June 17, 1930. L. G. DANIELS 1,764,155

WATER SOFTENER

Filed March 7, 1927 2 Sheets-Sheet 1

Fig 1

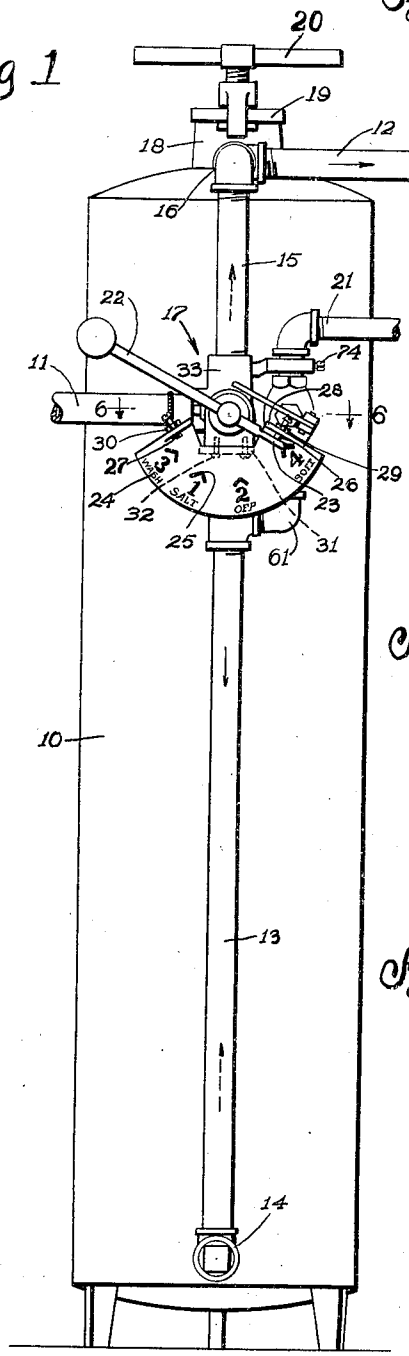


Fig 2

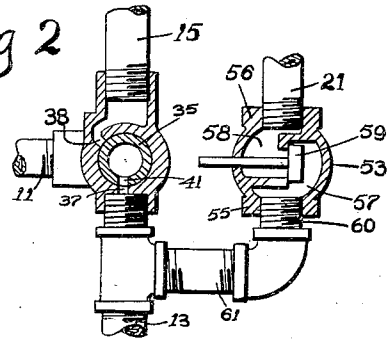


Fig 3

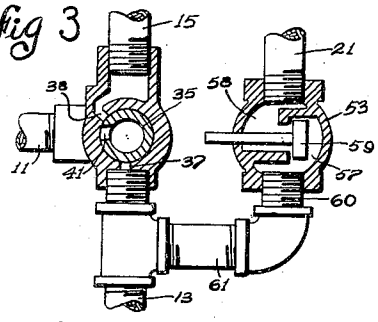


Fig 4

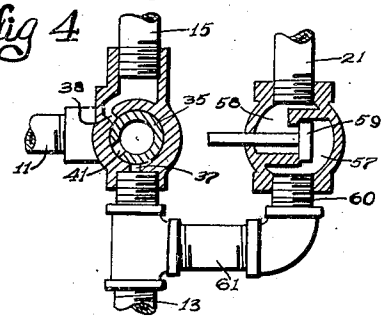
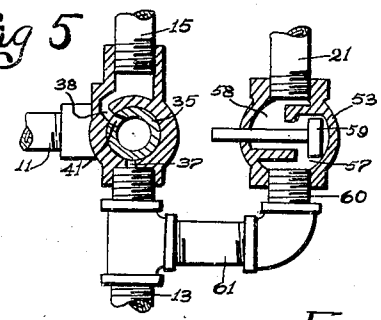


Fig 5



Inventor
Lee G. Daniels
By Wilson & McCanna
Attys

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WATER SOFTENER

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Fig 6

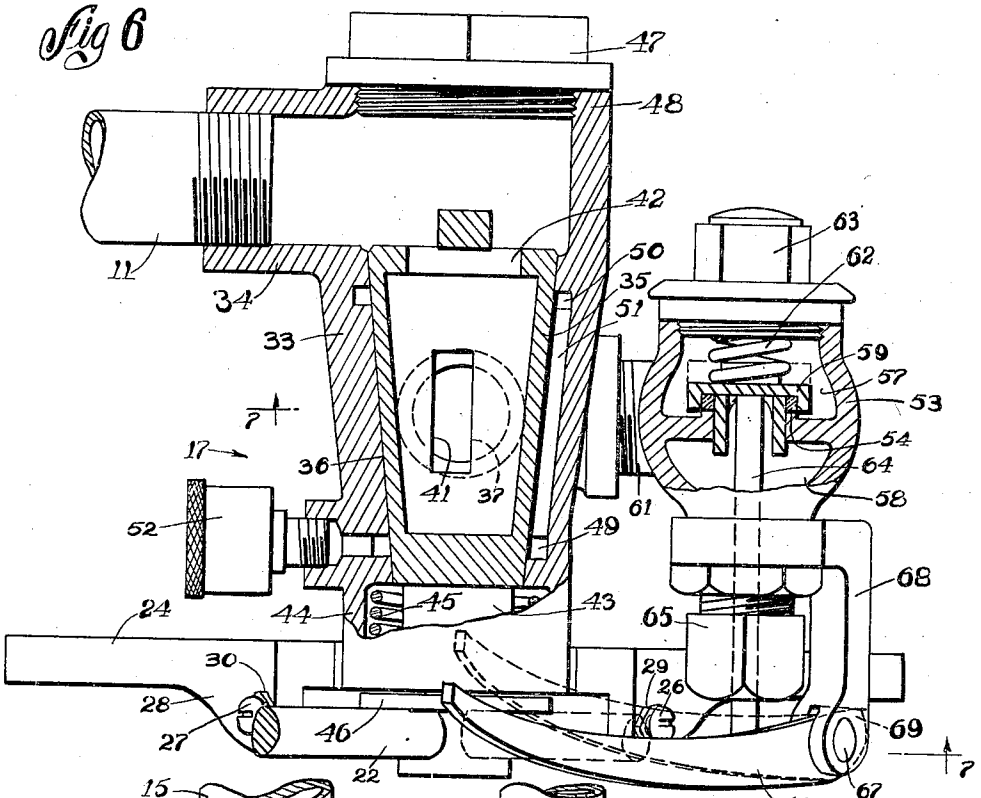
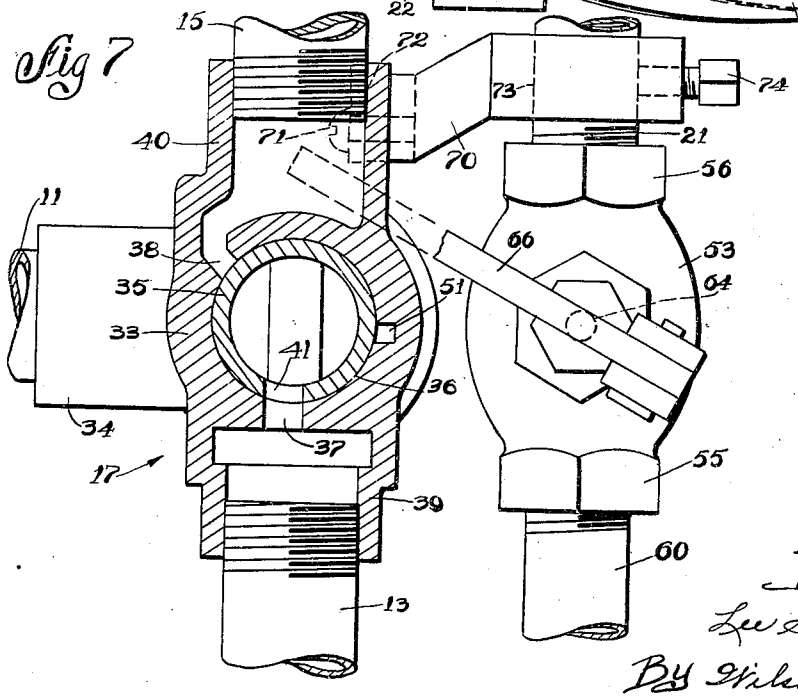


Fig 7



Inventor
Lee G. Daniels
By Wilson & McCanna
Attys

Patented June 17, 1930 1,764,155

UNITED STATES PATENT OFFICE

LEE G. DANIELS, OF ROCKFORD, ILLINOIS

WATER SOFTENER

Application filed March 7, 1927. Serial No. 173,249.

This invention relates to water softeners of the base-exchange type and is principally concerned with those designed for domestic use and, still more particularly, the hand operated type.

The principal object is to provide a softener having a valve mechanism of an extremely simple and practical form arranged for operation in a novel manner to make it easy for the average person to put the softener through its regenerations.

It is well known that water softeners have heretofore required three or more valves for the control of the flow of water in softening and regeneration which made it a difficult task for the average mechanically unskilled person to regenerate the softener. Lengthy instructions had to be furnished with each softener and these had to be kept at hand for reference by the user on each occasion of regeneration in order to avoid confusion and mistakes. The present invention is principally directed toward avoiding this objectionable feature by providing a single control lever shiftable to different positions to operate the valve mechanism according to a predetermined scheme, the different positions of the lever being clearly indicated preferably by numbers so that the operator is insured against the likelihood of doing anything out of turn. The operation is rendered extremely simple when thus reduced to a matter of routine.

Another important object consists in the provision of a valve with the fewest possible number of ports for accomplishing the operations referred to, enabling a much simpler construction and rendering the valve far more serviceable and less apt to leak. In connection with this valve I have also provided for ample lubrication to prevent sticking of the valve, the lubricant being provided in such a way as to serve in the nature of a fluid seal against leakage, and have also provided an auxiliary valve the only function of which is to control communication between the softener and the waste outlet or drain when the softener is supplied with salt for regeneration and when the salt is washed through the bed of water softening material.

Still another important object consists in providing means in connection with the valve mechanism whereby the valve opening in softening and regeneration may be varied to secure a predetermined rate of flow of water regardless of the available water pressure in the particular locality where the softener is installed. In the present embodiment where the valve mechanism is operated by a hand lever shiftable to different positions marked on an index plate, the adjustment of the valve opening is secured by adjustably limiting the movement of the lever when the same arrives at the softening and when the same arrives at the softening and regenerating positions to correspondingly limit the extent of the valve opening in each case.

This application is a continuation in part of my application Serial No. 155,385, filed December 17, 1926.

The invention is illustrated in the accompanying drawings wherein—

Figure 1 is a front view of a softener equipped with an improved valve mechanism in accordance with my invention;

Figs. 2–5 are diagrams showing the valve positions corresponding to four different positions of the control lever; Fig. 2 being the #4 position for softening operation; Fig. 3 being the #1 position for the water draining and salt charging operation; Fig. 4 being the #2 position for the "soaking" operation; and Fig. 5 being the #3 position for the regenerating operation;

Fig. 6 is an enlarged horizontal sectional detail taken on the line 6—6 of Fig. 1; and

Fig. 7 is an enlarged vertical sectional detail partly in elevation taken on the broken line 7—7 of Fig. 6.

The same reference numerals are applied to corresponding parts throughout the views.

The softener comprises a tank 10 serving as a container for a bed of zeolite mineral or other water softening material. Hard water is supplied to the softener from a suitable source as, for example, the city water mains, through a pipe 11 and softened water is arranged to be discharged to the service

system through a pipe 12. A pipe 13 communicates at 14 with the lower end of the tank preferably through a distributor pipe, as described in my copending application above referred to, while another pipe 15 communicates with the upper end of the tank, as at 16. The service pipe 12 and the pipe 15 are both in open communication with the upper end of the tank at all times, as described in the copending application. The hard water supply pipe 11, however, is arranged to be placed selectively in communication with either end of the tank through the valve mechanism, indicated generally by the reference numeral 17, the valve mechanism being also arranged to shut off either communication, as will hereinafter appear. In the normal softening operation the hard water supplied through the pipe 11 flows through communicating ports in the valve mechanism 17 and passes downwardly through the pipe 13, as indicated by the full line arrow, for discharge into the lower end of the tank beneath the bed of water softening material therein. The distributor pipe, previously referred to, distributes the water evenly throughout the cross-sectional area of the bed for uniform contact with the material and the water in passing upwardly through the bed is softened and supplied to the service system through the pipe 12. When the softener is to be regenerated salt or brine is arranged to be injected into a head space in the tank above the bed therein through the neck 18. The latter has a cap 19 suitably clamped in place by the hand screw device 20. During regeneration the hard water supplied through the pipe 11 is conducted through registering ports in the valve mechanism 17 upwardly through the pipe 15, as indicated by the dotted arrow, for discharge into the upper end of the tank. This water picks up and dissolves or assimilates the salt or brine for passage downwardly through the mineral for the purpose of permitting a chemical exchange, commonly termed "base-exchange", to occur between the brine and the mineral to revive or regenerate the exhausted mineral. The waste water leaving the lower end of the tank passes upwardly through the pipe 13, as indicated by the dotted arrow, and is conducted to the sewer through a waste pipe 21. Broadly speaking, no invention is claimed in the mere provision of means for introducing hard water at one end of the tank and discharging soft water at the other end, or in means for controlling the direction of water flow so as to carry brine or dissolved salt through the mineral in the reverse direction from the softening flow and discharging the waste water to the sewer. Such means, generally speaking, are well known in this art. However, as will hereinafter appear, I have provided improved means whereby these operations may be accomplished with much greater ease and facility by practically anyone who is relatively unskilled in a mechanical way, and invention is, therefore, claimed in this case in the valve mechanism and its novel controlling means.

The valve mechanism herein shown is similar in some respects to that disclosed in my copending application above referred to and comprises a single hand lever 22 for operating the same. This lever has a pointer 23 movable from one extreme position to another across an index plate 24. The plate has reference marks, indicated at 25, with suitable legends in connection therewith to aid the operator in shifting the lever in the controlling of the operation of the softener. Thus, the position marked "1—Salt" indicates the place to which the pointer must be moved by the lever when the softener is to be charged with salt or brine for the regenerating operation. At this point the operator removes the cap 19 and pours in the proper amount of salt or brine and then replaces the cap. The position marked "2—Off" indicates the place to which the pointer must be moved in order to completely shut off the softener to allow the mineral to stand for a time to "soak" in order that the mineral will have an opportunity more thoroughly to make a chemical exchange with the brine. The shifting of the lever to this position is not always necessary if the softener has not been run beyond its prescribed capacity, but every now and then it is found desirable to allow the brine and mineral to soak over night to relieve a more than ordinary exhausted condition of the mineral. This method of regenerating the softener has the advantage of economy in the amount of salt or brine required. The position marked "3—Wash" corresponds to the regenerating operation in which the salt or brine is washed through the mineral bed at a predetermined rate, the waste water being discharged to the sewer. Upon the completion of the regeneration the lever is shifted back to the position marked "4—Soft" from which position it was moved at the commencement of the series of shifts just described. In this position the softener is in its normal softening operation. Just after regeneration it is usually a good practice to open a bib near the softener as, for example, in a laundry tub, long enough to allow all of the hard water in the head space in the tank to be flushed out so that this water will not get into the service system.

Having in mind the considerable variation in water pressures in different communities I have provided means whereby the valve openings may be varied to secure a predetermined rate of flow in softening and regenera-

tion regardless of the available water pressure. A pair of set screws 26 and 27 are provided in lugs 28 projecting from the face of the index plate 24 at the two extreme positions to which the lever 22 is arranged to be moved. The screw 26 limits the movement of the lever at the position marked "4—Soft" when the pointer 23 comes into engagement therewith. The adjustment of this screw accordingly varies the amount of valve opening and the flow during softening can be confined to a predetermined desired rate irrespective of the available water pressure. The water will not, therefore, pass through the mineral bed at a rate beyond that at which it can be properly softened. A lock nut 29 serves to hold the set screw 26 in its adjusted position. In a like manner the screw 27 limits the movement of the lever 22 when it is moved to the position marked "3—Wash" and the adjustment of this screw serves to vary the amount of valve opening for the regeneration flow. Accordingly the brine will not be washed through the mineral beyond a rate at which a complete chemical exchange can properly occur between the brine and the mineral regardless of the available water pressure. The lock nut 30 serves to hold the set screw 27 in its adjusted position. The plate 24 may obviously be supported in any suitable manner but for convenience I have provided the same with a flange 31 to receive screws 32 for fastening the plate to the body 33 of the main valve.

Referring now, more particularly, to Figs. 6 and 7 in which the valve mechanism 17 is illustrated in detail, it will be observed that the body 33 of the main valve has the hard water supply pipe 11 threading in a boss 34 at the rear thereof. A hollow valve plug 35 of tapered form is received in a bore 36 of complementary form provided in the body 33. Two ports 37 and 38 of elongated form are provided in the body 33 opening into the bore 36 at the lower and upper sides thereof, as indicated in Fig. 7. The port 37 opens into a boss 39 into which the pipe 13 leading to the lower end of the tank 10 is threaded while the port 38 opens into a boss 40 wherein the pipe 15 is threaded. The valve plug 35 has a single port 41 of elongated form arranged to register with either one of the ports 37 and 38. When the port 41 is in registry with the port 37 the lever 22 is in the softening position indicated by the marking "4—Soft" on the plate 24, and when the port 41 is in register with the port 38 the lever 22 is in the regenerating position market "3—Wash." The way in which the valve openings for these two positions are adjusted by adjustment of the set screws 26 and 27 it is believed will now be apparent. In Fig. 7 the port 41 is in full registry with the port 37, but an adjustment of the set screw 26 will serve to restrict the ports to less than full registration. The valve plug 35 is open at the rear, as shown at 42, so that the interior thereof is always in communication with the hard water supply pipe 11. The front end of the valve plug is closed and has a steam 43 extending outwardly through a hollow boss 44 to receive the hand lever 22 at its outer end. A coiled compression spring 45 received in the boss 44 and acting between the valve body 33 and a washer 46 on the stem 43 serves to hold the valve plug 35 seated in the bore 36 with a snug fluid-tight fit. The plug 47 threading into an opening 48 at the rear of the valve body 33 affords access to the valve plug and, of course, permits the removal and replacement thereof. Two annular grooves 49 and 50 are provided in the valve body 33 near the opposite ends of the bore 36 and having a communicating groove 51 extending longitudinally relative to the bore. These grooves are supplied with lubricant under pressure by the grease cup 52. The circumferential lubrication at the opposite ends of the bore insures easy turning of the valve plug and also provides a fluid seal against leakage. Neither of the annular grooves 49 and 50 is, of course, in registry with the ports in the valve body and plug and the same is true of the longitudinal groove 51. The latter does not come into register at any time with the port 41 of the valve plug but this groove insures easy turning of the valve plug by providing lubricant along practically the entire length of the plug. In addition to the fact that a fluid seal against leakage is provided by this manner of lubrication it should be observed that the ample displacement of the ports 37 and 38 in the valve body is in a large measure a protection against leakage and insures long satisfactory service. It is only by reason of the fact that I have reduced the number of ports positively to a minimum that such protection against leakage is afforded, as it will be obvious that a valve designed with numerous ports would prove unsatisfactory on account of leakage unless the valve were built of sufficiently large proportions so as to displace the ports to the proper distances and, of course, a valve designed along such lines would be expensive and impractical for the present purposes besides being hard to operate.

In connection with the main valve I have provided an auxiliary valve 53 of the quick-opening and self-closing type commonly known as a "whistle valve." This valve provides a seat 54 between the inlet and outlet ends 55 and 56 of the body thereof. The chamber 57, appearing in Fig. 6, is in communication with the inlet end 55, while the chamber 58 is in communication with the outlet end 56. The disk, generally desig-

nated by the reference numeral 59, is thus held to its seat partially under the pressure of the water in the pipe 60 communicating with the inlet end, the pipe 60 being connected, as at 61, with the pipe 13. The outlet end 56 is connected with the waste pipe 21, previously referred to, which communicates with the sewer. The disk 59 is also normally held seated under the action of a compression spring 62 acting between the disk 59 and a hollow plug 63 threading into the valve body. The disk 59 has a stem or spindle 64 extending therefrom through a packing gland nut 65 to project from the valve body for operation by a cam lever 66. The latter is pivoted at 67 on a bracket 68 mounted on the valve body and in its inoperative position has a stop portion 69 thereof engaging the bracket 68 to hold the free end of the lever 66 in a predetermined relation to the lever 22, as indicated in full lines in Fig. 6. The valve disk 59 is, as stated before, normally held closed but when the lever 22 is moved from the softening position in which it is shown in Fig. 1, the lever 22 comes into engagement with the lever 66 and moves it to the dotted line position shown in Fig. 6, to open the valve 53. When the lever 22 is in the position marked "1—Salt", the valve 53 is opened slightly, as represented in Fig. 3, but when the lever is moved still farther to the position marked "3—Wash" the valve 53 is fully opened, as represented in Fig. 5. In positions intermediate the "4—Soft" position and the "2—Off" position of the hand lever 22 and, of course, in the marked "4—Soft" thereof, the valve 53 remains closed because the lever 22 is not in engagement with the lever 66 in these positions. For convenience in the mounting of the auxiliary valve 53 alongside the main valve a bracket 70 may be provided arranged to be fastened, as by means of screws 71, to a lug 72 provided on the valve body 33, the bracket 70 having an opening 73 for the reception of the pipe 21 and being equipped with a set screw 74 for fastening the pipe 21 in position with the auxiliary valve in a proper definite relation to the main valve where the cam lever 66 is properly disposed with respect to the hand lever 22.

In operation, the valve mechanism is arranged to be set in four different positions as diagrammatically illustrated in Figs. 2–5 inclusive. In the normal softening operation, as illustrated in Fig. 2, the plug 35 of the main valve has its port 41 in register with the port 37 to conduct the hard water supplied through the pipe 11 down through the pipe 13. The auxiliary valve 53 is closed and the disk 59 thereof, in addition to being held seated by the spring 62, is urged toward its seat under the pressure of the water in the pipe 13 through the communication established by the pipe connections 60 and 61. The water softened after passage upwardly through the bed of water softening material is discharged through the pipe 12 at the top of the tank, as described before. In Fig. 3 the valve mechanism is shown shifted to the salt filling position herein called the "1—Salt" position. It will be observed that the valve plug 35 has its port 41 intermediate the ports 37 and 38 so that there is no communication between the hard water supply pipe 11 and either of the pipes 13 and 15. The auxiliary valve, however, is partially opened and establishes communication between the pipe 13 and the waste pipe 21. This permits the tank to drain a certain amount when the cap 19 is removed for the pouring of salt into the tank. The lowering in level of the water in the tank avoids overflowing when the salt is poured in. After the salt has been poured in and the cap 19 is replaced the valve mechanism may be shifted to the position "2—Off" for the soaking operation. This position is illustrated in Fig. 4. It will be observed that both of the valves are closed so that the softener is completely shut off. After the soaking operation the valve mechanism is shifted to the position "3—Wash" illustrated in Fig. 5. Here it will be observed that the hard water supply pipe is placed in communication with the pipe 15 by reason of the registry of the ports 41 and 38. The water entering the top of the tank washes the salt down through the bed of water softening material and the waste water issuing from the bottom of the tank is conducted upwardly through the pipe 13 and out through the pipe connections 61 and 60 through the valve 53 and waste pipe 21 to the sewer. The valve 53, it will be seen, is fully opened. After the regeneration is completed the valve mechanism is shifted back to the "4—Soft" position for normal softening operation.

It is believed the foregoing description conveys a clear understanding of my invention and all of its objects and advantages. It should be apparent that the invention is not to be limited in its application to the particular embodiment shown as the same has been selected merely for the purposes of illustration. The appended claims are, therefore, for the purpose of covering all legitimate modifications, adaptations and variations of the invention which may suggest themselves to one skilled in the art as a result of the present disclosure.

I claim:

1. In a water softener, the combination with a softener tank containing softening material, means for establishing communication between said tank and a source of hard water supply, and means for establishing communication between said tank and a service system, of a valve for controlling

communication between the first means and said tank whereby to introduce hard water into either end of said tank, a waste outlet, another valve for controlling communication between said tank and said waste outlet, and a hand lever for operating one of said valves in the swinging movement thereof, said lever being arranged in a certain position to also operate the other valve.

2. In a water softener, the combination with a softener tank containing softening material, means for establishing communication between said tank and a source of hard water supply, and means for establishing communication between said tank and a service system, of a valve for controlling communication between the first means and said tank whereby to introduce hard water into either end of said tank, a waste outlet, another valve for controlling communication between said tank and said waste outlet, and a single means for operating both of said valves, said means when shifted to one position being arranged to establish communication from the supply source through the first named valve through said tank in one direction to the service system, in another position closing communication between the tank and the supply source but establishing communication between the tank and the waste outlet through the second named valve, and in still another position establishing communication from said supply source through the first mentioned valve through said tank in the opposite direction from the first flow and from thence through the second named valve to the waste outlet.

3. In a water softener, the combination with a softener tank containing softening material, means for establishing communication between said tank and a source of hard water supply, and means for establishing communication between said tank and a service system, of a valve for controlling communication between the first means and said tank whereby to introduce hard water into either end of said tank, a waste outlet, another valve for controlling communication between said tank and said waste outlet, and a single means for operating both of said valves, said means when shifted to one position being arranged to establish communication from the supply source through the first named valve through said tank in one direction to the service system, in another position closing the communication between the tank and the supply source but establishing communication between the tank and the waste outlet through the second named valve, in another position closing both of said valves so as to close communication between the tank and the supply source and between the tank and the waste outlet for the purpose described, and in still another position establishing communication from said supply source through the first mentioned valve through said tank in the opposite direction from the first flow and from thence through the second named valve to the waste outlet.

4. In a water softener, the combination with a softener tank containing softening material, means for establishing communication between said tank and a source of hard water supply, and means for establishing communication between said tank and a service system, of a valve for controlling communication between the first means and said tank whereby to introduce hard water into either end of said tank, a waste outlet, another valve for controlling communication between said tank and said waste outlet, a lever for operating the first named valve from a softening position to a regenerating position, and means operated by said lever for operating the second named valve.

5. In a water softener, the combination with a softener tank containing softening material, means for establishing communication between said tank and a source of hard water supply, and means for establishing communication between said tank and a service system, of a valve for controlling communication between the first means and said tank whereby to introduce hard water into either end of said tank, a waste outlet, another valve for controlling communication between said tank and said waste outlet, a lever for operating the first named valve from softening position to regenerating position, and means operated by said lever in an intermediate position thereof for operating the second named valve.

6. In a water softener, the combination with a softener tank containing softening material, means for establishing communication between said tank and a source of hard water supply, and means for establishing communication between said tank and a service system, of a valve for controlling communication between the first means and said tank whereby to introduce hard water into either end of said tank, a waste outlet, another valve for controlling communication between said tank and said waste outlet, a lever for operating the first named valve from softening position to regenerating position, and means operated by said lever in an intermediate position thereof for operating the second named valve, said last named valve being opened at the intermediate position of said lever and remaining open in any position intermediate this position and regenerating position but being closed in any position of said lever between said intermediate position and the softening position thereof.

7. In a water softener, the combination with a softener tank containing softening material, means for establishing communi-

cation between said tank and a source of hard water supply, and means for establishing communication between said tank and a service system, of a valve for controlling communication between the first means and said tank whereby to introduce hard water into either end of said tank, a waste outlet, another valve for controlling communication between said tank and said waste outlet, a lever shiftable from one extreme position to another to operate said first named valve from softening position to regenerating position and vice versa, and a cam element for operating the second named valve arranged to be operated in the shifting of said lever from one position to the other whereby to open the second named valve.

8. In a water softener, the combination with a softener tank containing softening material, means for establishing communication between said tank and a source of hard water supply, and means for establishing communication between said tank and a service system, of a valve for controlling communication between the first means and said tank whereby to introduce hard water into either end of said tank, a waste outlet, another valve for controlling communication between said tank and said waste outlet, a lever shiftable from one extreme position to another to operate said first named valve from softening position to regenerating position and vice versa, and a cam lever operated by said first mentioned lever in its swinging movement from one position to the other arranged to operate the second named valve whereby the latter is opened at an intermediate position of said first lever and remains open in any position of said first lever between this intermediate position and the regenerating position thereof but is closed between this intermediate position and the softening position of said lever.

9. In a water softener comprising a container for a bed of water softening material, means for supplying hard water for passage through said material, and means for conducting softened water from said container to a service system, of valve mechanism for controlling communication between said first mentioned means and said container and determining the direction of flow of the water through said container for softening and regeneration, a lever for operating said mechanism arranged to be shifted to different positions, a plate having reference marks at different points thereon for indicating the different control positions of said lever, means at the softening and regenerating positions serving to limit the movement of the lever and thereby regulate the valve opening for softening and regeneration for the purpose specified, and an auxiliary valve in connection with said valve mechanism controlling communication between said container and a waste outlet, said valve having an operating part so arranged with respect to said lever to be operated thereby when the lever is moved into the vicinity of the regenerating position.

10. In a water softener comprising a container for a bed of water softening material, means for supplying hard water for passage through said material, and means for conducting softened water from said container to a service system of valve mechanism for controlling communication between said first mentioned means and said container and determining the direction of flow of the water through said container for softening and regeneration, a lever for operating said mechanism arranged to be shifted to different positions, a plate having reference marks at different points thereon for indicating the different control positions of said lever, means at the softening and regenerating positions serving to limit the movement of the lever and thereby regulate the valve opening for softening and regeneration for the purpose specified, and an auxiliary valve in connection with said valve mechanism controlling communication between said container and a waste outlet, said valve having an operating part so arranged with respect to said lever to be operated thereby when the lever is moved into the vicinity of the regenerating position, the auxiliary valve being opened prior to the opening of the main valve mechanism for regeneration.

11. In a water softener comprising a container for a bed of water softening material, means for supplying hard water for passage through said material, and means for conducting softened water from said container to a service system of valve mechanism for controlling communication between said first mentioned means and said container and determining the direction of flow of the water through said container for softening and regeneration, a lever for operating said mechanism arranged to be shifted to different positions, a plate having reference marks at different points thereon for indicating the different control positions of said lever, means at the softening and regenerating positions serving to limit the movement of the lever and thereby regulate the valve opening for softening and regeneration for the purpose specified, and an auxiliary valve in connection with said valve mechanism controlling communication between said container and a waste outlet, said valve having an operating part so arranged with respect to said lever to be operated thereby when the lever is moved into the vicinity of the regenerating position, the auxiliary valve being opened prior to the opening of the main valve mechanism for regeneration, and there being an "off" position of said lever where

the main valve mechanism and the auxiliary valve are both closed.

12. The combination with a water softener, of a rotating plug type valve, and a spring closed type valve for controlling the connections of the water softener with a source of water supply, a service system, and a waste outlet, and a single lever arranged to be moved manually to different positions for rotating the plug of the first mentioned valve to open and close the same, said lever being arranged to open the second mentioned valve against the action of its closing spring in a predetermined relation to the opening and closing of the first named valve to control the operation of the water softener.

13. The combination with a water softener, of a rotating plug type valve, and a spring closing type valve for controlling the connections between the water softener and a source of water supply, a service system, and a waste outlet, and a lever connected to the plug of the first named valve for rotating the same to different positions as required in softening operation, regeneration, etc., said lever being arranged in different positions thereof to open the second named valve against the action of its closing spring in a predetermined relation to the opening and closing of the first named valve for the complete control of the operation of the softener.

14. In a water softener, the combination with a softener tank containing softening material, means for establishing communication between said tank and a source of hard water supply, and means for establishing communication between said tank and a service system, of a valve for controlling communication between the first means and said tank whereby to introduce hard water into either end of said tank, a waste outlet, another valve for controlling communication between said tank and said waste outlet, the last mentioned valve having spring means for normally holding the same in one position, and a hand lever for operating the first valve by swinging movement of said lever, said lever being arranged in a certain position to also operate the last mentioned valve against the action of its spring means.

15. In a water softener, the combination with a softener tank containing softening material, means for establishing communication between said tank and a source of hard water supply, and means for establishing communication between said tank and a service system, of a valve for controlling communication between the first means and said tank whereby to introduce hard water into either end of said tank, a waste outlet, another valve for controlling communication between said tank and said waste outlet, one of said valves having spring means for normally holding the same in a certain position, a lever directly connected with the other valve for operating the same, and means operated by said lever for operating the spring actuated valve against the action of its spring means.

In witness of the foregoing I affix my signature.

LEE G. DANIELS.