

Jan. 18, 1966

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3,229,854

WATER CONDITIONING SYSTEM

Filed June 5, 1963

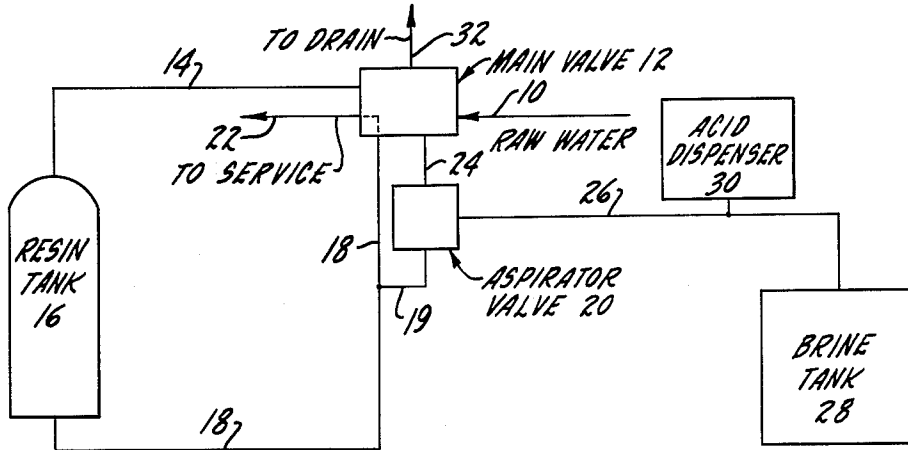


FIG. 1.

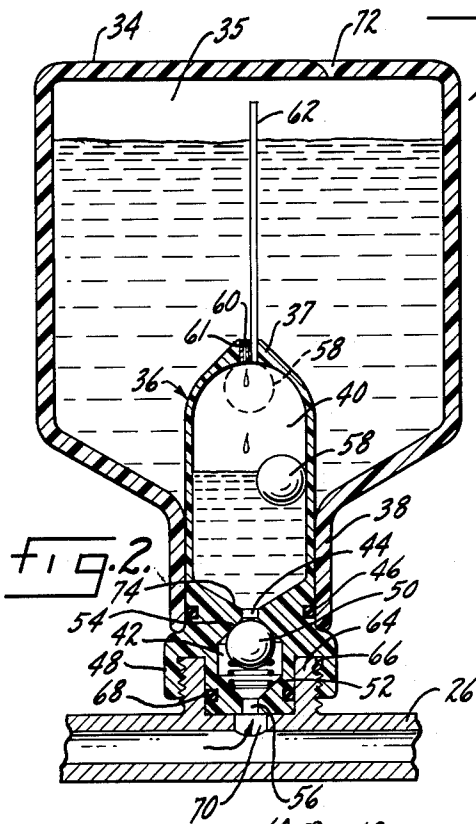


FIG. 2.

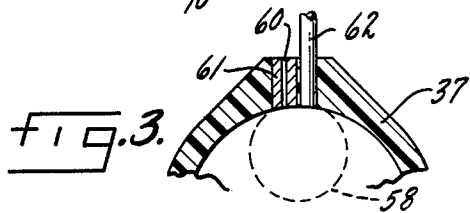


FIG. 3.

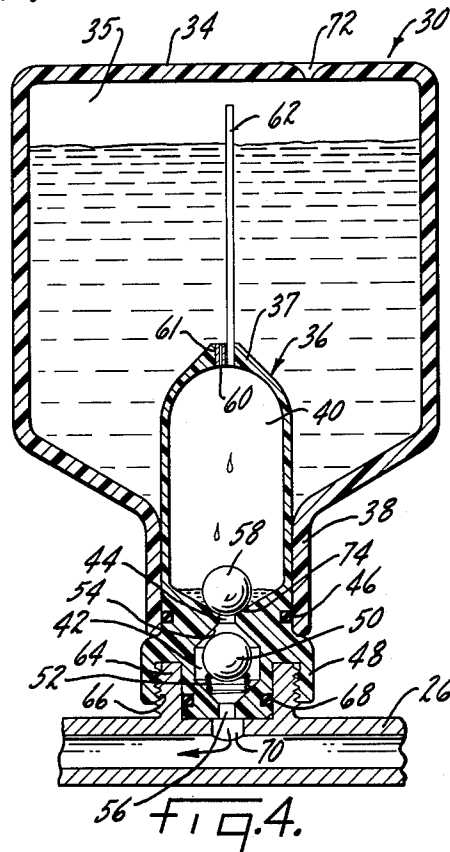


FIG. 4.

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3,229,854

WATER CONDITIONING SYSTEM

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Filed June 5, 1963, Ser. No. 285,638

10 Claims. (Cl. 222-67)

This invention relates to means for dispensing a liquid and, more particularly, to an acid dispenser suitable for use in a water softening system.

Water softening with ion exchange resin particles is well known in the art. After prolonged contact of the ion exchange resin particles with raw water, these resin particles become "exhausted," i.e., their ability to exchange soft ions for the hard ions in the raw water is substantially diminished. When the ion exchange resin particles become exhausted, they must be regenerated. Heretofore, regeneration has been effected by contacting the resin particles with a brine solution, e.g., an aqueous solution of sodium chloride. More recently, it has been found that it is desirable to regenerate the ion exchange resin particles by contacting the resin particles with an aqueous acid solution, such as citric acid or the like, and a brine solution. A sequential process may be employed wherein the resin particles are contacted first with the acid solution and then the brine solution. Likewise, the resin particles may be simultaneously contacted with the acid solution and the brine solution. These processes are discussed in detail in copending application Serial No. 170,043, filed January 31, 1962, now abandoned, and assigned to the assignee of the present application. In any event, such processes require means to dispense the aqueous acid solution which is to be contacted with the resin particles during the regeneration cycle.

Accordingly, it is an object for the present invention to provide a means for dispensing a liquid.

It is another object of the present invention to provide a means for dispensing a predetermined amount of liquid.

It is a further object of the present invention to provide a liquid dispenser adapted to dispense a predetermined amount of a liquid to a line, the liquid dispenser being actuated by the pressure in the line.

It is still another object of the present invention to provide means for dispensing a predetermined amount of an aqueous acid solution.

It is a still further object of the present invention to provide a metering device for a liquid dispenser.

It is yet another object of the present invention to provide a metering device for a liquid, the metering device being adapted to be used with a container for the liquid.

These and other objects more apparent hereinafter are realized by the liquid dispenser embodying the features of the present invention. The liquid dispenser is adapted to dispense a predetermined amount of liquid to a line to which it is attached. The pressure in the line actuates the liquid dispenser. A metering device embodying the features of the present invention receives and dispenses the predetermined amount of liquid and is adapted to be used with various containers for the liquid.

The invention, both as to its organization and method of operation, taken with further objects and advantages thereof, will be understood by reference to the following description taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a schematic diagram of a water softening system wherein water is treated with ion exchange resin particles, which are regenerated by an acid solution and a brine solution, the acid solution being supplied from an acid dispenser embodying the features of the present invention;

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FIGURE 2 is a cross-sectional view of the acid dispenser shown in FIGURE 1 as a metering device in the acid dispenser is being filled with acid solution;

FIGURE 3 is an enlarged fragmentary view of the acid dispenser shown in FIGURE 1 as the metering device in the acid dispenser is being filled with acid solution, as illustrated in FIGURE 2;

FIGURE 4 is a cross-sectional view of the acid dispenser of FIGURE 1 after acid solution has been dispensed to the ion exchange resin particles.

Referring to the drawings, and more particularly to FIGURE 1, there is schematically illustrated a water softening system for treating water with ion exchange resin particles. Suitable ion exchange resin particles are well known in the art and do not constitute a part of the present invention. In this system the ion exchange resin particles, when they become exhausted, are regenerated sequentially with an acid solution and a brine solution.

During the service cycle, raw water from a suitable source is passed through a feed line 10 to a main valve indicated generally by reference numeral 12. The main valve 12 directs the raw water through a line 14 to a resin tank 16 which contains a bed of the ion exchange resin particles as is well known in the art. The raw water passes through the bed of ion exchange resin particles and is withdrawn from the tank 16 through a line 18. The treated water, which has been softened by contact with the ion exchange resin particles, passes through the line 18 to the main valve 12 which directs it to a service line 22. There is, of course, no mixing of the treated water with the raw water in the main valve 12.

After a predetermined quantity of raw water has passed through the resin tank 16, the ion exchange resin particles lose their capacity to effectively soften the raw water and must be regenerated. This is effected by sequentially contacting the exhausted resin particles with an acid solution and a brine solution. The regeneration cycle is initiated by actuating the main valve 12 so that a portion of the raw water from the line 10 is directed to the service line 22. In this manner, a supply of water is maintained to the service line 22 during the regeneration cycle. The remainder of the raw water is directed by the main valve 12 through a line 24 into an aspirator valve 20. As the raw water passes through the aspirator valve 20 in this direction a partial vacuum, i.e., a pressure less than atmospheric pressure, is created therein and in a line 26 which communicates with the aspirator valve 20, a brine tank 28 and an acid dispenser 30 embodying the features of the present invention. By virtue of the partial vacuum created in the line 26, a predetermined amount of acid solution is drawn from the acid dispenser 30 and brine solution is drawn from the brine tank 28. The acid solution and brine solution pass sequentially through the line 26 into the aspirator valve 20 and through a line 19 to the line 18 and into the tank 16. Suitable valve means (not shown) prevent acid solution and brine solution from passing directly from the line 18 into the main valve 12. After passing upwardly through the bed of resin particles in the tank 16, and thereby regenerating the resin particles, the acid solution and brine solution are passed to drain through a line 31 after passing through the line 14 and the main valve 12. The main valve 12 prevents the raw water from mixing with the brine solution and acid solution. Likewise, the acid solution and brine solution cannot enter the service line 22.

When the regeneration of the resin particles in the tank 16 is complete, the regeneration cycle is terminated by actuating the main valve 12 so that the raw water passes through the line 14, the tank 16, the line 18, the main valve 12, and the service line 22, as discussed hereinbefore. During the service cycle some of the treated

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water passes through the line 19 and the aspirator valve 20 to the line 26 to supply make-up water to the brine tank 28, as is well known in the art. The line 26 has suitable valve means (not shown) in the brine tank 28 to automatically terminate the flow of make-up water to the brine tank 28 after sufficient make-up water has been added thereto. Valve means for this purpose are well known in the art and do not constitute a part of the present invention. The make-up water dissolves solid sodium chloride or the like in the brine tank 28 to form the brine solution utilized in the next regeneration cycle.

As will be more fully explained hereinafter, the high pressure (greater than atmospheric pressure) of the treated water in the line 26 causes the acid dispenser 30 to meter another predetermined amount of acid solution during the service cycle so that the acid dispenser 30 is ready to discharge this acid solution to the line 26 during the regeneration cycle. The partial vacuum or low pressure in the line 26 during the regeneration cycle actuates the acid dispenser 30 whereupon it dispenses the predetermined amount of acid solution which has been metered during the service cycle.

The main valve 12 does not constitute a part of the present invention and suitable valves for this purpose are well known in the art, e.g., the main valve disclosed in United States Patent No. 2,999,514, assigned to the assignee of the present application. Another suitable main valve is disclosed in copending application Serial No. 190,995 filed April 30, 1962, and assigned to the assignee of the present application. Similarly, suitable aspirator valves 20 are well known in the art. However, it is preferred in this system to employ an aspirator valve of the type disclosed in copending applications Serial No. 170,043, filed January 31, 1962, now abandoned and Serial No. 191,767, filed May 2, 1962, which are assigned to the assignee of the present application. The system may, of course, be operated manually, automatically or semi-automatically by suitable means (not shown) which do not constitute a part of the present invention.

Referring now to FIGURES 2-4, the acid dispenser 30 embodying the features of the present invention will be discussed in detail. The acid dispenser 30 comprises an acid container 34 and a metering device indicated generally by reference numeral 36. The acid container 34 is, in this instance, a plastic bottle having a neck portion 38, though the container 34 may be made of suitable metal or glass if desired. The container 34 forms an acid reservoir chamber 35 and contains a relatively large supply of a suitable aqueous acid solution, such as citric acid or the like.

The metering device 36 is mounted in the neck portion 38 of the container 34 and extends into the reservoir chamber 35. The metering device 36 comprises a body member 37, made of suitable plastic, metal or the like, having a metering chamber 40 and an outlet chamber 42 interconnected by a passageway 44 and is adapted to be mounted in the neck portion 38 of the acid container 34. To these ends the body member 37 has exterior sealing means 46, such as an O-ring or the like, adapted to engage the interior of the neck portion 38 to prevent acid from leaking between the neck portion 38 and the body member 37. An enlarged end portion 48 of the body member 37 engages the neck portion 38 so that the metering device 36 extends into the acid container 34 a predetermined distance.

The outlet chamber 42, which communicates with the line 26 through a passageway 56 in the body member 37 and a passageway 70 in the line 26, has mounted therein a ball valve 50 biased by a spring 52. The ball valve 50 is biased to engage a valve seat 54 and thereby close the passageway 44 interconnecting the metering chamber 40 with the outlet chamber 42. The passageway 56 allows acid solution to pass from the outlet chamber 42 to the line 26.

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The metering chamber 40 has a floatable ball valve 58 therein. An inlet passageway 60 in the body member 37 connects the reservoir chamber 35 with the metering chamber 40 and communicates with the metering chamber 40 at the end of the chamber 40 opposite from the passageway 44. Acid solution passes from the reservoir chamber 35, through the passageway 60, and into the metering chamber 40. The passageway 60 is in a sleeve member 61 press-fitted or the like into an opening in the body member 37. There is no leakage between the sleeve member 61 and the body member 37. If it is desired to decrease or increase the time for filling the metering chamber 40, the sleeve member 61 may be replaced with another sleeve member having a smaller or larger passageway, respectively. A vent tube 62, which communicates with the metering chamber 40, is attached to the body member 37 and extends outwardly from the metering device 36 to vent air displaced as the metering chamber 40 is being filled with acid solution through the passageway 60. The floatable ball valve 58 is adapted to rise with the level of the acid solution as it fills the metering compartment 40 and will close the passageway 60 and the vent tube 62 when the metering compartment 40 has been substantially filled with acid solution, as shown in dotted lines in FIGURES 2 and 3.

The line 26 has a radially extending, annular flange 64 with a threaded exterior surface. The end portion 48 of the metering device 36 has an annular groove with a threaded portion 66 to threadedly engage the annular flange 64. An annular seal 68 is provided in the end portion 48 of the body member 37 to prevent air and liquid leakage between end portion 48 and the flange 64. In this manner, the metering device 36 may be attached to the flange 64 so that the outlet chamber 42 communicates with the line 26 through the passageway 56 and the passageway 70 in the line 26.

To install the acid dispenser 30, the metering device 36 is inserted into the acid container 34 while the latter is in its upright position, i.e., the neck portion 38 extending upwardly. The metering device 36 is inserted into the container 34 until the enlarged end portion 48 of the body member 36 abuts the neck portion 38. The acid container 34 has a relatively large supply of acid solution therein. The acid dispenser 30 is then turned over to its operating position shown in FIGURES 2-4 and attached to the line 26 by screwing the metering device 36 onto the flange 64. The spring-biased ball valve 50, which is seated on the valve seat 54, prevents acid solution from leaking out the passageway 44 when the acid dispenser 30 is turned over. In addition, the sealing means 46 prevents air and acid leakage between the acid container 34 and the metering device 36 as discussed hereinbefore. A hole 72 is then opened in the bottom of the acid container 34 so that the acid reservoir chamber 35 is vented to the atmosphere. As seen in FIGURES 2 and 4 when the dispenser 30 is turned over into its operative position and attached to the line 26, the level of the acid solution in the reservoir chamber 35 will be above the passageway 60 and below the free end of the vent tube 62.

Assuming that the water softening system is in its service cycle, the line 26 will be under high pressure and the ball valve 50 will be seated on the valve seat 54 so that the passageway 44 is closed. Acid solution will flow by gravity from the reservoir chamber 35 into the metering chamber 40 through the passageway 60. Air displaced from the metering chamber 40 will leave the metering chamber 40 through the vent tube 62. As the acid solution fills the metering chamber 40, the floatable ball valve 58 raises with the level of the acid solution until it closes the passageway 60. In this manner, a predetermined amount of acid solution enters the metering chamber 40.

When the resin particles are ready for regeneration, the regeneration cycle is initiated and the line 26 placed under

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a partial vacuum or low pressure as described hereinbefore. By virtue of the pressure differential between the metering chamber 40 and the outlet chamber 42, the ball valve 50 will unseat against the force of the spring 52, as shown in FIGURE 4. When the ball valve 50 unseats, acid solution flows from the metering chamber 40 through the passageway 44, the outlet chamber 42, and the passageway 56 into the passageway 70 and the line 26. The flow of acid solution continues until the floatable ball valve 58 closes the passageway 44 by resting on a valve seat 74.

The discharge of the acid solution from the metering chamber 40 is relatively rapid and only a small amount of acid solution will enter the metering chamber 40 during acid discharge if the passageway 60 is small, as in this instance. Accordingly, the amount of acid solution dispensed to the line 26 is essentially the volume of the metering chamber 40. However, as discussed hereinbefore, the size of the passageway 60 may be varied to allow a greater amount of acid solution to enter the metering compartment 40 during discharge and this additional acid solution will simultaneously be dispensed to the line 26. In any event, with a given passageway 60 the amount of acid solution dispensed in each regeneration cycle will be substantially constant and not less than approximately the volume of the metering chamber 40. Of course, the passageway 60 cannot be so large that acid solution enters the metering chamber 40 faster than it is withdrawn from the metering chamber 40 through the passageway 44.

The floatable ball valve 58 seats on the valve seat 74 when there is a small amount of acid solution left in the metering chamber 40, as shown in FIGURE 4. In this manner, gas may not be drawn into the system through the passageway 44. Furthermore, the partial vacuum in the line 26 during the regeneration cycle prevents the floatable ball valve 58 from unseating, even though acid solution continues to enter the metering chamber 40, until the service cycle begins and the ball valve 50 has seated on the valve seat 54.

After the regeneration cycle has been completed, the service cycle is initiated again. The line 26 is again placed under a high pressure, causing the ball valve 50 to seat on the valve seat 54 and the ball valve 58 to unseat. The metering chamber 40 fills up with acid solution in the manner described hereinbefore and the cycle is repeated.

When the level of the acid solution in the reservoir chamber 35 approaches the level of the passageway 60 additional acid solution must be added to the reservoir chamber 35, for example, through the vent opening 72. In the alternative, the acid dispenser 30 may be removed and the metering device 36 placed in another acid container. The metering device 36 and the other acid container are then connected to the line 26 in the same manner as the acid dispenser 30.

Although the ball valve 50 has been described and illustrated as a spring-biased ball valve, any one-way valve which will open at low pressure and close at high pressure may be employed. Such valves are well known in the art and the selection of a suitable valve means to be substituted for the ball valve 50 would be within the ordinary skill of one in the art.

It will be understood that by altering the piping from the aspirator valve 20 the resin particles in the tank 16 may be contacted simultaneously with acid solution and brine solution. In such instances, the acid solution and brine solution are mixed in the aspirator valve 20 or in a line connected thereto as the acid solution and brine solution travel to the resin tank 16.

Though the dispenser 30 has been discussed in detail with respect to dispensing acid solution, it may be used to dispense any liquid by constructing its parts of suitable material.

While the embodiment described herein is at present considered to be preferred, it will be understood that

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various modifications and improvements may be made therein and it is intended to cover in the appended claims all such modifications and improvements as fall within the true spirit and scope of the invention.

What is claimed is:

1. A metering device comprising a body member having a metering chamber therein to receive liquid from a reservoir chamber, said metering chamber having a floatable valve means therein, said body member having an outlet passageway communicating with said metering chamber, said outlet passageway having a normally closed valve means therein openable under a predetermined pressure differential, said valve means preventing liquid from flowing into said metering chamber from said outlet passageway and allowing liquid to flow from said metering chamber to said outlet passageway when said pressure differential between said metering chamber and said outlet passageway opens said valve means.

2. The metering device of claim 1 wherein said body member has a second passageway to allow liquid to flow into said metering chamber, said floatable valve means closing said second passageway when said metering chamber has been substantially filled with liquid.

3. The metering device of claim 1 wherein said body member has an end adapted to be inserted into a liquid container and another end adapted to be connected to a line so that said outlet passageway communicates with said line.

4. The metering device of claim 2 wherein said floatable valve means closes said outlet passageway when said metering chamber is substantially without liquid.

5. A liquid dispenser comprising a container means for a liquid and a metering device, said metering device including a body member having a metering chamber therein to receive liquid from said container means, said metering chamber having a floatable valve means therein, said body member having an outlet passageway communicating with said metering chamber, said outlet passageway having a normally closed valve means therein openable under a predetermined pressure differential, said valve means in said outlet passageway preventing liquid from flowing into said metering chamber from said outlet passageway and allowing liquid to flow from said metering chamber to said outlet passageway when said pressure differential between said metering chamber and said outlet passageway opens said valve means.

6. The liquid dispenser of claim 5 wherein said body member cooperates with said container means to prevent liquid leakage between said body member and said container means.

7. The liquid dispenser of claim 6 wherein said body member has a second passageway to allow liquid to flow into said metering chamber from said container means, said floatable valve means closing said second passageway when said metering chamber has been substantially filled with liquid.

8. The liquid dispenser of claim 7 wherein said body member has an end extending from said container means which is adapted to be connected to a line to which liquid is dispensed from said metering chamber.

9. A liquid dispenser comprising a container means for a liquid and a metering device, said metering device including a body member extending into said liquid container means, said body member having first and second end portions, a metering chamber in said first end portion and an outlet chamber in said second end portion, said outlet chamber and metering chamber being connected by a first passageway, a second passageway in said body member to connect said metering chamber with said container means, a floatable valve means in said metering chamber which closes said second passageway when said metering chamber is substantially full of said liquid and closes said first passageway when said metering chamber is substantially empty of said liquid, a valve means

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mounted in said outlet chamber, said valve means including means for closing said first passageway when said outlet chamber is under a high pressure and opening said first passageway when said outlet chamber has a low pressure.

10. The dispensing device of claim 9 wherein said second end portion has means for attaching said dispensing device to a line, said outlet chamber communicating with said line so that said liquid from said metering chamber passes to said line.

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References Cited by the Examiner

UNITED STATES PATENTS

1,698,890	1/1929	McGill	210—206
1,905,726	4/1933	Lindsay	210—190
2,627,503	2/1953	Anderson	210—190
2,895,652	7/1959	Rockriver	222—442
3,039,655	6/1962	Pfeuffer	222—133
3,049,266	8/1962	Werry	222—133
3,072,302	1/1963	Giouannoni et al.	222—442

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