

July 13, 1937.

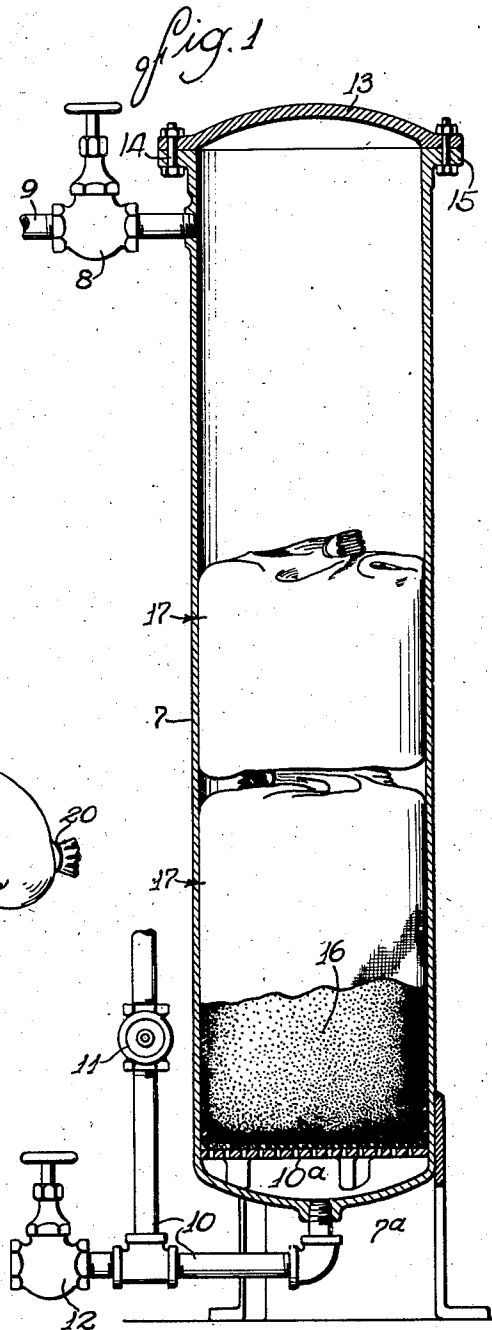
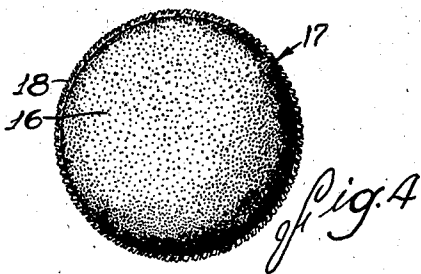
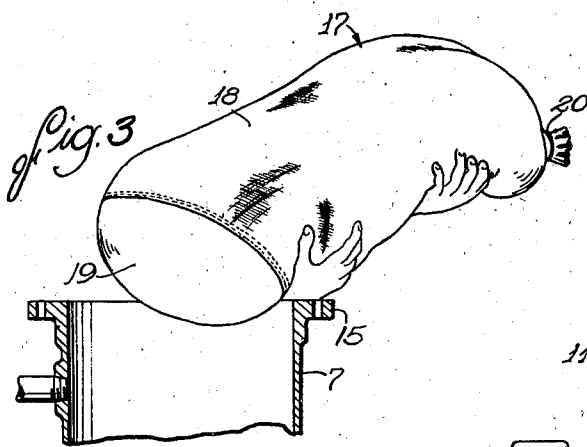
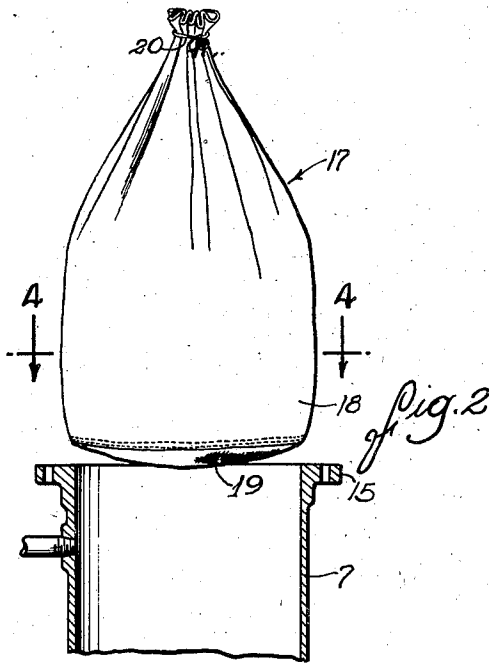
L. C. LIND

2,087,157

ART OF WATER SOFTENING

Filed March 19, 1937

2 Sheets-Sheet 1



INVENTOR
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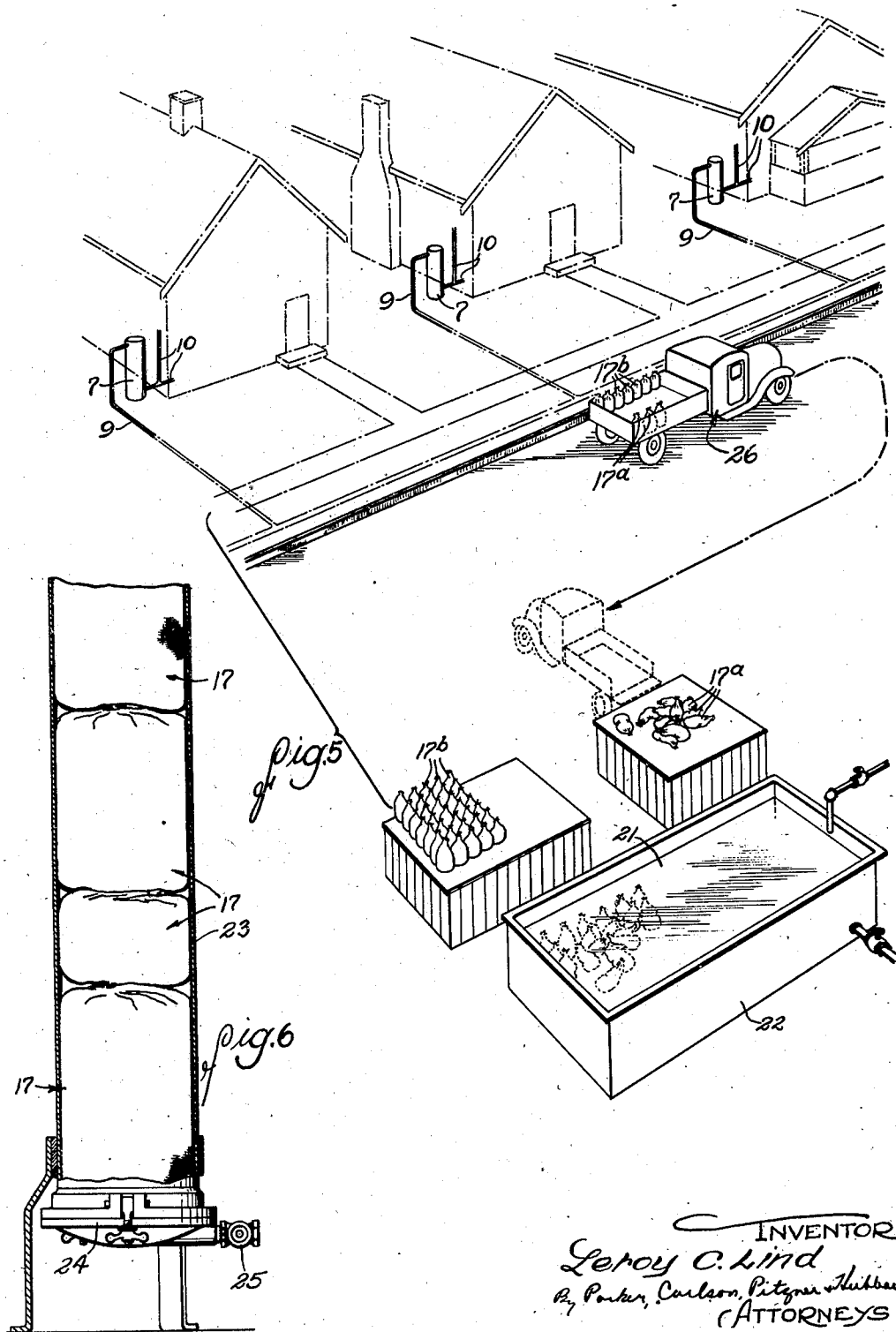
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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ART OF WATER SOFTENING

Leroy C. Lind, Rockford, Ill.

Application March 19, 1937, Serial No. 131,794

6 Claims. (Cl. 210-24)

This invention relates to an improved method of and apparatus for softening water for domestic purposes utilizing regeneratable granulated mineral such, for example, as zeolite. Heretofore, domestic water softening systems of this character have employed permanent beds of softening mineral and have been arranged for automatic or manual regeneration. The automatic systems involve a substantial initial investment and embody relatively complicated apparatus which is apt to get out of adjustment frequently, necessitating repair by a skilled service man. Softeners of the manually regenerative type are less expensive but are open to the objection that the average householder, through carelessness or lack of knowledge, will fail to regenerate the softener regularly. As a result, properly softened water is not ordinarily available at all times. In addition, regeneration necessitates a substantial interruption of the soft water supply.

The primary object of the present invention is to overcome the above disadvantages and uncertainties of operation by providing an improved method of supplying and conditioning water softening mineral which enables the exhausted mineral at any installation to be replaced quickly and without appreciably interrupting the water supply, which simplifies the softening apparatus required and which enables the spent mineral from a number of individual installations to be regenerated collectively and at a low cost without attention or inconvenience to the individual householders and this, without appreciably adding to the average cost of softened water.

The invention also resides in the novel construction of the individual softeners which facilitates rapid reconditioning thereof while at the same time insuring efficient utilization of the softening mineral at all times.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which

Figure 1 is a vertical sectional view of a water softener embodying the present invention.

Fig. 2 is an elevational view of one of the mineral cartridges after removal thereof from the softener tank which is shown in vertical section.

Fig. 3 is a similar view illustrating the manner of shaping the cartridge preparatory to insertion in the softener tank.

Fig. 4 is a cross sectional view taken along the line 4-4 of Fig. 2,

Fig. 5 is a schematic view illustrating the different equipment that may be used in carrying out the method.

Fig. 6 is a fragmentary vertical sectional view illustrating a modified method of regenerating the softener cartridges.

While the invention is susceptible of various modifications, I have illustrated in the drawings and will herein describe in detail the preferred embodiment and method of practicing the invention. It is to be understood, however, that I do not intend to limit the invention by such disclosure but aim to cover all modifications and alternative methods and constructions falling within the spirit and scope of the invention as expressed in the appended claims.

The present invention contemplates the supplying and conditioning of water softening mineral for a plurality of independent softener installations or stations each having a tank permanently connected in a water supply system for the passage therethrough of water to be treated. Generally stated, the method comprises packaging the mineral in individual water pervious containers to form a plurality of cartridges substantially in excess of the number of such installations and each interchangeably mountable in the different softener tanks, inserting one or more cartridges in the respective tanks so as to compel the flow of water therethrough, periodically removing the cartridges from the tanks before the softening capacity of the mineral has been exceeded, and substituting regenerated cartridges for the withdrawn cartridges at the time of such removal, and subjecting the removed cartridges to the action of a regenerating solution at a common regenerating station.

As shown in Fig. 1, each individual softening installation includes a tank 7 preferably in the form of an upright vertical cylinder of substantial length and of relatively smaller diameter as compared to its length. Near its upper end, the tank is connected through a valve 8 and a pipe 9 to a source of water to be softened. The tank is closed at its lower end by a bottom wall 7^a and has an outlet pipe 10 leading through a valve 11 to the pipes through which softened water is to be delivered. The softener tank may be drained by opening a valve 12. To enable the mineral cartridges to be inserted and removed readily, the tank is open at its upper end, preferably to its full cross sectional width and is adapted to be closed by a cover 13 which may be removed after loosening a series of bolts 14

which serve to clamp the cover against an end flange 15 of the tank. The usual perforated plate 10^a is provided in the bottom of the tank to support the mineral bed above the tank outlet.

The zeolite or softening mineral indicated at 16 in loose granular form is contained in cartridges 17 which may be inserted conveniently into the tank through the upper end thereof, withdrawn readily from the tank after removal of the cover, and handled conveniently during transportation and regeneration. Each of the cartridges comprises a sack of strong yet relatively flexible fabric or the like preferably comprising a generally cylindrical body portion 18 and a separately formed circular bottom piece 19 sewed to one end of the body. The other end is gathered together uniformly and properly closed in any preferred way, such for example as by a cord 20 wound around the gathered portion and properly tied. The upper end of the sack, when contracted and tied in this manner, constitutes a handle by which the source for lifting the sack out of the tank may be applied uniformly around the entire periphery of the sack and the latter removed conveniently from the tank.

The sack fabric is sufficiently thin and coarse to permit the ready flow of water therethrough but is sufficiently fine to properly retain granulated zeolite mineral of ordinary fineness. The cross sectional shape of the sack corresponds to the internal wall of the tank, and is so correlated in size to the transverse cross-section of the wall that the side wall of the sack will expand automatically under the weight of the mineral contained therein into full contact with the tank walls and form an effective liquid seal which avoids the possibility of water being bypassed around the mineral cartridge. To this end, the sack is formed of a diameter which, when expanded under the weight of the mineral therein and after normal shrinkage, is slightly larger than the internal diameter of the tank (see Fig. 2). To the same end, the sack is filled only partially with mineral thereby enabling the mineral in the sack to be spread out longitudinally of the latter and the effective diameter of the cartridge as a whole to be so reduced that the cartridge will slide readily into the upper end of the tank, and yet will, after being inserted, expand into full engagement with the inner tank wall. Advantage is thus taken of the granular or flowable character of the softening mineral in providing an effective yet simple form of seal between the mineral and the tank.

The extent to which the sack may be filled while permitting proper distribution of the mineral body preparatory to insertion in the tank may of course vary considerably. Ordinarily, this will be in proportion to the difference in the cross-sectional sizes of the sack and the tank. To insure the formation of an effective seal, the sack need only be slightly larger in diameter than the interior of the tank, proper allowance being made for normal shrinkage of the fabric of which the sack is made. For example, it has been found that with a tank having an internal diameter of nine inches, the sack may have a diameter approaching ten inches. Of course, the greater difference between the diameters of the sack and tank, the larger will be the number of folds or the sizes of the folds which may be formed when the sack is inserted in the tank.

These folds are not, however, conducive to the formation of by-pass channels around the cartridge and do not detract from the effective sealing action which is obtained under the weight of the mineral as it settles down in the sack after insertion of the cartridge in the tank.

The tank 7 is made substantially longer than the individual cartridges 17 in order that several cartridges of the same or different lengths may be inserted so as to proportionately increase the capacity of the softener. It has been found desirable to employ cartridges containing different quantities of mineral, for example, twenty and ten pound cartridges as shown in Fig. 1, all having the same diameter so as to be usable interchangeably in the tanks of the different installations. By employing cartridges of this character, the capacity of the softener as a whole may be adjusted in smaller increments and thus more readily adapted to the requirements of a given household. When several cartridges are thus used in one tank, one is supported directly on top of the other as shown in Fig. 1 so that the water flows successively through the mineral in these cartridges. The amount of mineral contained in the larger cartridges is preferably sufficiently to satisfy the requirements of a small size household during the period between successive reconditioning operations.

It is contemplated that the cartridges will be replaced regularly at intervals well within the normal period of service use that would normally result in complete exhaustion of the softening mineral at any installation. To effect such replacement, the valve 8 is closed to shut off the water supply, the valve 12 is opened to drain the tank, and the valve 11 is closed to avoid the possibility of draining the soft water delivery lines and the subsequent trapping of air therein. After the cover 13 has been removed from the tank, the cartridges 17 are released by lateral movements of the handles and lifted out one by one. An equal number of cartridges containing fresh or regenerated mineral is inserted in the tank. To accomplish this, the operator usually holds the cartridge in horizontal or tilted position as illustrated in Fig. 3 for the purpose of distributing the mineral longitudinally of the sack and thereby reducing the effective diameter of the cartridge. While thus contracted, the cartridge may be slid into the open end of the tank and will fall readily to the bottom. Then, by grasping the handle and applying a slight lifting force, the sack may be located properly in upright position and will, under the weight of the mineral therein, become uniformly expanded against the tank wall as illustrated in Fig. 1.

After the required number of regenerated cartridges have been placed in the tank, the drain valve 12 is closed and the inlet valve 8 is opened to admit sufficient water to substantially fill the tank. This avoids the possibility of the air, which would otherwise be trapped in the upper part of the softener, from rising through the hard water pipe lines to the service valves thereof. Finally, the cover is replaced and the valve 11 opened to restore the soft water supply. It has been found that only a few minutes, for example three, are required to remove the spent cartridges and replace them with fresh ones so that the interruption in the softer water service is substantially negligible.

Regeneration of the spent cartridges may be effected collectively at a central station in various ways. For example, the spent cartridges indi-

cated at 17^a may be introduced in a salt solution 21 contained in a common tank 22 where the cartridges are allowed to remain until the regeneration is complete. After removal from the solution and proper washing, the regenerated cartridges indicated at 17^b are ready for re-use.

If desired, the cartridges may be regenerated in smaller numbers in elongated vertical tanks 23 of the character shown in Fig. 6 and having a plate 24 at the lower end which may be removed to permit withdrawal of the cartridges after regeneration and washing. After the cartridges are placed in the tank 23 in the manner shown, the salt or other regenerating solution may be introduced at the upper end and caused to flow down through the mineral in the different cartridges and out through a valve 25. Any desired number of such regenerating tanks may be employed at the common regenerating station.

The cartridges containing the spent and regenerated mineral may be transported between the central regenerating station and the individual softener installations by a truck 26 or other suitable conveyance.

It will be apparent from the foregoing that the number of cartridges will be in excess of the number of softener installations. Such excess will ordinarily be relatively small as compared to the total number of cartridges in actual use at any time. However, owing to the advantageous manner of maintaining the mineral in efficient working condition, it has been found that the amount of mineral required at the individual softener installation to provide a given softening capacity is substantially less than with softeners heretofore used.

The improved method of utilizing zeolite mineral for the softening of water at a plurality of separated stations not only eliminates the necessity of attention on the part of the individual householder and in many instances results in a decrease in cost of softened water but also enables the individual softening equipment to operate in a much more effective manner than otherwise. The mineral itself, being regularly replaced before its softening capacity has been reached, is always effective in assuring a supply of fully softened water. The periodic transporting and other handling of the flexible walled cartridge sacks effects a mechanical loosening and rearrangement of the granules of water softening mineral. In this manner, caking and channeling common in water softeners having permanent zeolite beds are effectively eliminated.

From the foregoing, it will be observed that the tank valves and associated equipment of each installation are of simple construction and substantially less expensive than present day water softeners either of the manually operated or automatically regenerated types. Likewise, the cost of regenerating the spent mineral may be effected on a mass production basis and therefore at a lower cost. It has been found that these reductions in equipment and regenerating costs practically offset the cost of handling the spent and regenerated cartridges and transporting them between the regenerative plant and the different individual softeners in the community. Accordingly, the householder may be assured of a continuous supply of properly softened water without attention on his part and at an average cost not appreciably greater, and frequently less, than with present day equipment. In addition, the initial investment in equipment is substantially less.

This application is a continuation in part of my

application Serial No. 108,172, filed October 29, 1936.

I claim as my invention:

1. The method of supplying and conditioning regeneratable water softening mineral for a plurality of independent installations having individual tanks of uniform cross-section and each permanently connected in the water supply systems at one of said installations for the passage therethrough of the water to be treated, said method comprising providing individual water pervious mineral containing cartridges substantially in excess of the number of said installations and each mountable interchangeably in any one of said tanks, inserting cartridges in the respective tanks in numbers corresponding to the softening capacity required with the cartridges in each tank arranged to compel the flow of water therethrough successively, periodically removing the cartridges from the respective tanks and substituting therefor at the time of removal an equal number of regenerated cartridges, and regenerating the removed cartridges collectively.

2. The method of supplying and conditioning regeneratable water softening mineral for a plurality of independent installations each having a tank permanently connected in a water supply system for the passage therethrough of the water to be treated, said method comprising packaging the mineral in individual water pervious containers to form a plurality of interchangeable cartridges substantially in excess of the number of said installations, inserting cartridges in the respective tanks so as to compel the flow of water therethrough, periodically removing the cartridges from the tanks and substituting therefor at the time of removal regenerated cartridges, and subjecting the removed cartridges collectively to the action of regenerating solution.

3. The method of regenerating a water softener having an upright tank connected in a water supply system and one or more mineral cartridges partially filling the tank, said method comprising opening the upper end of said tank and draining the same, removing the cartridges through the tank opening, inserting regenerated cartridges, substantially filling said tank with water, and finally reclosing the tank opening.

4. A water softener comprising, in combination, an elongated upright tank adapted to be connected in a water supply line for the flow of water therethrough from end to end and having an opening at its upper end for exposing the tank substantially to its full internal cross section, a removable cover for closing said opening, and a removable cartridge in said tank comprising a sack containing granular softening mineral and composed of flexible material with water pervious ends and an effective cross-sectional area greater than the internal cross section of said tank so as to expand automatically under the weight of said mineral into liquid sealing engagement with the internal tank wall, said mineral partially filling said sack whereby to permit of reduction in the cross section of the cartridge for insertion thereof in said tank.

5. A water softener comprising, in combination, a tank adapted to be connected permanently into a water supply line for the flow of water thereto from end to end and having a cover adapted when removed to open the tank substantially to its full cross sectional size, and a flexible walled cartridge containing granular water-softening mineral adapted to be inserted into and removed from the tank through said end and

- having a transverse cross-section corresponding in shape to but greater than the inner wall of said tank whereby said cartridge will expand into liquid sealing engagement around the entire periphery of said wall and substantially throughout the effective length of the cartridge, said cartridge having porous end walls whereby water flowing through said tank will pass through said cartridge.
- 5 6. A water softener comprising, in combination, an upright tank adapted to be connected in a water supply line for the flow of water therethrough from end to end and having an opening at its upper end for exposing the tank substantially to its full internal cross section, a removable cover for closing said opening, and a water pervious cartridge in said tank removable through said opening and containing granular softening mineral, said cartridge having flexible walls dimensioned to expand under the weight of said mineral into liquid sealing engagement with the internal tank wall substantially through the length of the cartridge. 10

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