Nov. 22, 1938. J. A. JOHNSON 2,137,406

WATER SOFTENER VALVE

Filed Dec. 8, 1936 2 Sheets-Sheet 1

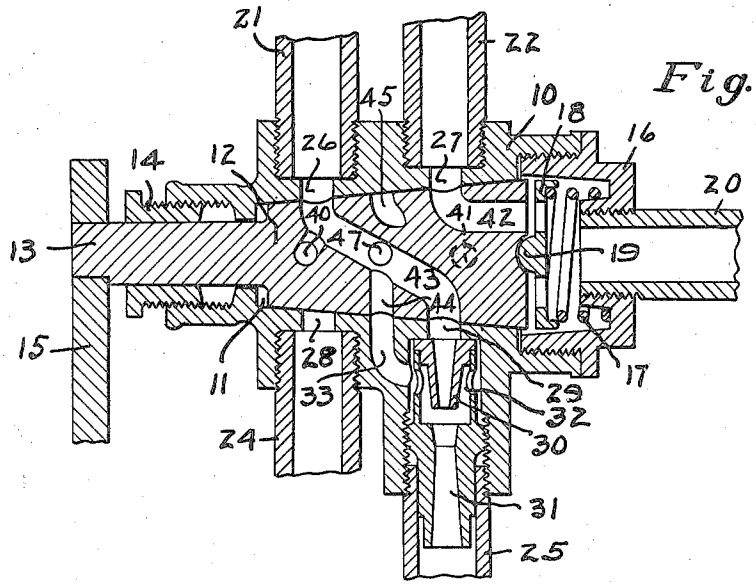


Fig. 1

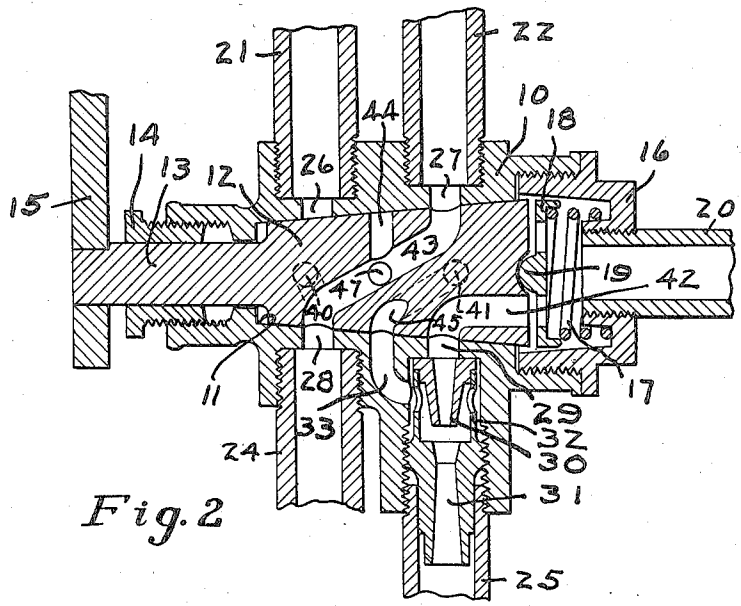


Fig. 2

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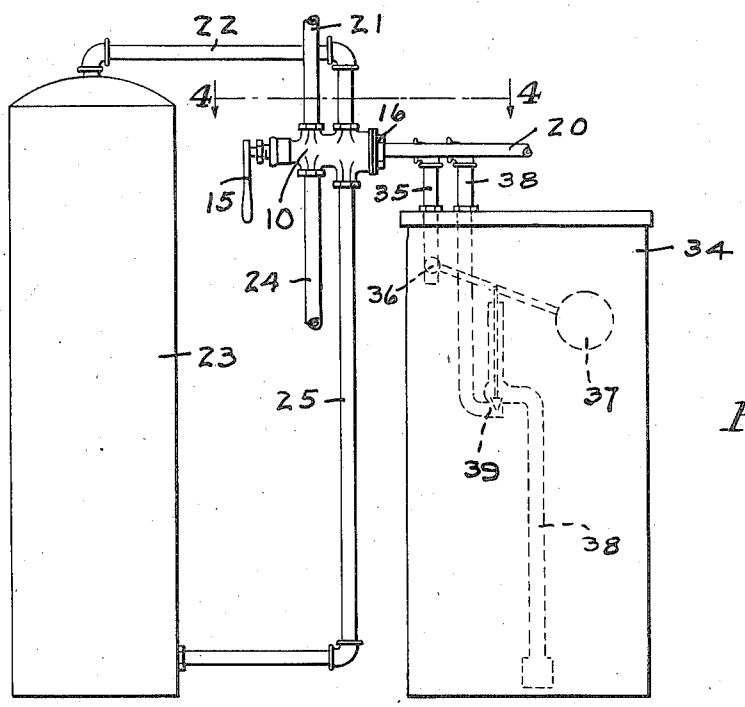


Fig. 3

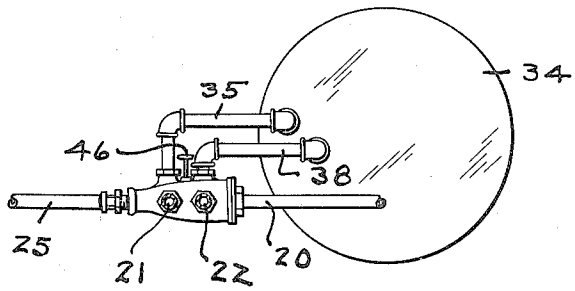


Fig. 4

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# UNITED STATES PATENT OFFICE

2,137,406

## WATER SOFTENER VALVE

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Application December 8, 1936, Serial No. 114,793

9 Claims. (Cl. 210—24)

This invention relates to means for controlling flows of water and brine through a base exchange water softener and has for its primary purpose the provision of a single control valve for accomplishing the various flows desired. In the particular type of softener to which the invention is to be applied, the raw water enters the top of the softener to pass down through the mineral bed and have the softened water discharging from the bottom. In brining the mineral bed, the brine is introduced into the bottom of the mineral bed and carried upwardly therethrough in a direction reversed to that of the flow of the raw water in softening. In other words the softening flow is down and the brining flow is up.

Incorporated in the invention is the feature of providing a brine injector operated by the flow of water and so designed as to have the normal soft water flow back through the injector in a reversed direction and therearound as a means of clearing the injector and keeping it clean.

The particular embodiment of the invention herein described, being a single control valve for the purpose indicated, is operable in two positions, namely the "softening" position and the "brining and back wash" position. Normally the valve is in the "softening" position and the entire operation of the valve consists in merely shifting the valve to the "brining" position, leaving it there a predetermined length of time and then restoring the valve to the "softening" position, the single valve controlling all flows without the necessity of the use of any auxiliary valves.

The invention is more or less diagrammatically illustrated in the accompanying drawings, in which

Fig. 1 is a vertical longitudinal section through a valve structure embodying the invention;

Fig. 2, a similar view with the valve rotated 180°;

Fig. 3, a side elevation of the valve as applied to a water softener, and

Fig. 4, a top plan view thereof.

Like characters of reference indicate like parts throughout the several views in the drawings.

Referring to the drawings, the valve body 10 is provided with a tapered bore 11 in which is carried a revoluble frusto-conical valve plug 12. The plug 12 has a stem 13 extending from the valve body 10 through any suitable packing means such as a nut 14 and carries externally of the body a suitable operating handle or lever 15.

The larger end of the body 10 receives a plug 16 which, through any suitable means, urges the valve plug 12 into sealing contact with the wall of the bore 11. One such means is herein shown as comprising a compression spring 17 abutting the plug 16 by one end and by the other end a pressure plate 18 which bears centrally by a button 19 against the end of the plug 12. The plate 18 is so formed as to permit passage of fluids therearound or therethrough.

The valve body 10 is connected with a hard or raw water supply pipe 20 through the plug 16 so that the discharge from the pipe 20 may be against the end of the plug 12. The body 10 is further connected with the house supply or soft water flow pipe 21; a pipe 22 leading to the top of the softener tank 23, the pipe 22 normally carrying the raw water to the tank; a waste or drain pipe 24; and a pipe 25 leading to the lower or bottom part of the tank 23. In the form herein shown, the pipes 21 and 22 are connected to the valve body 10 on its upper side while the pipes 24 and 25 are connected to the valve body on its lower side. The valve body 10 is provided with respective ports 26, 27 and 28, 29 permitting flow from or toward these pipes from the bore 11 of the valve plug 10.

Interposed between the pipe 25 and the port 29 is a brine injecting device consisting of a nozzle 30 adjacent the port 29 but directed toward the pipe 25 and a Venturi tube 31 between the nozzle and the pipe. A cage 32 surrounds the nozzle 30 in spaced relation and has openings therein, the cage 32 being of a smaller external diameter than that of the chamber in the valve plug 10 in which it is positioned so that fluid introduced into that chamber may flow inside of the cage past the open end of the nozzle 30 and discharge out of the Venturi tube 31 into the pipe 25 thereby tending to induce a flow of fluid through the nozzle 30. A by-pass 33 is provided in the valve plug 10 opening by its upper end in the bore 11 and by its lower end into the chamber surrounding the cage 32.

A brine solution tank 34 is provided in conjunction with the softening tank 23. This brine tank, not entering in detail into the present invention, consists essentially of a tank holding a quantity of salt in which water is introduced from time to time to provide a solution of the salt, and further having means for maintaining a normal level of that solution, together with means for permitting withdrawal of a predetermined amount of the salt solution or brine. The particular form herein indicated in Fig. 3 of the drawings, has a tank 34 provided with a water inlet pipe 35 which runs to a float operated valve

36 within the tank. When the float 37 is down, the valve 36 is open to admit water, and when the float 37 is lifted by the level of solution in the tank 34 to the desired elevation, the float 37 closes the valve 36. The tank 34 is also provided with a brine outlet pipe 38 which runs to the bottom of the tank and has interposed in that length of the pipe within the tank a valve 39 closing the pipe in the down position of the float 37 and opening the brine pipe 38 in the "up" position.

The brine water supply pipe 35 leads from the brine tank 34 to the side of the valve housing 10 to communicate with the internal bore 11 through a port 40. The brine pipe 38 likewise leads from the tank 34 to connect with the valve housing 10 to communicate with the internal bore 11 through the port 41. In the form herein shown, these ports 40 and 41 are 90° between the upper ports 26 and 27 and the lower ports 28 and 29.

Assuming first that the water softener is functioning in the usual manner and is operating to supply soft water, the valve plug 12 is then in the position as indicated in Fig. 1. In this position, a passageway 42 in the plug 12 receives raw water from the pipe 20 from the large or rear end of the plug and conducts the raw water through a short length of the plug and then discharges the raw water laterally from the plug through an opening then registering with the port 27 so that the raw water is then allowed to flow out through the pipe 22 into the top of the tank 23 and thence down through the bed of mineral (not shown) to become softened, discharge from the bottom of the tank through the pipe 25 and thence through the Venturi tube 31, from which the water may flow in two branches, one through the nozzle 30 and out through the port 29 into a diagonal passageway 43 provided in the valve plug 12 and across up to discharge through the port 26 into the soft water supply pipe 21. The other branch of the flow from the pipe 25 leaving the Venturi tube 31 is through the by-pass 33 and thence through a short transverse passage 44 in the valve plug 12 to discharge into the diagonal passageway 43. In this manner it is to be readily seen that the flow of the water is not only around the opening of the nozzle 30 and laterally thereof, but also directly through the nozzle thereby insuring that any foreign particles otherwise collecting about the nozzle are removed and washed away. Furthermore by providing the flow in two branches, a full flow from the pipe 25 is secured past the nozzle 30 which would otherwise tend to restrict the flow of the soft water.

Now when it is desired to regenerate the mineral content of the tank 23, the valve plug 12 is rocked to an opposite position, herein shown in the particular form as 180° from that position shown in Fig. 1 to the position shown in Fig. 2. In this position it is to be noted that the diagonal passageway 43 through the valve plug 12 then provides intercommunication between the pipes 22 and 24 and that the port 26 is completely closed over, thereby stopping any flow into the pipe 21. Likewise the end of the transverse passage 44 is closed over by the wall of the bore 11 preventing any flow through the passageway 44 in this position.

A second diagonal passageway 45 below the passageway 43, Fig. 2, in the valve plug 12 interconnects the brine port 41 and the by-pass 33, this interconnection being made independently of the passageway 43. Also in this rotated position, Fig. 2, the raw water inlet passageway 42 in the valve plug 12 is turned to have its discharge end register with the port 29.

In this position of the valve plug 12, Fig. 2, raw water comes from the pipe 20 through the passageway 42 through the injector nozzle 30, the Venturi tube 31 and then through the pipe 25 into the bottom of the softener 23. As the water goes across from the nozzle 30 into the tube 31, sufficient vacuum is produced to draw brine from the tank 34 up past the valve 39 (normally open) and the pipe 38 through the valve plug passageway 45, and the by-pass 33 into the cage 32 where it mixes with the raw water and is carried on into the softener tank 23. The proportioning of the rate of flow of the brine with the flow of raw water is determined by the size of the nozzle 30 and the Venturi tube 31, in any event being such that there is a sufficient flow of brine into the tank 23 to accomplish the desired regeneration of the mineral therein. The brine will continue to flow as indicated until the level in the tank 34 drops sufficiently to cause the valve 39 to close off the outlet pipe by reason of the lowering of the interconnecting float 37.

When the brine flow is thus stopped automatically, raw water continues to flow into the bottom of the tank 23. However the flow is such that there will be a sufficient amount of time elapsed to permit the brine to remain in contact with the mineral in the tank 23 to accomplish the sufficient exchange. Continued flow of the raw water through the pipe 25 serves as a back wash to wash out the surplus brine. This surplus brine escapes through the pipe 22 across through the valve plug 12 through the passageway 43 and out into the waste pipe 24. After all of the brine has been flushed out, soft water will appear in the discharge pipe 24. At this time the valve plug 12 should be rotated back 180° to the position shown in Fig. 1 wherein the flows above described in reference to that position will again be set up. While the length of time may be known in advance to permit the brine to contact the mineral in the tank 23 and then be flushed out, the condition of the flow coming through the pipe 22 can be determined by a suitable pet cock 46 mounted on the valve body 11 receiving a discharge from the port 47, which port registers with a transverse passage from the diagonal passageway 43 in both positions of the valve plug, Fig. 1 and Fig. 2. Thus by sampling the water in either position, the condition of that water as to hardness and as to brine content may be determined.

So far the brine tank 34 has had a quantity of brine removed from it. As is the usual practice, this tank 34 already has an excess amount of salt which may go into solution as additional water may be added. To restore the water required for that additional solution and to bring the brine level up to the normal position, the port 40 is brought into communication with the passageway 43 by an extension thereof in the valve plug 12, Fig. 1, so that as long as the valve plug is in the normal flow position, Fig. 1, soft water coming from the tank 23 through the pipe 25 may flow out through the port 40 into the pipe 35 to go to the brine tank 34. When the float 37 is in the down position, Fig. 3, the valve 36 is open in the usual manner, and water may then flow into the tank 34 and continue to flow until the float 37 lifts sufficiently to shut off the valve 36. Thus the flow in the tank 34 is automatically maintained. The valve plug 12 does not have to

be shifted to shut off the flow of water to the tank 34.

It is to be noted in the foregoing description, that there are but two operative positions required of the valve plug 12 and that the brine solution level is automatically maintained, first being lowered to give an exact amount of flow therefrom and then a definite amount of soft water is supplied to restore the solution for a second operation. Furthermore it is to be noted that when the softener tank 23 is to be regenerated the brining and back washing operations are accomplished by upflow through the mineral thereby tending to loosen the mineral and wash out sediment and deposits. The softening flow is downward tending to maintain the mineral bed in a stable condition. Also, as above indicated, the soft water flow is back past the brine injecting nozzle, both through it and around it so as to maintain a clean nozzle. At the same time by reason of the proportioning of the by-pass 33, a sufficient flow of the soft water is maintained for normal usage while the raw water flow into the tank is quite restricted to prevent too rapid a back wash.

While I have herein shown and described my invention in the one best form as now known to me, it is obvious that structural variations may be employed without departing from the spirit of the invention and I, therefore, do not desire to be limited to that precise form beyond the limitations as may be imposed by the following claims.

I claim:

1. For a water softener having a softening tank and a brine tank with automatic means regulating elevations of a brine solution therein, a control valve comprising a body, a revoluble plug in the body, said softener having a soft water conduit leaving from one side of the body, a flow conduit between the same side of the body and the top of said softening tank, said softener having a waste discharge conduit leaving the valve body from another side, and having a raw water and brine conduit leading from said valve body from said other side to the bottom of said water softener tank, said softener having a brine pipe and a water supply pipe interconnecting said brine tank and a side of said valve body between said one and said other sides, and having a raw water supply pipe entering an end of said valve body, said valve plug having a raw water passage opening in said valve body end and discharging laterally from the plug by a port in circumferential alignment with ports in the valve body from said softener tank top and bottom connecting conduits, a diagonal passage having one end in circumferential alignment with said top and bottom conduits and its other end in circumferential alignment with body ports from said soft water and waste conduits, said ports and said plug diagonal passage being arranged to interconnect the soft water and bottom tank conduits in one position of the plug and the top tank and the waste conduits in a revolved position with said plug raw water passage discharging into the top tank conduit in the first position and into the bottom tank conduit in the second position, a brine injector nozzle between said body and said bottom tank conduit, said body providing a by-pass around said nozzle, said plug carrying a brine passage closed off in said first position and interconnecting said brine pipe and said by-pass in said second position, and said plug further having a passage interconnecting said diagonal passage and said brine tank water supply pipe in said first position only.

2. For a water softener having a softening tank and a brine tank with automatic means regulating elevations of a brine solution therein, a control valve comprising a body, a revoluble plug in the body, said softener having a soft water conduit leaving from one side of the body, a flow conduit between the same side of the body and the top of said softening tank, said softener having a waste discharge conduit leaving the valve body from another side, and having a raw water and brine conduit leading from said valve body from said other side to the bottom of said water softener tank, said softener having a brine pipe and a water supply pipe interconnecting said brine tank and a side of said valve body between said one and said other sides, and having a raw water supply pipe entering an end of said valve body, said valve plug having a raw water passage opening in said valve body end and discharging laterally from the plug by a port in circumferential alignment with ports in the valve body from said softener tank top and bottom connecting conduits, a diagonal passage having one end in circumferential alignment with said top and bottom conduits and its other end in circumferential alignment with body ports from said soft water and waste conduits, said ports and said plug diagonal passage being arranged to interconnect the soft water and bottom tank conduits in one position of the plug and the top tank and the waste conduits in a revolved position with said plug raw water passage discharging into the top tank conduit in the first position and into the bottom tank conduit in the second position, a brine injector nozzle between said body and said bottom tank conduit comprising a Venturi tube in the conduit, a cage in the conduit and a nozzle in the cage directed toward the Venturi tube, said body providing a by-pass around said cage and nozzle, said plug carrying a brine passage closed off in said first position and interconnecting said brine pipe and said by-pass in said second position, and said plug further having a passage interconnecting said diagonal passage and said brine tank water supply pipe in said first position only, said plug further having a passage interconnecting said diagonal passage and said by-pass in said second position only.

3. For a water softener having a brine tank automatically controlling its brine level, and having a softener top pipe, a softener bottom pipe, a raw water pipe, a soft water pipe, and a waste pipe; a single control valve comprising means, in a "softening" position, interconnecting said raw water pipe with said top pipe and means interconnecting said bottom pipe with said soft water pipe to provide a down flow through said softener, said second means, in a second position, interconnecting said top pipe with said waste, and said first means interconnecting said raw water pipe with said bottom pipe, a brine injector between said valve and said bottom pipe comprising a Venturi tube in the pipe and a nozzle between the tube and valve directed toward the tube, and means carried by said valve interconnecting said brine tank and said bottom pipe adjacent said injector.

4. For a water softener having a brine tank automatically controlling its brine level, and having a softener top pipe, a softener bottom pipe, a raw water pipe, a soft water pipe, and a waste pipe; a single control valve comprising means, in a "softening" position, interconnecting said

raw water pipe with said top pipe and means interconnecting said bottom pipe with said soft water pipe to provide a down flow through said softener, said second means, in a second position, interconnecting said top pipe with said waste, and said first means interconnecting said raw water pipe with said bottom pipe, a brine injector between said valve and said bottom pipe comprising a Venturi tube in the pipe and a nozzle between the tube and valve directed toward the tube, and means carried by said valve interconnecting said brine tank and said bottom pipe adjacent said injector, a by-pass around the injector and further means operated by said valve for supplying soft water in said first position to said brine tank.

5. For a water softener having a brine tank automatically controlling its brine level, and having a softener top pipe, a softener bottom pipe, a raw water pipe, a soft water pipe, and a waste pipe; a single control valve comprising means, in a "softening" position, interconnecting said raw water pipe with said top pipe and means interconnecting said bottom pipe with said soft water pipe to provide a down flow through said softener, said second means, in a second position, interconnecting said top pipe with said waste, and said first means interconnecting said raw water pipe with said bottom pipe, a brine injector between said valve and said bottom pipe, and means carried by said valve interconnecting said brine tank and said bottom pipe adjacent said injector, said valve carrying a by-pass around said injector, whereby flow from said bottom pipe to said soft water pipe may be both through said injector and through said by-pass.

6. For a water softener having a brine tank automatically controlling its brine level, and having a softener top pipe, a softener bottom pipe, a raw water pipe, a soft water pipe, and a waste pipe; a single control valve comprising means, in a "softening" position, interconnecting said raw water pipe with said top pipe and means interconnecting said bottom pipe with said soft water pipe to provide a down flow through said softener, said second means, in a second position, interconnecting said top pipe with said waste, and said first means interconnecting said raw water pipe with said bottom pipe, a brine injector between said valve and said bottom pipe comprising a Venturi tube in the pipe, a cage above the tube in the pipe and a nozzle in the cage between the valve and Venturi tube directed toward the tube, and means carried by said valve interconnecting said brine tank and said bottom pipe adjacent said injector, said valve carrying a by-pass around said injector discharging against the cage, whereby flow from said bottom pipe to said soft water pipe may be both through said injector and through said by-pass, and said brine tank interconnecting means interconnecting the bottom pipe through said by-pass.

7. In a water softening apparatus having a softening tank and a source of brine solution, a valve having a raw water inlet, a soft water outlet, a normal raw water outlet connected to the top of said tank, a waste outlet, a brine solution inlet connected with said source, and serving also as a normal soft water inlet, a valve plug in said valve having in one position thereof passageways connecting said raw water inlet and outlet and said soft water inlet and outlet, and in another position thereof, close off the soft water outlet and having the same passageways connect the raw and soft water inlets, the raw water the waste outlets by an additional passage, the brine solution and soft water inlets, and a brine solution injector carried by said valve in a fixed position at said soft water inlet adjacent said additional passage.

8. In a water softening apparatus having a softening tank and a source of brine solution, a valve having a raw water inlet, a soft water outlet, a normal raw water outlet connected to the top of said tank, a waste outlet, a brine solution inlet connected with said source, and serving also as a normal soft water inlet, a valve plug in said valve having in one position thereof passageways connecting said raw water inlet and outlet and said soft water inlet and outlet, and in another position thereof, close off the soft water outlet and having the same passageways connect the raw and soft water inlets, the raw water the waste outlets by an additiontional passage, the brine solution and soft water inlets, and a brine solution injector carried by said valve in a fixed position at said soft water inlet adjacent said additional passage, said valve carrying a by-passage to said injector, and said additional plug passage discharging into said by-passage.

9. In a water softening apparatus having a softening tank and a source of brine solution, a valve having a raw water inlet, a soft water outlet, a normal raw water outlet connected to the top of said tank, a waste outlet, a brine solution inlet connected with said source, and serving also as a normal soft water inlet, a valve plug in said valve having in one position thereof passageways connecting said raw water inlet and outlet and said soft water inlet and outlet, and in another position thereof, close off the soft water outlet and having the same passageways connect the raw and soft water inlets, the raw water and waste outlets by an additional passage, the brine solution and soft water inlets, and a brine solution injector carried by said valve in a fixed position at said soft water inlet adjacent said additional passage, said valve carrying a by-passage to said injector, and said additional plug passage discharging into said by-passage, said by-passage discharging into said first passage in said first plug position to provide then an auxiliary soft water flow around said injector.

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