,808,882

MULTIPLE VALVE

Malcolm Harry Aukerman and Hubert Leon Lincoln, Eaton, Ohio

Application December 1, 1953, Serial No. 395,384

3 Claims. (Cl. 161—7)

This invention relates to a multiple valve which, while it is susceptible to many uses, is particularly useful in connection with water softening systems of the ion exchange type.

In water softening systems of the type under consideration, there is provided a tank containing a particular type of resin and the hard water to be treated flows through this tank, whereby the calcium and magnesium salts which render the water hard are converted to the soluble sodium salts, while the calcium is retained in the resin. The soft water then flows into the water system of the residence.

In systems of this sort it is necessary periodically to backwash the system to flush out solid material trapped by the resin in a filtering action. For this purpose, the flow through the water softener tank is reversed and the solid material is flushed out of the resin and passes into a drain.

Also periodically, it is necessary to regenerate the resin by the addition of common salt. When the salt is added to the water softener tank, means must be provided for the overflow to pass out to a drain and it is desirable, if the salt has been added, to run hard water through the water softener for a period of time up to perhaps as much as two hours to remove the salt taste from the water.

In water softening systems of this type, in order to accomplish the various operations outlined above, there have in the past been provided a number of valves controlling a somewhat complicated piping system, such that the average housewife was not able to perform the necessary operations herself.

With the foregoing considerations in mind, it is the principal object of our present invention to provide a multiple valve having a single control lever or knob which may be set in one of the number of positions so as to perform one or another of the various operations outlined above.

It is another object of our invention to provide a multiple valve as outlined which will be simple and positive in action so that even a child can perform the necessary operations in connection with the water softening system.

It is yet another object of the invention to provide a mechanism whereby it is unnecessary to run the water through the domestic water system in flushing out the salt taste and whereby, instead, during the flushing operation, the water does not enter the residence system at all but passes out to a drain.

These and many other objects of the invention which will be described in detail hereinafter or which will become apparent to one skilled in the art, upon reading these specifications, we accomplish by that certain construction and arrangement of parts of which we shall now describe an exemplary embodiment.

Reference is made to the drawings forming a part hereof, and in which:

Figure 1 is a top plan view of a valve according to the invention.

Figure 2 is a front elevational view of the same.

Figure 3 is a bottom plan view of the same.

Figure 4 is a side elevational view as seen from the right side of Figure 2.

Figure 5 is a side elevational view as seen from the left side of Figure 2.

Figure 6 is a cross sectional view taken on the line 6—6 of Figure 2.

Figure 7 is a cross sectional view taken on the line 7—7 of Figure 6.

Figure 8 is a diagrammatic view of the valve and the associated water softening tank showing the flow during a water softening operation.

Figure 9 is a view similar to Figure 6 on a reduced scale showing the positions of the valves.

Figure 10 is a cross sectional view taken on the line 10—10 of Figure 9.

Figure 11 is a view similar to Figure 8 showing the flow during a backwash operation.

Figure 12 is a view similar to Figure 9 showing the positions of the valves during this operation.

Figure 13 is a cross sectional view taken on the line 13—13 of Figure 12 showing the flow during the backwash operation.

Figure 14 is a view similar to Figures 8 and 11 showing the flow during the "salt" or regenerating operation.

Figure 15 is a view similar to Figures 9 and 12 showing the positions of the valves.

Figure 16 is a cross sectional view taken on the line 16—16 of Figure 15.

Figure 17 is a view similar to Figures 8, 11 and 14 showing the flow during the flushing operation which immediately follows the salting operation.

Figure 18 is a view similar to Figures 9, 12 and 15 showing the positions of the valves.

Figure 19 is a cross sectional view taken on the line 19—19 of Figure 18.

Figure 20 is a cross sectional view taken on the line 20—20 of Figure 19 on an enlarged scale, showing the closed position of the diaphragm valve.

Figure 21 is a view similar to Figure 20 showing the open position of the diaphragm valve.

Figure 22 is an enlarged view of a portion of Figure 6 showing the pressure adjustment of one of the valves; and

Figure 23 is an exploded view showing the manner of attachment of the multiple valve to the water softening tank.

Briefly, in the practice of our invention, we provide a valve having a body within which there is an entrance chamber, a first intermediate chamber, a second intermediate chamber, a drain chamber and a cam chamber. An inlet port for hard water communicates with the entrance chamber. A port having a valve communicates with the first intermediate chamber and another port having a valve communicates between the entrance chamber and the second intermediate chamber. A port having a valve communicates between the second intermediate chamber and the drain chamber. The first intermediate chamber has an inlet port for softened water and a delivery port for softened water. The second intermediate chamber has a delivery port for hard water and the drain chamber has a drain port.

The soft water delivery port of the first intermediate chamber communicates with a diaphragm chamber which has a port for delivery of soft water to the residence system and which port may be closed by a valve actuated by a diaphragm in the diaphragm chamber. There is a communication between the diaphragm chamber beyond the diaphragm and the drain chamber and this communication is controlled by a normally closed valve which may be opened for a predetermined period of time for a flushing operation and which, when it is open, causes the diaphragm valve to close.

Referring now in more detail to the drawings, the valve itself is disclosed in Figures 1 to 7 inclusive. The valve body is designated generally at 10 and is provided with the inlet port 11 through which hard water from a source enters the valve. Hard water entering through

the port 11 enters the entrance chamber 12. This chamber is provided with two ports, 13 and 14. The port 13 communicates with a first intermediate chamber 15 and the port 14 communicates with a second intermediate chamber 16. A port 17 communicates between the second intermediate chamber 16 and the drain chamber 18. The drain chamber 18 has a drain port 19. The first intermediate chamber 15 is provided with a port 20 which may be designated a soft water supply port and a port 21 which may be designated a soft water delivery port. The second intermediate chamber 16 has a port 22 which may be designated a hard water delivery port.

The ports 13, 14 and 17 are substantially in the same horizontal plane and are aligned with each other. These ports are closed by the respective valves 23, 24 and 25. Each of these valves has a stem, 26, 27 and 28 respectively, the axes of which are in the same vertical plane. The valve stems have bearings in the bosses 29, 30 and 31 respectively, in the walls 29*a*, 30*a* and 31*a*. The stems are sealed within their bearings by the O-rings as shown. The valves are urged downwardly by the respective springs 32, 33 and 34. As will be described in greater detail hereinafter, the axial position of the valve stem 26, with relation to the valve 23, can be adjusted to take care of varying water pressures and this construction will be described later in connection with Figure 22.

A cam shaft 35 is journaled in the body with its axis in the same plane as the axes of the valve stems 26, 27 and 28, and at right angles thereto. The cam shaft 35 is sealed where it passes through the walls 36, 37 and 38 by means of O-rings as shown. For each of the valve stems the cam shaft carries a cam 39, 40 and 41, respectively, and exteriorly of the body the cam shaft is provided with the manual control knob 42. As will be explained in more detail hereinafter, the cams 39, 40 and 41 are arranged in certain positions so that the control knob 42 may be set in any one of three positions entitled "soft," "backwash," and "salt," so as to connect the various ports in the appropriate way to perform the various operations previously outlined.

The soft water delivery port 21 communicates with a diaphragm chamber as best seen in Figures 19, 20 and 21. The diaphragm chamber is indicated generally at 43 and contains a diaphragm 44 to which is secured the stem 45 of a valve 46 which is adapted to close the port 47 through which soft water is delivered to the residence system. The two sides of the diaphragm chamber on either side of the diaphragm are in communication by means of a port 48 passing through the diaphragm and in the diaphragm chamber beyond the diaphragm is a passage 49 which may be closed by a valve 50. The passage 49 communicates by means of a pipe 51 with a passage 52 (Figure 19) which in turn communicates through an opening 53 (Figure 18) with the drain port 19.

The valve 50 is normally closed, as seen in Figure 21, but it may be opened by means of a timer mechanism indicated generally at 54. It will be clear that with the valve 50 closed, water entering the diaphragm chamber 43 can pass through the port 48 and will bear on both sides of the diaphragm 44 with equal pressure. The diaphragm will, therefore, be in the position of Figure 21 with the valve 46 open. If now the timer mechanism is actuated to open the valve 50 as in Figure 20, water passing through the port 48 can pass out through the passages 49, 51, 52 and 53 to the drain port 19, so that the pressure on the right side of the diaphragm, as seen in Figures 20 and 21, or in other words behind the diaphragm, is reduced with respect to the pressure in front of the diaphragm or on the left side thereof, as seen in these figures. The diaphragm is thereby distorted as shown in Figure 20 and causes the valve 46 to close the port 47.

"Soft"

Reference is now made to Figures 8 to 10 inclusive showing the so-called "soft" operation. A water softening tank is indicated at 74 and it contains a body of resin 55. A removable cover is shown at 56. A fitting 57 communicates with a pipe 58 extending to near the bottom of the tank 74 and a fitting 59 communicates with the pipe 60 extending upwardly. During the ordinary water softening operation, the control knob 42 is set in the "soft" position. In this position, as best seen in Figure 9, the central valve 24 is open while the valves 23 and 25 are closed. Hard water from a source entering the port 11 passes through the port 14 into the intermediate chamber 16 and thence through the port 22 to the fitting 59 on the water softening tank. The water flows downwardly through the resinous material 55 and up through the pipe 58 and the fitting 57 to the port 20. The water, which is now soft, passes through the port 20 through the first intermediate chamber 15 and through the port 21 into the diaphragm chamber and, since the valve 50 is closed and the valve 46 is open, it passes out through the port 61 to the residence water system in a soft condition.

"Backwash"

During the operation of a water softening system of this nature, the resinous material acts as a filter and collects particles of solid material. It is periodically necessary to backwash the water softener to flush out this filtered material. Referring to Figures 11 to 13 inclusive, with the control knob 42 set at "backwash" and by reference to Figure 12, it will be observed that the valves 23 and 25 are open while the valve 24 is closed. Water entering at 11 passes through the port 13 into the intermediate chamber 15 and may pass through the port 21 to the residence system without being softened. Assuming, however, that all the faucets in the house are shut off, the water passes through the port 20 and thence in a reverse flow through the tank 74 and returns to the valve at the port 22 and enters the second intermediate chamber 16. From there it passes through the port 17 under the valve 25 and out the drain fitting 19 so that the solid material flushed out of the softening tank is flushed down the drain.

"Salt"

Periodically it is necessary in systems of the type herein referred to, to regenerate the resin by the addition of common salt. Since the tank 74 is normally full of water, it will be understood that when salt is added a certain amount of the water is displaced and provision must be made for overflow. In the "salt" position, the valves 23 and 24 are closed and the valve 25 is open so that overflow water from the tank 74 entering the port 22 passes through the chamber 16 and thence under the valve 25 through the chamber 18 and out the drain 19. In this manner provision is made for overflow caused by the addition of salt to the tank 74.

Flushing out excess salt

After the regeneration or "salting" operation, the water will have a salty taste for a while and it is desirable to let the water run down the drain for a period of time to get rid of the salt taste. For this operation, the control knob 42 is returned to the soft position and the timer 54 is set for a period of time sufficient to remove the salty taste from the water. We employ a timer of the spring clock movement type which may be set up for periods up to two hours.

When the timer 54 is moved off zero, the valve 50 is open. The valves 23, 24 and 25 are again in the positions they occupy in the softening operation of Figures 8 to 10 inclusive. Now water entering at 11 passes under the valve 24 into the second intermediate chamber 16 and thence through the port 22, as in the water softening operation, to the tank 74. Softened water returning from the tank 74 reenters at port 20 and passes into the first intermediate chamber 15 and thence to the port 21 into the diaphragm chamber 43. Since the valve 50 is open,

the pressure behind the diaphragm is lower than the pressure in front of the diaphragm so that the diaphragm occupies the position of Figures 19 and 20. The valve **46** is, therefore, closed and the water passes through the passages **49**, **51**, **52** and **53** and the drain **19**. This condition prevails until the timer **54** returns to zero at which time the valve **50** is closed, whereupon the diaphragm returns to the position of Figure 21 opening the valve **46** and the valve is back to the condition of Figures 8 to 10 inclusive.

It is desirable that the valve **23** be capable of adjustment to take care of different water pressures. We have provided means whereby the opening of the valve **23** may be adjusted by providing an adjusting screw **62** having a slot **63**. By adjusting the screw **62**, the position of the valve stem **26**, in relation to the valve **23**, may be adjusted. The screw **62** is turned by a member **64** passing through the valve body and having a bearing in the body at **65** and having a blade **66** engaging in the slot **63** and having, exteriorly of the casing, a slot **67**. By adjustment of the member **64** from outside the valve body, the degree of opening of the valve **23** can thus be adjusted.

In Figure 23 we have shown a convenient way in which the valve body **10** may be attached to a tank **74**. A plate **70** is suitably welded over an opening **71** in the wall of the tank **74**. To the plate **70** are attached the fittings **59** and **57**. Threaded holes **72** are also provided in the plate **70**. The wall of the valve body, having the ports **20** and **22**, is made in the form of a plate having holes for the passage of bolts **73** which may be screwed into the holes **72** when the valve is attached to the tank.

This arrangement is very convenient since the valve may readily be disconnected from the tank if it is desired to move the tank for any purpose whatever. When the valve body has been disconnected from the tank, the port **20** may be plugged and with the control knob **42** in the backwash position, hard water can still be supplied to the residence system.

From the foregoing description, it will be noted that we have provided a unitary control for a number of valves whereby various operations in connection with an ion exchange type water softening system may be performed. While we have described the valve particularly in connection with such a water softening system, it will be understood that it is capable of many other uses. For convenience and by way of identification only, certain of the ports have been identified in the description in terms of soft water entrance port, soft water delivery port, hard water entrance port, hard water delivery port and the like. It should be understood that these are simply for convenience in identifying the particular ports and that the valve may be used in installations where entirely different fluids flow through the ports.

Furthermore, the portion of the valve including the diaphragm chamber with the diaphragm, the valve **46**, the valve **50** and the timer, is in the nature of a refinement. The valve will function without this refinement except that for the flushing operation it will be necessary to flush the water through the residence system by leaving a water faucet open somewhere in the house. It will also be necessary to shut off the faucet after a required length of time because the operation will not be automatic. With the refinement of the diaphragm valve and the timer valve, the operation is automatic because the knob **42** is returned to soft position and as soon as the timer **54** has run its course, soft water without a salty taste will automatically be available.

For these reasons, therefore, we do not intend to limit ourselves to various details disclosed herein by way of example, but to limit ourselves only insofar as specifically set forth in the claims.

Having now fully described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A valve comprising a body having an entrance chamber, a drain chamber, a first intermediate chamber, a second intermediate chamber, and a diaphragm chamber, an inlet port in said entrance chamber, a valve port between said entrance chamber and first intermediate chamber, a valve port between said entrance chamber and second intermediate chamber, a valve port between said second intermediate chamber and said drain chamber, and a drain port in said drain chamber, an entrance port in said first intermediate chamber, a delivery port in said first intermediate chamber, communicating with said diaphragm chamber, a delivery port in said second intermediate chamber, a valve associated with each of said valve ports, common manual control means for said valves located exteriorly of said chamber, and an operative connection between said control means and said valves, a diaphragm in said diaphragm chamber, a valve port in said diaphragm chamber, a normally open valve for said diaphragm chamber valve port operatively connected to said diaphragm, a port bypassing said diaphragm, a passage connecting said diaphragm chamber on the other side of said diaphragm from said diaphragm chamber valve port with said drain chamber, a normally closed valve for said passage and a timer for opening said normally closed valve for a predetermined period of time whereby to cause said diaphragm valve to close and to place said delivery port in said first intermediate chamber in communication with said drain chamber.

2. A valve for water softening systems of the ion exchange type, and the like, comprising a body, an entrance chamber in said body, an inlet port for said entrance chamber, two outlet ports for said chamber, a valve for closing each of said outlet ports, one of said outlet ports communicating with a second chamber, said second chamber communicating with a delivery port and with a supply port, the other of said outlet ports communicating with a third chamber, a drain port for said third chamber and a valve for closing said drain port, all of said valves having stems and said stems being aligned, a valve control shaft having its axis in the plane of the axes of said stems and at right angles thereto, a cam on said control shaft for each of said stems, and a manually settable element on said control shaft exteriorly of said body for positioning said shaft and thereby said valves in one position to open said other valve only, in a second position to open said drain valve only, or in a third position to open said one valve and said drain valve only.

3. A valve according to claim 2, wherein there is provided a diaphragm chamber having a diaphragm, said diaphragm chamber being in communication with said second chamber delivery port, a valved port in said diaphragm chamber having a valve secured to said diaphragm, a port behind said diaphragm and a normally closed valve for said last named port, a port in said diaphragm chamber bypassing said diaphragm whereby pressure on both sides of said diaphragm is normally equal and said diaphragm valve is normally open, and means for opening said normally closed valve for a predetermined length of time, said last named port communicating with said drain, whereby when said last named port is open, the pressure behind said diaphragm is reduced, said diaphragm is deflected and said diaphragm valve closes.

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