June 26, 1928. 1,674,717

C. P. EISENHAUER

AUTOMATIC WATER SOFTENER

Filed Oct. 12, 1925 4 Sheets-Sheet 1

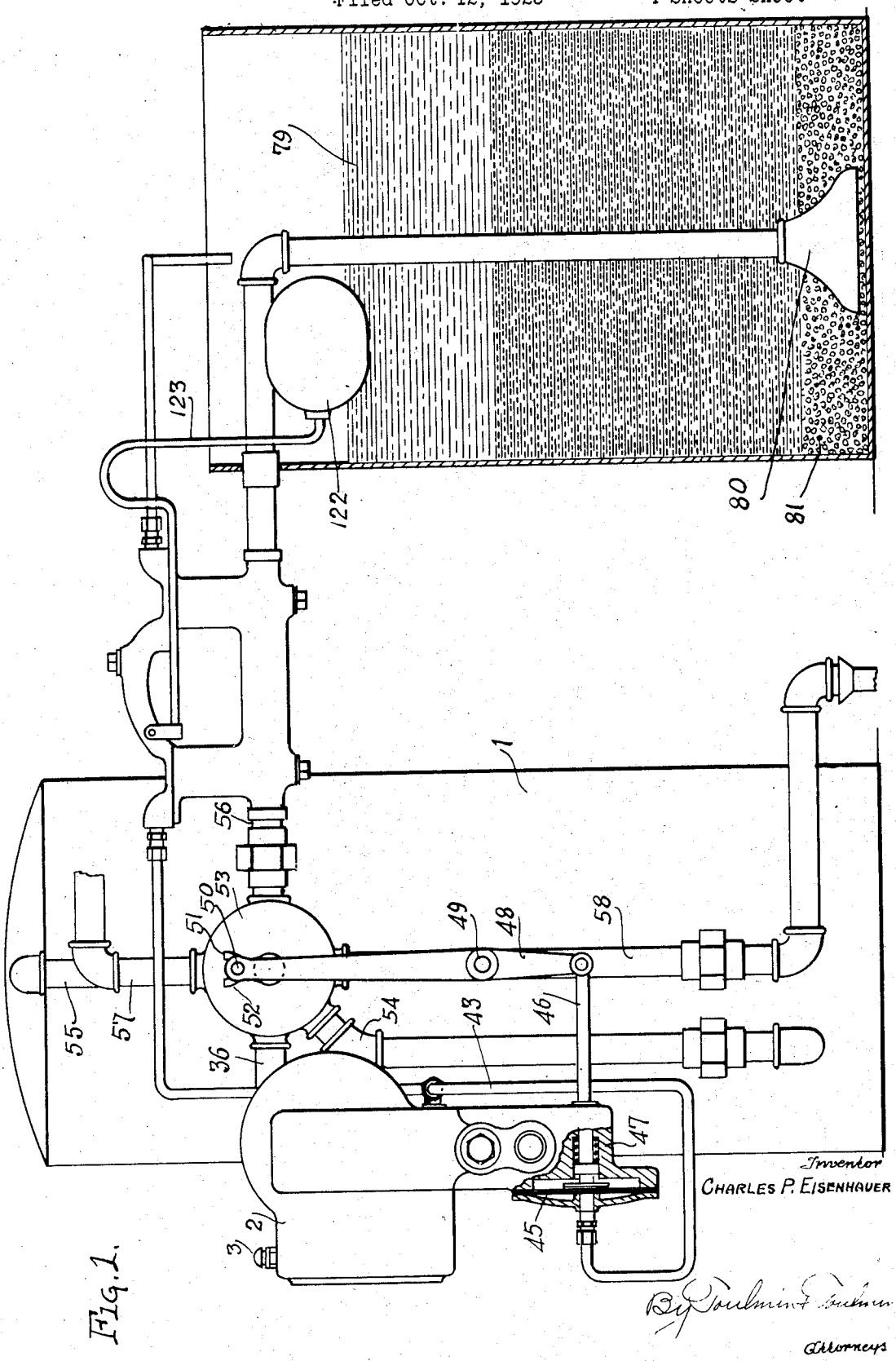


Fig. 1.

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Fig. 2.

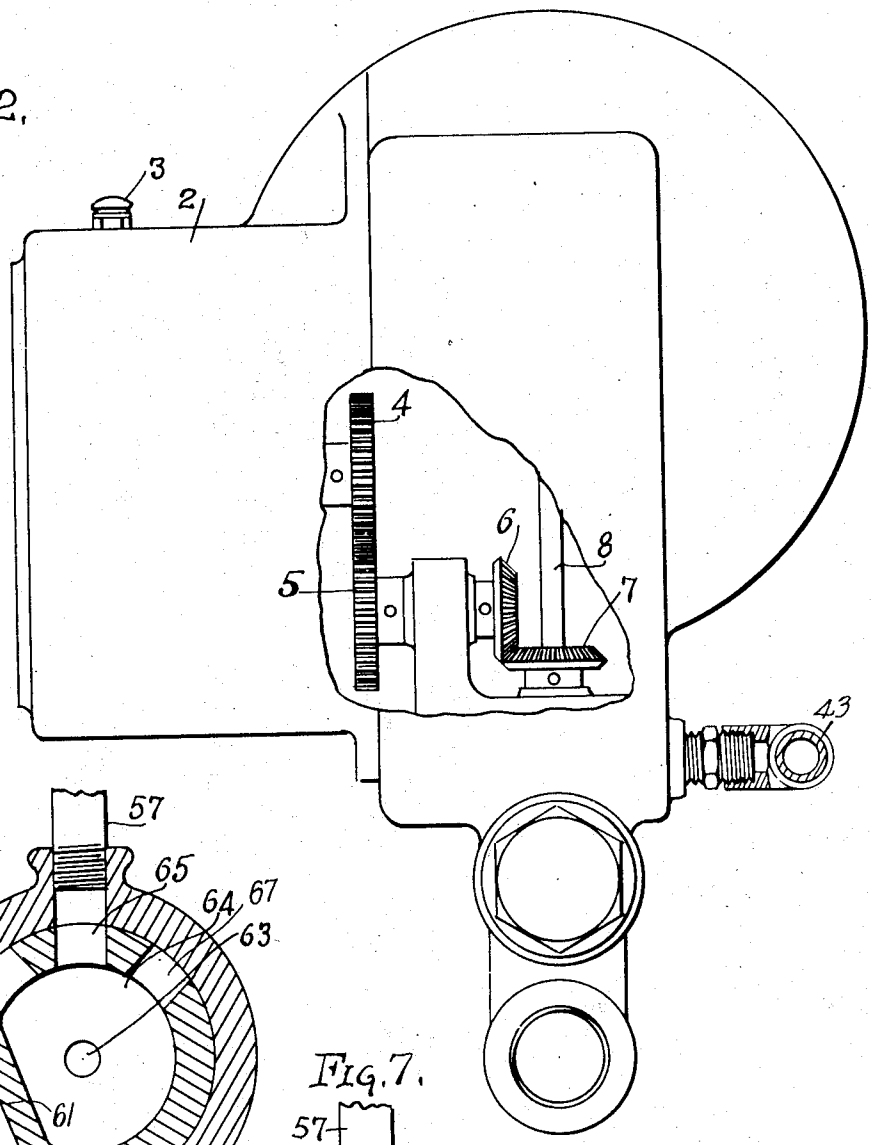


Fig. 6.

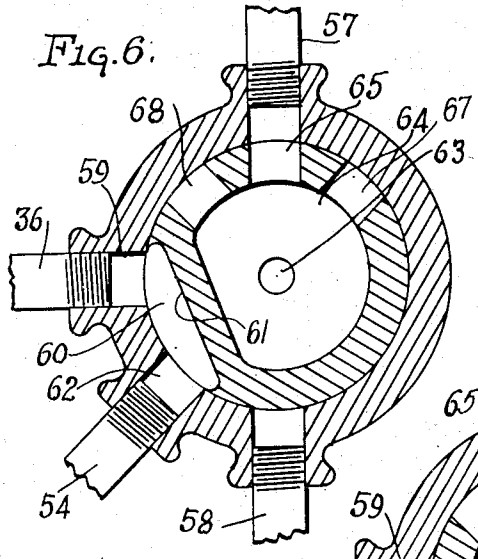
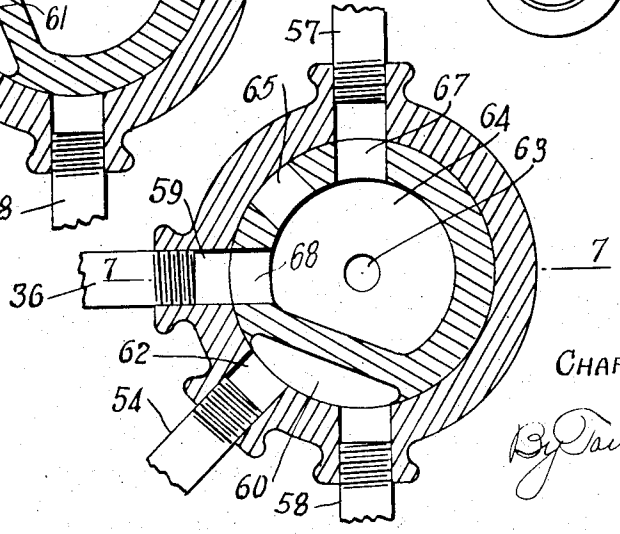


Fig. 7.



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Fig. 3.

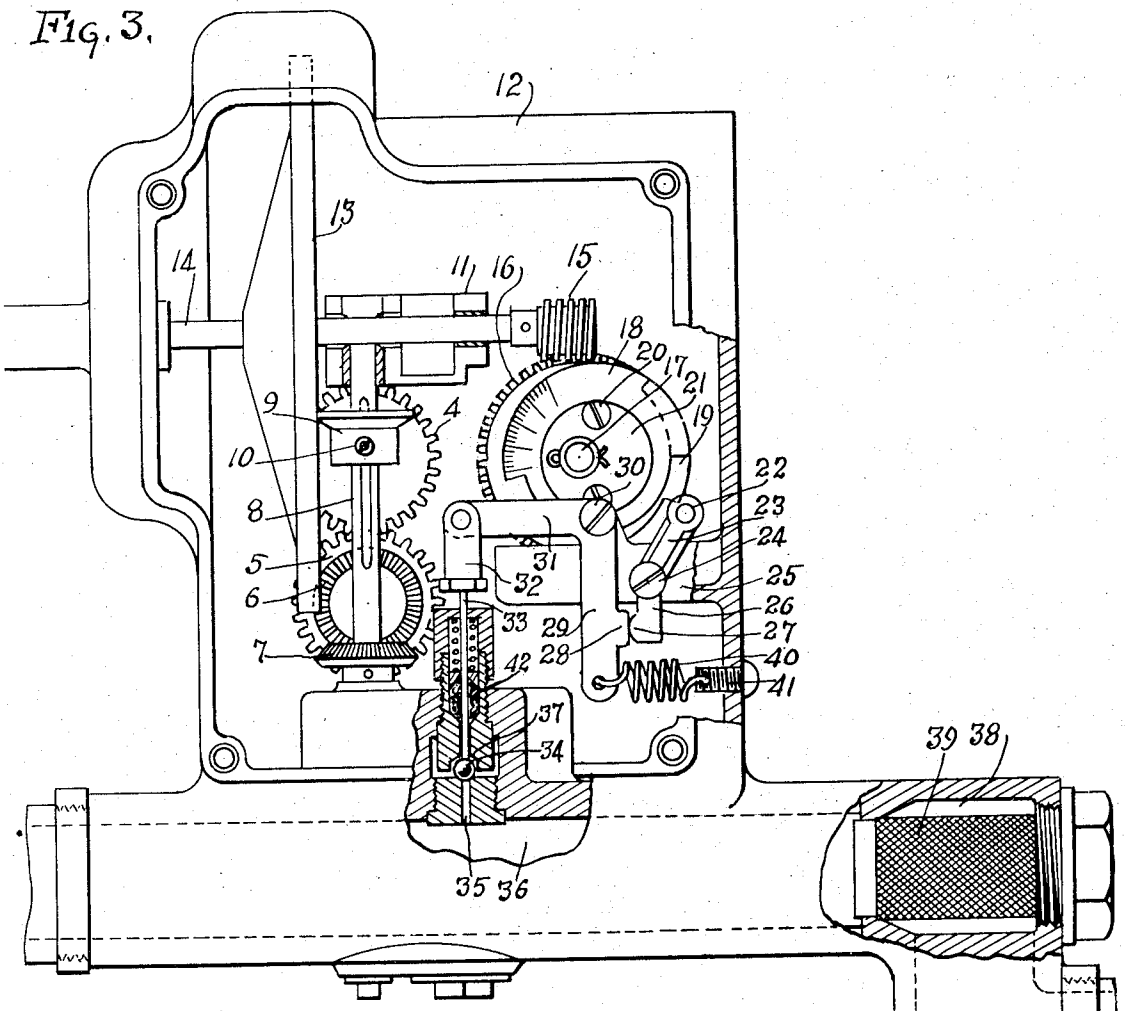
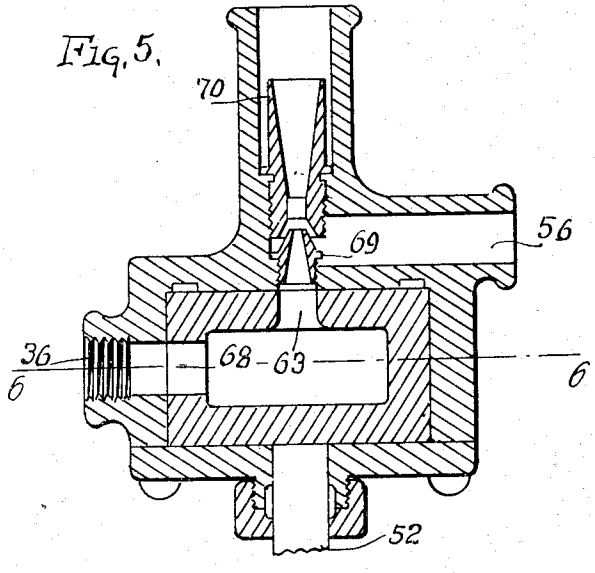


Fig. 5.



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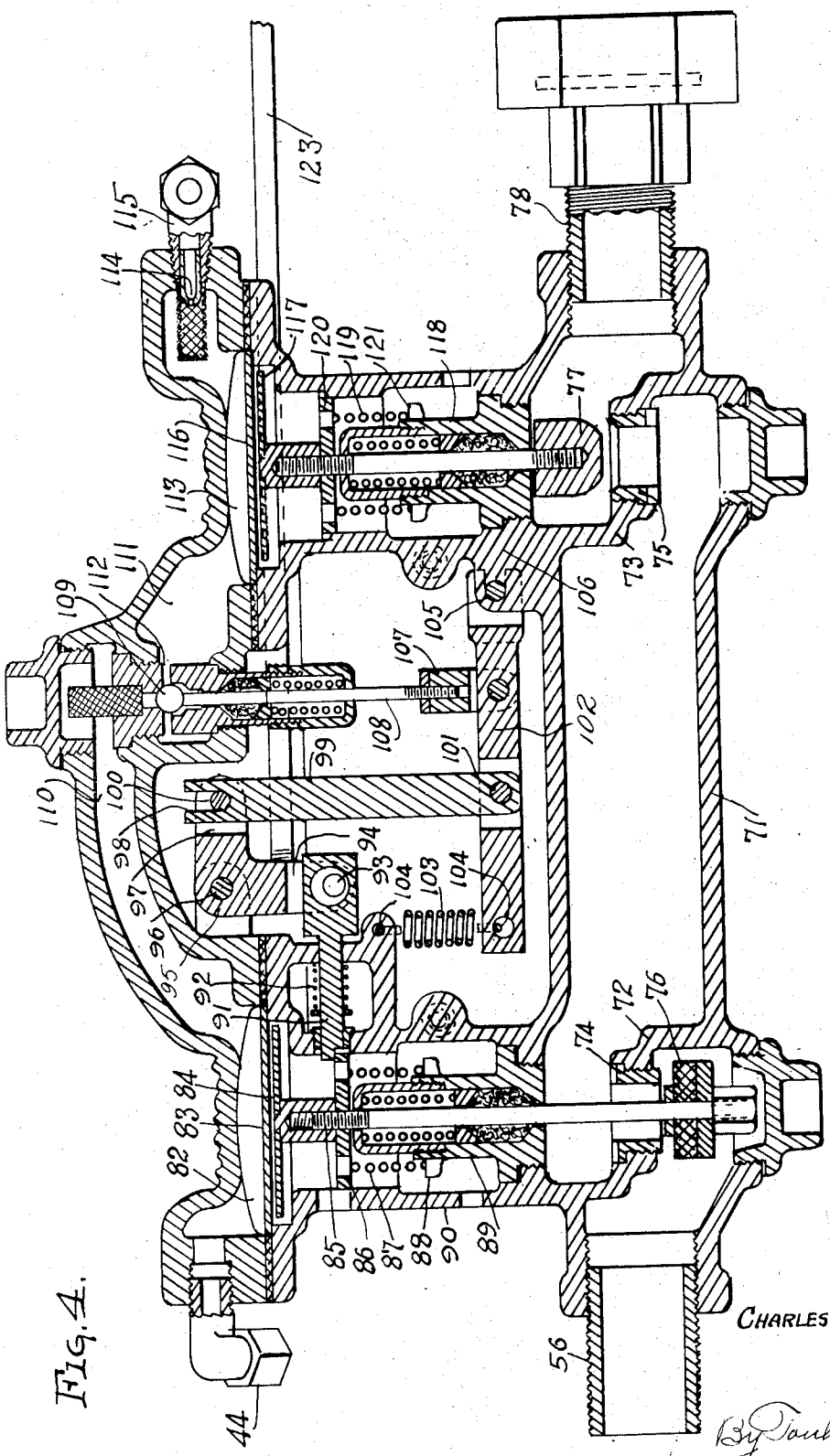


Fig. 4.

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Patented June 26, 1928. 1,674,717

UNITED STATES PATENT OFFICE.

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AUTOMATIC WATER SOFTENER.

Application filed October 12, 1925. Serial No. 61,999.

My invention relates to water softeners and in particular to an automatic water softener.

It is the object of my invention to provide an automatic water softener which is operated through a timing mechanism consisting of a self-winding, electric clock operating a mechanical needle valve to control the application of hydrostatic pressure to a diaphragm mechanism which, in turn, operates a master control valve. This hydrostatic pressure is also admitted to operate a refill valve and a brine valve.

In the accompanying drawings:

Figure 1 is a side elevation of the complete apparatus partially in section;

Figure 2 is an end elevation of a self-winding clock and driving mechanism, the casing being broken away to show the driving mechanism;

Figure 3 is a side elevation of the casing with the cover removed and with the casing partially in section to show the needle valve;

Figure 4 is a section through the refill valve and brine valve;

Figure 5 is a transverse section through the rotary control valve;

Figure 6 is a section on the line 6—6 of Figure 5 showing the control valve in softening position;

Figure 7 is a similar view showing the parts in regenerating position.

Referring to the drawings in detail, 1 is a water softener tank having the usual screens and softening material therebetween with means of controlling the water by removing it or introducing it at opposite ends of the tank on the outside of the screens.

2 is a self-winding clock supplied with current through the terminals 3. This clock may be of any conventional, self-winding type. It is not essential to have it self-winding, but that it a matter of convenience. The same will still operate satisfactorily on any method of winding with any type of clock.

This clock 2 drives a train of gears 4, 5, 6 and 7. The gear 7 is attached to the shaft 8, which shaft carries a driving member 9 which is detachably fixed thereto by the set screw 10. The upper end of the shaft 8 is journaled in the bracket 11 which forms a part of the housing 12. The driving member 9 drives a large disk 13 which is fixed to a shaft 14 journaled at one end in the bracket 11 and at the other end in the side of the housing 12. This shaft 14 carries a worm 15 engaging with a worm wheel 16. The worm wheel 16 is mounted on a shaft 17 journaled in the housing 12. This shaft also carries a pair of cams 18 and 19 adapted to be adjustably mounted with respect to one another through the set screws 20. Such set screws are mounted in the eccentric disk 21 also mounted upon the shaft 17, which disk carries one of the cams 18 in the form of a cam ring. This ring may be adjusted on the eccentric disk 21 in order to shorten or lengthen the high point of the two cams which are superimposed one over the other. A cam follower is provided consisting of a shoulder or roller 22 carried on one arm 23 of a bell crank which is pivoted at 24 on a bracket 25 of the housing. The other arm of the bell crank 26 has a nose 27 engaging with a head 28 carried on one arm 29 of a bell crank pivoted at 30 on the bracket 25. The other arm of this bell crank 31 carried on its free end suspended a link 32 to which is attached a valve stem 33 of a ball valve or needle valve having a ball or head 34 adapted to control the passageway of fluid through the passageway 35 from the main inlet passageway 36. This fluid passes through the passageway 35 into the passageways 37 to the pipes having hydrostatic pressure to the diaphragm valves. The pipe 36 is provided with a filter or screen chamber 38 and a screen 39 through which the water must enter prior to getting into the system.

The bell crank arm 29 has attached to it a spring 40 which is hooked to a casing by a screw 41. The usual spring-pressed packing 42 surrounds the needle valve stem.

When the high point of the cam lifts the cam follower (Figure 3), the bell cranks are operated and the needle valve is opened, admitting a portion of the hydrostatic pressure from the main line into the pipe lines 43 and 44. The pipe line 43 allows hydrostatic pressure to engage the diaphragm 45 and actuate a plunger 46 against the spring 47 thereby moving the lever 48 about its pivot 49 and actuating its upper end so that the transverse pin 50 in the jaws 51 of the handle 52 of the rotary valve will be moved. The rotary valve is contained within a casing 53. A pipe 54 leads from the valve to the bottom of the softener; a pipe behind the valve, as seen in Figure 1, designated 55 leads to the top of the tank or the top por-

tion of the tank, while the pipe 56 connects the brine line. The pipe 57 has a line that leads to service while the pipe 58 has a drain line.

Referring to the rotary valve (Figure 5), the water passes in, in softening position, through the port 59 in the housing of the valve, through the passageway 60 to one side of the flat portion 61 of the rotor, through the port 62, pipe 54 to the bottom of the tank, thence upwardly into the pipe which enters at the back of the valve, through the opening 63 into the chamber 64 of the rotor, thence out through the port 65 in the rotor, through the pipe 57 to service.

In regenerating position (Figure 6), the water enters through the pipe 36 to the port 59 into the chamber 64, through the opening 63 to the top of the tank, downwardly and up through the pipe 54 and port 62 into the passageway 60, out the port 66 in the valve housing, through the pipe 58 to drain. In the meanwhile, a portion of the water is by-passed through the rotor, out the port 67 in the rotor, through the pipe 57 to furnish hard water to the service line during regeneration. The water enters through the port 68 in getting to the inside of the rotor.

In passing out the port 63 (Figure 7), the water passes through two members with restricted orifices 69 and 70 forming an injector mechanism. At the point where they are separated, the brine line comes into the system at right angles, so that brine may be supplied from the pipe 56 by the injector action thus set up by the water, and the brine is then delivered to the top of the tank, taken downwardly through the material to regenerate it and back up through the rotary valve and thence down again to the drain.

Turning to the refill and brine valves (Figure 4), it will be observed that the pipe 56 has connected to it a casting 71 which has partitions at either end near the ends, designated 72 and 73, which support the seats 74 and 75 for the refill valve member 76 and the brine valve member 77.

The other end of the pipe 71 is connected to the pipe 78 which leads into the salt or brine tank 79 and thence down to the bottom, terminating in a bell 80 from whence the material, such as the brine, is drawn through the gravel bed 81.

Hydrostatic pressure through the pipe 44 enters the diaphragm chamber 82 over the diaphragm 83 of the refill valve to actuate the valve by pressing the diaphragm against the diaphragm head 84 carried on the upper end of the valve stem 85, the lower end of which carries the valve member 76. This valve stem also carries a locking plate 86 against which rests a spring 87 at one end, and which rests at its other end upon a shoulder 88 formed on the guiding casing 89 within the housing 90. This locking plate 86 is adapted to be engaged by the locking plunger 91 which reciprocates in a side of the casing of the valve. This is spring pressed in one direction by the plunger 92. The upper end of the plunger is carried on a pin 93 between the jaws 94 of the bell crank arm 95 which is pivoted on the casting at 96. The other end of this bell crank arm is bifurcated at 97 to receive the jaws 98 of a link 99, there being a pin 100 fitting between these jaws, such pin being carried by the arms 97. The lower end of this link is pivoted at 101 to a lever 102, the upper end of which is connected to a spring 103. This spring is hung upon the frame of the casting at 104. This lever is pivoted on the pin 105 on the adjacent casing of the brine valve marked 106. Between this pivotal point and the pivot 101 of the link 99 is a pivoted link 107 carrying a needle valve stem or ball valve stem 108 which carried on its upper end the ball 109 which controls the application of hydrostatic pressure through the passageway 110 to the passageway 111 through the intermediate passageway 112. The hydrostatic pressure so controlled is admitted to the diaphragm chamber 113 from which it is adapted to pass slowly through the bleed opening 114 of the drain pipe 115 which drains in the salt tank. In the diaphragm chamber 113 is the diaphragm 116 over the diaphragm plate 117 carried on the valve stem 118 which supports the brine valve member 77. A spring 119 is adapted to engage with a plate 120 carried on the valve stem and supported upon a shoulder 121 on the casting, comprising the shell or the valve.

The several valves are provided with spring-pressed packing of conventional design which form the most essential part of this invention.

Method of operation.

When the clock has turned a sufficient number of revolutions, as it is timed in a predetermined fashion, the machine will be converted from softening position to regenerating position by the opening of the needle valve 34 to admit hydrostatic pressure into the line 43. This operates the main diaphragm 45 and the plunger 46 as well as the lever 48 and the lever 52 moving the parts to the position shown in Figure 6 in the rotary valve. Up to this time, the brine valve 77 is normally open and the refill valve 76 is closed. The introducton of hydrostatic pressure through the line 44 causes the refill valve to open and the plunger 91 locks it open. The action of the injector draws the brine through the brine line into the softening tank and this continues until the float 122 with its float arm 123 drops down until it gets to a point that the pin 100 is at the bottom of the jaws 98 which causes the link

99 to be depressed with the lever 102, thus opening the valve 109 and admitting fluid pressure to the chamber 113 actuating a brine valve diaphragm 116 closing the brine valve and cutting off a further suply of brine. The softener then continues for a period to wash out the salt and, due to the movement of the clock, it is then restored to softening position which results in relief of the hydrostatic pressure in the line 44 and the restoration of the brine valve to its normal open position. But the refill valve is still open as it is locked open. A portion of the water which is then in the service line during the softening diverts itself into the brine line and proceeds to the brine tank, as both the refill valve and brine valve are open, thus replenishing the brine tank with fluid. This continues until the float rises until it gets to a point to withdraw the locking plunger 91 which permits the refill valve to close, and thereby cuts off further delivery of water to the brine tank.

It will be understood that I desire to comprehend within my invention such modifications as may be necessary to adapt it to varying conditions and uses.

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

1. In a water softener, a container for softening means, a container for regenerating means, means to convert the softener from softening position to regenerating position and back to softening position, a mechanical needle valve for controlling the application of hydrostatic pressure to operate said means, hydrostatic pressure means to be so operated, and a clock for determining the period at and during which said cycle of regeneration and softening shall take place.

2. In a water softener, a clock, means operated thereby for intermittently operating a needle valve, a needle valve for admitting hydrostatic pressure, valves adapted to be operated by said hydrostatic pressure, a valve for converting the softener from softening position to regenerating position and back to softening position, a softening tank and a brine supply tank.

3. In a water softener, a clock, means operated thereby for intermittently operating a needle valve, a needle valve for admitting hydrostatic pressure, valves adapted to be operated by said hydrostatic pressure, a valve for converting the softener from softening position to regenerating position and back to softening position, a softening tank and a brine supply tank, a refill valve and a brine valve controlled by said hydrostatic pressure.

4. In a water softener, a clock, means operated thereby for intermittently operating a needle valve, a needle valve for admitting hydrostatic pressure, valves adapted to be operated by said hydrostatic pressure, a valve for converting the softener from softening position to regenerating position and back to softening position, a softening tank and a brine supply tank, a refill valve and a brine valve controlled by said hydrostatic pressure, a float and float arm associated with said brine valve and refill valve, a lock associated with the refill valve whereby when the refill valve is open it is locked open, and remains locked until the float means rises to a predetermined point and unlocks it, and said brine valve remains open until the float descends to a predetermined point when hydrostatic pressure is permitted to close it.

5. In a water softener, a container for softening means, a container for brine, a rotor master control valve, a driving clock, timing mechanism driven thereby, a mechanical means in connection with said timing mechanism for operating a needle valve, a mechanical needle valve operated thereby adapted to admit hydrostatic pressure to a diaphragm mechanism, a diaphragm mechanism to operate said rotor valve whereby the operation of the mechanism will convert the system from one cycle of operation to the other.

6. In a water softener, a container for softening means, a container for brine, a rotor master control valve, a driving clock, timing mechanism driven thereby, a mechanical means in connection with said timing mechanism for operating a needle valve, a mechanical needle valve operated thereby adapted to admit hydrostatic pressure to a diaphragm mechanism, a diaphragm mechanism to operate said rotor valve whereby the operation of the mechanism will convert the system from one cycle of operation to the other, diaphragm valves operated by the hydrostatic pressure consisting of a refill valve and a brine valve, a lock to the refill valve, a float and float arm associated with a brine tank, a brine tank whereby the float and float arm controls the unlocking and closing of the refill valve and the opening and closing of the brine valve.

7. In a water softener, a container for softening means, a container for brine, a control valve, a clock mechanism for operating a mechanical needle valve, a mechanical needle valve, timing mechanism therefor operated by the clock, a plurality of diaphragm valves controlled by the hydrostatic pressure admitted by the needle valve, a hydrostatically operated diaphragm mechanism, a system of levers connected to said diaphragm mechanism, yielding means associated with said diaphragm mechanism, a master control valve operated by said system of levers, and a brine and refill valve with a float and float arm, and lock for said re-

fill valve, said float and float arm and lock adapted to control the supply of brine to the softening container and the supply of refill water to the brine container.

8. In a water softener, an operating clock, a driving member driven thereby, a driving disk driven by the driving member, cam mechanism driven thereby, a cam follower, a bell crank associated with said cam follower moved yieldingly in one direction and in the other direction by the cam and cam follower, a needle valve connected therewith and means associated with the needle valve adapted to be operated by hydrostatic pressure for operating a main valve to control the softener in its softening and regenerating positions, and a main valve.

9. In a water softener, an operating clock, a driving member driven thereby, a driving disk driven by the driving member, cam mechanism driven thereby, a cam follower, a bell crank associated with said cam follower moved yieldingly in one direction and in the other direction by the cam and cam follower, a needle valve connected therewith and means associated with the needle valve adapted to be operated by hydrostatic pressure for operating a main valve to control the softener in its softening and regenerating positions, and a main valve, and means to adjust said cam means to vary the period during which regeneration takes place.

10. In a water softener, an operating clock, a driving member driven thereby, a driving disk driven by the driving member, cam mechanism driven thereby, a cam follower, a bell crank associated with said cam follower moved yieldingly in one direction and in the other direction by the cam and cam follower, a needle valve connected therewith and means associated with the needle valve adapted to be operated by hydrostatic pressure for operating a main valve to control the softener in its softening and regenerating positions, and a main valve, and means to adjust said cam means to vary the period during which regeneration takes place, and means to vary the relationship between the driven and driving members to vary the period of operation of the machine during the respective cycles.

11. In a water softener, a container for a softening means, a container for a brine means, a clock mechanism, mechanism driven thereby to operate a needle valve intermittently, a needle valve, hydrostatic pressure controlled by said needle valve adapted to operate diaphragm valves, diaphragm valves, a hydrostatically operated diaphragm mechanism adapted to operate a rotary valve, a rotary valve, said rotary valve being so arranged that in one position the water will pass from the inlet to one end of the softening means and back out from the other end of the softening means, and thence to service, and in another position the direction of the water will be reversed, a portion of the incoming hard water will be diverted to service to furnish hard water to the service line, and, upon re-conversion to the first mentioned position, a portion of the softened water will be diverted to the brine means to replenish it.

12. In a water softener, a container for softening means, a container for a brine means, a clock mechanism, mechanism driven thereby to operate a needle valve intermittently, a needle valve, hydrostatic pressure controlled by said needle valve adapted to operate diaphragm valves, diaphragm valves, a hydrostatically operated diaphragm mechanism adapted to operate a rotary valve, a rotary valve, said rotary valve being so arranged that in one position the water will pass from the inlet pipe to one end of the softening means and back out from the other end of the softening means and thence to service, and in another position the direction of the water will be reversed, a portion of the incoming hard water will be diverted to service to furnish hard water to the service line, and, upon re-conversion to the first mentioned position, a portion of the softened water will be diverted to the brine means to replenish it, an injector means associated with said valve.

13. In a water softener, a container for a softening means, a container for a brine means, a clock mechanism, mechanism driven thereby to operate a needle valve, a needle valve, hydrostatic pressure controlled by said needle valve adapted to operate diaphragm valves, diaphragm valves, a hydrostatically operated diaphragm mechanism adapted to operate a rotary valve, a rotary valve, said rotary valve being so arranged that in one position the water will pass from the inlet pipe to one end of the softening means and back out from the other end of the softening means and thence to service, and in another position the direction of the water will be reversed, a portion of the incoming hard water will be diverted to service to furnish hard water to the service line, and, upon reconversion of the valve to the first mentioned position, a portion of the softened water will be diverted to the brine means to replenish it, an injector means associated with said valve, said hydrostatically-operated, diaphragm valves consisting of a brine valve and a refill valve, a lock for the refill valve, and a float and float arm associated with the brine means adapted to unlock the refill valve and control the application of hydrostatic pressure to the brine valve so that the exit of brine from the brine tank and the return of refill water to the brine container will be controlled.

14. In a water softener, a container for a

softening means, a container for a brine means, a clock mechanism, mechanism driven thereby to operate a needle valve, a needle valve, hydrostatic pressure controlled by said needle valve adapted to operate diaphragm valves, diaphragm valves, hydrostatically operated diaphragm mechanism adapted to operate a rotary valve, a rotary valve, said rotary valve being so arranged that in one position the water will pass from the inlet pipe to one end of the softening means and back out from the other end of the softening means and thence to service, and in another position the direction of the water will be reversed, a portion of the incoming hard water will be diverted to service to furnish hard water to the service line, and, upon reconversion of the valve to the first mentioned position, a portion of the softened water will be diverted to the brine means to replenish it, an injector means associated with said valve, said hydrostatically-operated, diaphragm valves consisting of a brine valve and a refill valve, a lock for said refill valve, and a float and float arm associated with the brine means adapted to unlock the refill valve and control the application of hydrostatic pressure to the brine valve, said means consisting of a needle valve opened by said float and float arm when it gets to its lowermost position, said lock being operated by the float when it gets in its uppermost position whereby the delivery of brine from the brine container and the redelivery of water to the brine container will be controlled.

15. In a water softener apparatus, a clock, a needle valve controlled thereby, and a hydrostatic valve controlled by said needle valve through the application of hydrostatic pressure through the needle valve to the hydrostatic valve, a tank for softening material, a tank for brine, which brine is delivered at intervals to the softening tank, a float in said brine tank for regulating the flow therefrom and means to control the replenishment of the liquid in the brine tank.

16. In a water softening system, a tank for softening material, a tank for brine, means to deliver brine to the softening tank, a service line leading from the softening tank, a needle valve, a clock for controlling the operation of the needle valve, means to control the replenishment of the brine tank with fresh water, means to control the movement of the brine from the brine tank to the softening tank, an injector to induce the movement of the brine from the brine tank to the softening tank, a drain line to drain the brine from the softening tank, and a hydrostatic valve means controlled by the needle valve and in turn controlling a portion of the water softening system.

In testimony whereof I affix my signature.

CHARLES P. EISENHAUER.