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(54) **WATER SOFTENER APPARATUS**

WASSER-WEICHSPULERGERAT

APPAREIL ADOUCISSEUR D'EAU

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(56) References cited:
JP-A- 2003 001 249
US-A- 3 509 998
US-A- 4 539 106
US-A- 5 310 488
US-A1- 2009 090 662
US-A1- 2011 284 434

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Description

Field of the Invention.

[0001] The invention relates to a water softener apparatus comprising a water softener component which has to be rendered inoperable to soften water at intervals, for example, so that the component can be regenerated.

Background of the Invention.

[0002] The invention relates to a water softener comprising an active resin water softening component that has to be regenerated occasionally by passing brine through it. Whilst the component is being regenerated it is inoperable to supply softened water. In known domestic water softeners, this problem is ameliorated by arranging for regeneration to take place at a time of likely low demand, for example during the very early morning. Also known are water softeners comprising two softening components which are regenerated during respective different time intervals so that at least one of them is operable all the time, for example as disclosed in US Patent No. 5,273, 070. The apparatus according to this patent comprises an electrically motorised valve arrangement controlled by a microprocessor which is programmed to sequence the operations of the valve arrangement. However, this requires an electrical supply to the water softener which, in some cases, may be inconvenient and/or which may add to the cost of installation of the softener.

[0003] US Patent No. 5,681,454 discloses water treatment apparatus having several water treatment components all but one of which are coupled to respective pressure-controlled valves. The apparatus is intended for use where the demand for treated water may vary, e.g. because different numbers of consumers are using it at any one time, but where each component is most efficient over a particular range of throughput. Accordingly, the valves operate to bring different numbers of the components into operation depending on the demand level. Pressure operated valves are used so as to avoid the need for electronic metering.

[0004] Applicant's own prior patent GB2,363,114 discloses a water softener apparatus comprising two water softener tanks and valve means for causing said two tanks to be rendered inoperable to soften water at respective different intervals so that at least one tank is operable all the time, wherein said valve means comprises water-flow controlled valve means and the apparatus includes a water driven flow-meter for controlling said valve means. A regeneration meter measures a pre-set volume of softened water considered necessary to regenerate either of said two tanks.

[0005] Each of US2011/284434, US5310488 and US4539106 teach respective water treatment/softening apparatuses in which a regeneration meter measures a volume of clean or softened water used to regenerate a water softener component.

Objects of the Invention.

[0006] An object of the invention is to mitigate or obviate to some degree one or more problems associated with known water softener apparatuses.

[0007] The above object is met by the combination of features independent claim 1; ; the sub-claims disclose further advantageous embodiments of the invention.

[0008] Another object of the invention is to mitigate or obviate to some degree one or more problems associated with using a regeneration meter to measure a pre-set volume of softened water considered necessary to regenerate a water softener tank.

[0009] One skilled in the art will derive from the following description other objects of the invention. Therefore, the foregoing statements of object are not exhaustive and serve merely to illustrate some of the many objects of the present invention.

Summary of the Invention.

[0010] The invention provides a water softener apparatus comprising:

two water softener tanks each containing an ion exchange resin for softening water flowing through the water softener tanks and each having an upper port and a lower port, the lower ports of the two water softener tanks being connected to respective chambers of a shuttle valve providing a supply of water to be softened from a water supply connection of the shuttle valve, the shuttle valve also having a connection to a drain, the upper ports of the two water softener tanks being connected via respective check valves to a common input of a water-driven service meter with an output of said water-driven service meter leading via a softened water outlet pipe to a softened water outlet of the water softener apparatus; a brine tank and a brine valve connected to an injection input of an injector which has an input port connected to the softened water outlet pipe and an outlet port leading via further respective check valves to the upper ports of the two water softener tanks, the injector being shaped to cause brine from the brine tank to be sucked into the injector and mixed with softened water flowing from the outlet port, said softened water being received at the input port of the injector from the softened water outlet pipe; the water-driven service meter configured to control two service valves operable to control the shuttle valve to cause said two water softener tanks to be rendered inoperable to soften water at respective different intervals so that at least one water softener tank is rendered operable all the time; a regeneration system for alternately regenerating said two water softener tanks during said respective different inoperable intervals, said regeneration system including a water-driven regeneration meter configured to control two regeneration valves operable to control the shuttle valve to terminate regeneration of said two water softener tanks during said respective different inoperable intervals, the two regeneration valves

being connected to respective control ports of the shuttle valve; wherein the water-driven service meter measures the flow of softened water supplied via a respective one of said service valves such that each time a predetermined quantity of softened water has been supplied, regeneration of a respective one of the two water softener tanks is started; and, during regeneration, the water-driven regeneration meter operates via regeneration valves to set a predetermined quantity of water to pass through the respective one of the two water softener tanks being regenerated; wherein said water-driven regeneration meter is positioned in the apparatus downstream of the output port of the injector where brine for regeneration of the two water softener tanks is injected into the softened water received at the inlet port of the injector such that the brine mixed with the softened water flows to a respective one of the two water softener tanks during its inoperable interval for regeneration of said respective one of the two water softener tanks and such that the water-driven regeneration meter measures a volume of the softened water including the injected brine being used to regenerate the respective one of the two water softener tanks and wherein, after brine injection into the softened water terminates, the softened water continues to flow through the injector and the water-driven regeneration meter during a remaining period of the respective one of the two water softener components' inoperable interval to flush any residual brine from the water-driven regeneration meter and the respective one of the two water softener tanks to exit the drain of the water softener apparatus.

Brief Description of the Drawings.

[0011] The foregoing and further features of the present invention will be apparent from the following description of preferred embodiments which are provided by way of example only in connection with the accompanying figures, of which:

Figure 1 is a simplified diagram showing the components of a water softener and the connections therebetween;

Figures 2 and 3 are two diagrams for explaining the construction and operation of a shuttle valve used in the Figure 1 water softener;

Figures 4 and 5 are two diagrams for explaining the construction and operation of a service meter used in the Figure 1 softener;

Figures 6 and 7 are two diagrams for explaining the construction and operation of a regeneration meter used in the Figure 1 softener; and

Figures 8 and 9 are two diagrams for explaining the construction and operation of a brine tank and valve used in the Figure 1 water softener.

Description of Preferred Embodiments.

[0012] The following description is of preferred embodiments by way of example only and without limitation to the combination of features necessary for carrying the invention into effect.

[0013] Reference in this specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of the phrase "in one embodiment" in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. Moreover, various features are described which may be exhibited by some embodiments and not by others. Similarly, various requirements are described which may be requirements for some embodiments but not other embodiments.

[0014] The present description illustrates the principles of the present invention. It will thus be appreciated that those skilled in the art will be able to devise various arrangements that, although not explicitly described or shown herein, embody the principles of the invention and are included within its scope.

[0015] Moreover, all statements herein reciting principles, aspects, and embodiments of the invention, as well as specific examples thereof, are intended to encompass both structural and functional equivalents thereof. Additionally, it is intended that such equivalents include both currently known equivalents as well as equivalents developed in the future, i.e., any elements developed that perform the same function, regardless of structure.

[0016] The water softener of Figure 1 comprises two resin tanks 1 and 2. Each tank has a cylindrical central portion 3 and two dome-shaped ends 4 and 5 with, at the centre, a water entry/exit port 6. In one embodiment, the tank is formed in two halves each comprising a dome-shaped end 4 or 5 and half of the cylindrical portion 3. The two halves of the tank are then butt-welded together, i.e. around the centre of the tank. Before this, however, two stainless steel mesh screens 7 are welded into the interior of each half of the tank so that they will separate 4 the dome shaped ends 4 and 5 from the cylindrical portion 3, and this cylindrical portion 3 is filled with the ion exchange resin 8. In use of the water softener, the tanks are positioned upright as shown with water flowing upwards from the port 6 in the lower end 5 of the tank, through the resin 8 and then out of the port 6 in the upper end 4 of the tank when the resin is supplying softened water while, for regeneration, salt water (brine) flows down via port 6 in the upper end 4, through the resin 8, and out of the tank through the port 6 in its lower end.

[0017] It will be appreciated that different embodiments of resin containing water softener tanks may be utilised in embodiments of the invention.

[0018] The ports 6 at the lower ends 5 of the tanks 1 and 2 are connected via respective pipes to respective

ones of two chambers 9 and 10 in a shuttle valve 11 to be described later. The valve 11 also has a connection 12 from the supply of water to the softened, e.g. the water mains, and connections 13 to a drain via a regeneration meter 23, there preferably being a fine debris blocking screen (not shown) fitted at that side of the meter 23 which is nearest the connections 13. The regeneration meter 23 forms part of a regeneration system of the apparatus including also valve means to be described and a service meter 16 to be described.

[0019] The ports 6 at the upper ends 4 of the tanks 1 and 2 are connected via respective check valves 14 and 15 to a common input of the service meter 16. An output of this meter leads via pipe 17 to the softened water outlet of the softener apparatus. This pipe will be connected in use via a union (not shown) to the user's domestic stored water system (not shown).

[0020] The valves 14, 15, 25, 26, 27, 28, 29, 30 are preferably water controlled valves with the advantage that no electrical power supply is required for the apparatus. However, in some embodiments, electrically or electronically controlled valves may be utilised.

[0021] The softener also comprises a brine tank 18 and brine valve 19 connected to an injection input 20 of an injector 21 which also has an input port 22 connected to the softened water outlet pipe 17. An outlet port 24 of the injector 21 leads via respective further check valves 25 and 26 to the ports 6 at the upper ends of the tanks 1 and 2, i.e. so that the port 6 at the top of tank 1 is connected to both cheek valves 14 and 25 while port 6 at the top of tank 2 is connected to check valves 15 and 26. As shown in Figure 9, the injector 21 comprises a duct between the input and output ports 22 and 24 which duct is shaped to provide a restriction and hence a pressure drop when water is flowing through it from pipe 17. This causes brine from the tank 20 to be sucked into the injector 21 and mixed with the softened water flowing from the outlet port 24.

[0022] The service meter 16 is arranged to operate two service valves 27 and 28 while the regeneration meter 23 is similarly coupled to two regeneration valves 29 and 30. The valves 27, 28, 29 and 30 are in turn operable to control the shuttle valve 11. The valve 11 has two control ports 31 and 32. The valve 11 is a servo-valve and its operation is governed by the pressure of water at its two control ports. One port is connected via a suitable conduit, e.g. a relatively narrow bore tube, to an output of the valve 27 and to an output of the valve 29. Meanwhile, the other control input of shuttle valve 11 is connected via a suitable conduit an output of the service valve 28 and an output of the regeneration valve 30.

[0023] The service meter 16 measures the flow of softened water supplied by the water softener. The meter operates the service valves 27 and 28 so that each time a predetermined quantity of softened water has been supplied, regeneration of one of the tanks is started. Similarly, during regeneration, the regeneration meter 23 operates via regeneration valves 29 and 30 to set a predetermined quantity of water to pass through the tank being regenerated. During regeneration, brine from tank 18 is mixed with this water for a time (controlled by the brine valve 19). The position of the regeneration meter 23 is important. Previously, it has been known to position the regeneration meter in the pipe leading from the water outlet pipe 17 to the input port 22 of the injector. However, whilst this has been found to be generally effective, it has been found that the regeneration meter 23 is measuring only softened water being fed to the injector port 22 rather than the amount of softened water with injected brine required to flow through the tank 1, 2 being regenerated. As such, in the present embodiments, the water regeneration meter is preferably positioned in the apparatus at a point downstream of where brine for regeneration of the two water softener components is received into the apparatus, i.e. downstream of the injector 21, such that the regeneration meter 23 measures the volume of softened water and brine being used to regenerate one of the tanks 1, 2. This provides a more accurate operation of the regeneration meter in terminating alternate regeneration of the tanks 1, 2. Unexpectedly, it has been found that positioning the regeneration meter 23 adjacent to the shuttle valve 11 and, more particularly, at the drain provides the advantage that the regeneration meter 23 acts also to ensure all water to the drain is recorded. This in turn ensures that any error state that occurs in any of the valves does not cause excess volume of water to be lost down the drain. In short, the regeneration meter 23 not only operates to terminate alternate regeneration of the tanks 1, 2, but also acts as a fail safe mechanism for the valve means of the apparatus.

[0024] As shown in Figures 4 and 5, softened water from both tanks 1 or 2 enters the meter 16 and passes through the metering chamber 40. This metering chamber contains a piston type water meter which measures accurately the volume of water passing through to the outlet pipe 17. The meter chamber drives the service meter cam 41 via a series of gears 42. One rotation of the service meter cam is equivalent to the pre-set volume of water that may be softened by both resin tanks.

[0025] As the service meter cam 41 rotates anticlockwise the blade 43 on the service cam pushes a blade 44 on the service lever 45 so that the lever 45 moves about the pivot 46 which levers open the service valve 27 enabling a water pressure signal to flow from the meter to the shuttle valve port 29.

[0026] As softened water continues to flow through the meter the blade 24 wipes past the lever blade 43 and closes the service meter valve 'locking in' the water pressure to the shuttle valve port 31. The volume of water required to wipe the blades past each other is less than the pre-set volume of water required to regenerate a resin tank.

[0027] Service lever 45 operates service valve 27 and starts the regeneration of resin tank 1. Similarly, service lever 50 with blade 51 operates service valve 28 and applies a pressure signal to shuttle valve port 32 to start

the regeneration of resin tank 2. The lever blades 44 and 45 are positioned at 180 degrees to each other, therefore, the regeneration of either tank is 50% of the pre-set volume of one rotation of the service meter cam. The pre-set volume may be altered by changing the ratio of the gear chain between the meter chamber and the service cam.

[0028] The regeneration meter 23 measures the pre-set volume of softened water and brine necessary to regenerate either resin tank 1 or 2. After the pre-set volume of regeneration water with brine has passed through the meter it stops the regeneration.

[0029] As shown in Figures 6 and 7, softened water enters the metering chamber 61 of the regeneration meter 23 and flows through the metering chamber 61. This chamber again contains a piston type water meter which accurately measures the volume of water passing through the meter chamber. The meter chamber drives the regeneration cam 62 via a series of gears 63. Half a rotation of the regeneration meter cam is equivalent to the pre-set volume of water with entrained brine necessary to regenerate one resin tank.

[0030] At the start of the regeneration of resin tank 1 the regeneration meter cam 62 is positioned so that regeneration lever 64 is 'free' and therefore regeneration valve 29 is closed. This 'locks in' the pressure signal from the service valve 27 which opens drain shuttle valve port 31. The regeneration meter cam has pushed open the regeneration valve 30 via lever 65, this prevents resin tank 2 from regenerating at the same time as resin tank 1 by venting any pressure signal to drain shuttle valve port 32.

[0031] As regeneration water with brine passes through the regeneration meter 23 the cam 62 rotates clockwise until, at the end of the regeneration, the lever blade 68 on lever 65 drops off the rear step of the cam 62. Lever 65 is now free to let the spring close valve 30. The cam 62 continues to rotate anticlockwise. The front step 67 of the cam 62 pushes the blade 68 on lever 64 which opens valve 29. Opening valve 29 vents to drain the water pressure holding open drain shuttle valve port 31 so that the drain shuttle A then closes.

[0032] Regeneration lever 64 operates regeneration valve 29 and stops the regeneration of resin tank 1. Regeneration lever 65 operates regeneration valve 30 and stops the regeneration of resin tank 2. The lever blades are positioned at 180 degrees to each other, therefore the volume of regeneration water with brine for each tank is 50% of the pre-set water volume necessary to rotate the regeneration cam once. The pre-set volume may be altered by changing the gear ratio between the meter chamber and the regeneration cam.

[0033] Referring to Figures 2 and 3, the shuttle valve 11 distributes inlet water equally between resin tanks 1 and 2 when both tanks are in service, and diverts hard water to either resin tank 1 or 2 during regeneration. It also enables regeneration water from either resin tank 1 or 2 to flow to drain where such water volume is preferably measured by the regeneration meter 23.

[0034] In the service position hard water flows through the valve to both resin tanks 1 and 2. Drain shuttles 70 and 71 are held closed. The shuttle valve 11 comprises a housing defining chambers connected to the respective resin tanks. A shuttle 72 is mounted in the housing. it comprises a spindle with two pistons 75 and 76 at its ends and a central valve member. The shuttle 72 9 is held in a central position by the springs 73 and 74 which are of equal strength and oppose each other.

[0035] The regeneration of resin tank 1 is started by a water pressure signal from the service valve 27 which opens drain shuttle 70. The path of water to flow to drain is now open, the flow of water to drain now pushing across piston 75 and closing the valve seal on its seat. Hard water can only now flow to resin tank 1 for softening. The regeneration water now flows from resin tank 1 past piston 75 through the open drain shuttle and then to drain.

[0036] When regeneration valve 1 opens the water pressure signal opening drain shuttle 70 is vented to draw in allowing water pressure to push drain shuttle 70 back to the closed position which equalises the water pressure in resin tanks 1 and 2 enabling the shuttle to return to a central service position; hard water again now flows to both resin tanks, that is the shuttle valve has returned to its service position.

[0037] The regeneration of resin tank 2 is the same operation but uses drain shuttle 71 and piston 76 etc.

[0038] As shown in Figures 8 and 9, softened water fills the brine tank 18 via the brine valve 19 until shut off by the brine valve float 80 to a level above the platform 81. The salt 82 is gradually dissolved in the water producing brine.

[0039] During the regeneration of a resin tank softened water flows through the injector 21 from the inlet 22 to the outlet 24 producing a partial vacuum at the suction point in the injector 21 which draws brine from the brine tank as shown. The brine is mixed with the water flowing through the injector which then flows to the resin tank in regeneration and ultimately through the regeneration meter 23.

[0040] Brine continues to be sucked from the brine tank until the brine level stops filling when it reaches the height of the walls of a cup-shaped weir 85. The level continues to fall in the weir chamber 84 until it reaches a point which enables the upper seal 85 to check shut and no more brine is sucked from the brine tank. Water continues to flow through the injector to flush any brine to drain from the resin tank.

[0041] When the softener returns to the service position the brine tank again refills with water until shut off by the brine valve float.

[0042] The amount of brine being capable of being sucked from the brine tank may be adjusted by raising or lowering the brine valve relative to the weir. This raises or lowers the shut off point of the water refilling the brine tank, thus adjusting the volume of brine.

[0043] Placing the meter 23 adjacent to the shuttle

valve 11 and, more particularly, at the drain is such that, in most failure events of excess water to drain, the water is captured and registered by the meter 23 thereby driving the regeneration cam 62 via the series of gears 63. Rotating the regeneration cam 62 via the series of gears 63 opens the regeneration lever 64 which in turn releases the lock pressures on regeneration valves 29, 30 freeing any unwanted back pressure on a diaphragm of the meter 23 from unusual sight conditions or machine malfunctions. Removing the back pressure ensures valves associated with drain are firmly shut and no water is flowing to drain.

[0044] Various modifications may be made to the described apparatus. For example, the weir 85 is optional. Alternative means may be provided for adjustment of the water shut-off point or this point could be fixed rather than adjustable.

[0045] REGENERATION OF TANK 1 After a predetermined volume of water has passed through the softener as recorded by the service meter 16, service valve 27 opens and a pressure water signal is delivered to drain shuttle 70, opening it. The open drain shuttle 70 opens a path for water to flow to the drain. Water in chamber 9 pushes the shuttle 72 across a shown in Figure 3, stopping hard water flow to resin tank 1. All hard water flow is directed to resin tank 2 which softens all the water now passing through the softener. Soft water flows from pipe 17 to the injector 21 which sucks brine from the brine tank via the brine valve. The brine solution passes through the regeneration check valve 25 and into the top of resin tank 1. Service check valve 14 closes, stopping softened water from resin tank 2 from entering resin tank 1. The brine solution flows down through resin tank 1 and regenerates the cation ion exchange resin in the resin tank. The brine solution then passes through chamber 9 and then via the regeneration meter 23 to drain.

[0046] REGENERATION OF TANK 2 After a predetermined volume of water has passed through the softener as recorded by the service meter 16, service valve 28 opens and a pressure water signal is directed to drain shuttle 71, opening it. The open drain shuttle 71 opens a path for water to flow to the drain. Water in chamber 70 pushes the shuttle 72 across as shown in Figure 1, stopping hard water flow to resin tank 1. All hard water flow is directed to resin tank 1 which softens all the water now passing through the softener. Soft water flows from pipe 17 to the injector 21 which sucks brine from the brine tank via the brine valve. The brine solution passes through the regeneration check valve 26 and into the top of 12 resin tank 2. Service check valve 15 closes, stopping softened water from resin tank 1 from entering resin tank 2. The brine solution flows down through resin tank 1 and regenerates the cation ion exchange resin in the resin tank. The brine solution then passes through chamber 10 and then via the regeneration meter 23 to drain.

[0047] In general, the invention provides a water softener apparatus comprising two water softener tanks one of which is always operating, valves controlling the flow of water and a flow-meter, wherein, after a set volume of water has passed through one tank, water is passed through the other tank. The apparatus uses ion-exchange tanks which may be regenerated by brine when not softening hard water. The flow-meter preferably comprises an actuator which moves in a cyclic movement in response to the flow of a set quantity of water and actuates two service valves which send pressured water signals to a drain shuttle valve. The drain shuttle valve then diverts hard water from one tank to another and initiates regeneration of the first tank. A regeneration meter terminates the alternate regeneration of the two tanks. The regeneration meter is positioned in the apparatus downstream of a point where brine for regeneration of the two water softener components is received into the apparatus.

[0048] While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only exemplary embodiments have been shown and described and do not limit the scope of the invention in any manner. It can be appreciated that any of the features described herein may be used with any embodiment. The illustrative embodiments are not exclusive of each other or of other embodiments not recited herein. Modifications and variations of the invention as herein set forth can be made without departing from the scope thereof, and, therefore, only such limitations should be imposed as are indicated by the appended claims.

[0049] In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

[0050] It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art.

Claims

1. A water softener apparatus comprising:

two water softener tanks (1, 2) each containing an ion exchange resin (8) for softening water flowing through the water softener tanks (1, 2) and each having an upper port (6) and a lower port (6), the lower ports (6) of the two water softener tanks (1, 2) being connected to respective chambers (9, 10) of a shuttle valve (11) providing a supply of water to be softened from a water supply connection (12) of the shuttle valve (11), the shuttle valve (11) also having a connection

(13) to a drain, the upper ports (6) of the two water softener tanks (1, 2) being connected via respective check valves (14, 15) to a common input of a water-driven service meter (16) with an output of said water-driven service meter (16) leading via a softened water outlet pipe (17) to a softened water outlet of the water softener apparatus;

a brine tank (18) and a brine valve (19) connected to an injection input (20) of an injector (21) which has an input port (22) connected to the softened water outlet pipe (17) and an outlet port (24) leading via further respective check valves (25, 26) to the upper ports (6) of the two water softener tanks (1, 2), the injector (21) being shaped to cause brine from the brine tank (18) to be sucked into the injector (21) and mixed with softened water flowing from the outlet port (24), said softened water being received at the input port (22) of the injector (21) from the softened water outlet pipe (17);

the water-driven service meter (16) configured to control two service valves (27, 28) operable to control the shuttle valve (11) to cause said two water softener tanks (1, 2) to be rendered inoperable to soften water at respective different intervals so that at least one water softener tank (1,2) is rendered operable all the time;

a regeneration system for alternately regenerating said two water softener tanks (1, 2) during said respective different inoperable intervals, said regeneration system including a water-driven regeneration meter (23) configured to control two regeneration valves (29, 30) operable to control the shuttle valve (11) to terminate regeneration of said two water softener tanks (1, 2) during said respective different inoperable intervals, the two regeneration valves (29, 30) being connected to respective control ports (31, 32) of the shuttle valve (11);

wherein the water-driven service meter (16) measures the flow of softened water supplied via a respective one of said service valves (27, 28) such that each time a predetermined quantity of softened water has been supplied, regeneration of a respective one of the two water softener tanks (1, 2) is started; and, during regeneration, the water-driven regeneration meter (23) operates via regeneration valves (29, 30) to set a predetermined quantity of water to pass through the respective one of the two water softener tanks (1, 2) being regenerated;

wherein said water-driven regeneration meter (23) is positioned in the apparatus downstream of the output port (24) of the injector (21) where brine for regeneration of the two water softener tanks (1, 2) is injected into the softened water received at the inlet port (22) of the injector (21) such that the brine mixed with the softened water flows to a respective one of the two water softener tanks (1, 2) during its inoperable interval for regeneration of said respective one of the two water softener tanks (1, 2) and such that the water-driven regeneration meter (23) measures a volume of the softened water including the injected brine being used to regenerate the respective one of the two water softener tanks (1, 2) and wherein, after brine injection into the softened water terminates, the softened water continues to flow through the injector (21) and the water-driven regeneration meter (23) during a remaining period of the respective one of the two water softener components' inoperable interval to flush any residual brine from the water-driven regeneration meter (23) and the respective one of the two water softener tanks (1, 2) to exit the drain of the water softener apparatus.

2. The water softener apparatus according to claim 1, wherein the two service valves (27, 28) and the two regeneration valves (29, 30) are water-flow controlled valves.

3. The water softener apparatus according to claim 1 or claim 2, wherein said water-driven service meter (16) is arranged to initiate alternate regeneration of said two water softener tanks (1, 2) during said respective different inoperable intervals.

4. The water softener apparatus according to any one of claims 1 to 3, wherein the regeneration meter (23) is connected to the shuttle valve (11) by the drain connection (13).

5. The water softener apparatus according to any one of claims 1 to 4, wherein the water-driven service meter (16) comprises a movable actuator member arranged for cyclic movement in response to the flow of a predetermined quantity of softened water supplied by one of the two water softener tanks (1, 2) wherein said two regeneration valves (29, 30) are actuated by said actuator member at respective different positions in its cycle of movement, said two regeneration valves (29, 30) being operable when so actuated for initiating said regeneration.

6. The water softener apparatus according to any one of claims 1 to 4, wherein the regeneration meter (23) comprises a movable actuator member arranged for cyclic movement in response to the flow of a predetermined quantity of softened water supplied by one of the two water softener tanks (1, 2) wherein said two regeneration valves (29, 30) are actuated by said actuator member at respective different positions in its cycle of movement, said two regeneration valves (29, 30) being operable when so actuated for termi-

nating said regeneration.

Patentansprüche

1. Eine Wasserenthärtungsvorrichtung, bestehend aus:

zwei Wasserenthärtungstanks (1, 2), die jeweils ein Ionenaustauscherharz (8) zum Enthärten von Wasser enthalten, das durch die Wasserenthärtungstanks (1, 2) fließt, und die jeweils eine obere Öffnung (6) und eine untere Öffnung (6) aufweisen, wobei die unteren Öffnungen (6) der beiden Wasserenthärtungstanks (1, 2) mit den jeweiligen Kammern (9, 10) eines Wechselventils (11) verbunden sind, das eine Zufuhr von zu enthärtendem Wasser von einem Wasserversorgungsanschluss (12) des Wechselventils (11) bereitstellt, wobei das Wechselventil (11) auch eine Verbindung zum Abfluss (13) hat, wobei die oberen Öffnungen (6) der beiden Wasserenthärtungstanks (1, 2) über entsprechende Rückschlagventile (14, 15) mit einem gemeinsamen Eingang eines wasserbetriebenen Betriebszählers (16) verbunden sind, wobei ein Ausgang des wasserbetriebenen Betriebszählers (16) über eine Auslassleitung (17) für enthärtetes Wasser zu einem Auslass für enthärtetes Wasser der Wasserenthärtungsvorrichtung führt;

einem Salzwassertank (18) und einem Salzwasserventil (19), das mit einer Einspritzöffnung (20) einer Einspritzvorrichtung (21) verbunden ist, die einen mit der Auslassleitung (17) für enthärtetes Wasser verbundenen Eingangsanschluss (22) und einen Auslassanschluss (24) aufweist, der über weitere jeweilige Rückschlagventile (25, 26) zu den oberen Öffnungen (6) der beiden Wasserenthärtungstanks (1, 2) führt, wobei die Einspritzvorrichtung (21) so geformt ist, dass sie bewirkt, dass Salzwasser aus dem Salzwassertank (18) in die Einspritzvorrichtung (21) gesaugt und mit enthärtetem Wasser, das aus dem Auslassanschluss (24) fließt, gemischt wird, wobei das enthärtete Wasser am Eingangsanschluss (22) der Einspritzvorrichtung (21) von der Auslassleitung (17) für enthärtetes Wasser empfangen wird;

dem wasserbetriebenen Betriebszähler (16), der so konfiguriert ist, dass er zwei Betriebsventile (27, 28) steuert, die so betätigt werden können, dass sie das Wechselventil (11) steuern, um zu bewirken, dass die beiden fraglichen Wasserenthärtungstanks (1, 2) inaktiv werden, damit Wasser in jeweils unterschiedlichen Intervallen enthärtet werden kann, damit mindestens ein Wasserenthärtungstank (1, 2) die ganze Zeit über aktiv bleibt;

einem Regenerationssystem zum abwechselnden Regenerieren der beiden Wasserenthärtungstanks (1, 2) während der jeweiligen unterschiedlichen inaktiven Intervalle, wobei das Regenerationssystem ein wasserbetriebenes Regenerationsmessgerät (23) enthält, das so konfiguriert ist, dass es zwei Regenerationsventile (29, 30) steuert, die so betätigt werden können, dass sie das Wechselventil (11) steuern, um die Regeneration der beiden Wasserenthärtungstanks (1, 2) während der jeweils unterschiedlichen inaktiven Intervalle zu beenden, wobei die beiden Regenerationsventile (29, 30) mit den jeweiligen Steueranschlüssen (31, 32) des Wechselventils (11) verbunden sind;

wobei der wasserbetriebene Betriebszähler (16) den Strom von enthärtetem Wasser misst, der über das jeweils relevante der Betriebsventile (27, 28) zugeführt wird, sodass jedes Mal, wenn eine vorbestimmte Menge an enthärtetem Wasser zugeführt wurde, die Regeneration des jeweils relevanten der beiden Wasserenthärtungstanks (1, 2) eingeleitet wird; während der Regeneration stellt das wasserbetriebene Regenerationsmessgerät (23) über die Regenerationsventile (29, 30) zugleich die vorbestimmte Wassermenge ein, die durch den jeweils relevanten der beiden Wasserenthärtungstanks (1, 2), der gerade regeneriert wird, fließt;

wobei das wasserbetriebene Regenerationsmessgerät (23) in der Vorrichtung stromabwärts vom Auslassanschluss (24) der Einspritzvorrichtung (21) angeordnet ist, wo Salzwasser für die Regeneration der beiden Wasserenthärtungstanks (1, 2) in das enthärtete Wasser eingespritzt wird, das am Eingangsanschluss (22) der Einspritzvorrichtung (21) empfangen wird, sodass das mit dem enthärteten Wasser gemischte Salzwasser zu dem jeweils relevanten der beiden Wasserenthärtungstanks (1, 2) während seines inaktiven Intervalls zur Regeneration des jeweils relevanten der beiden Wasserenthärtungstanks (1, 2) fließt und so, dass das wasserbetriebene Regenerationsmessgerät (23) ein Volumen des enthärteten Wassers einschließlich des eingespritzten Salzwassers misst, das zur Regeneration des jeweils relevanten der beiden Wasserenthärtungstanks (1, 2) verwendet wird, und in welchem nach Beendigung der Salzwassereinspritzung in das enthärtete Wasser das enthärtete Wasser weiterhin durch die Einspritzvorrichtung (21) und das wasserbetriebene Regenerationsmessgerät (23) während eines verbleibenden Zeitraums des inaktiven Intervalls der jeweils relevanten der beiden Wasserenthärtungskomponenten fließt, um jegliche Salzwasserreste aus dem

wasserbetriebenen Regenerationsmessgerät (23) und dem jeweils relevanten der beiden Wasserenthärtungstanks (1, 2) zum Abfluss der Wasserenthärtungsvorrichtung zu spülen.

2. Die Wasserenthärtungsvorrichtung nach Anspruch 1, wobei die beiden Betriebsventile (27, 28) und die beiden Regenerationsventile (29, 30) wasserdurchflussgesteuerte Ventile sind.

3. Die Wasserenthärtungsvorrichtung nach Anspruch 1 oder Anspruch 2, wobei der wasserbetriebene Betriebszähler (16) so angeordnet ist, dass er eine abwechselnde Regeneration der beiden Wasserenthärtungstanks (1, 2) während der jeweiligen unterschiedlichen inaktiven Intervalle einleitet.

4. Die Wasserenthärtungsvorrichtung nach einem der Ansprüche 1 bis 3, wobei das Regenerationsmessgerät (23) über die Verbindung zum Abfluss (13) mit dem Wechselventil (11) verbunden ist.

5. Die Wasserenthärtungsvorrichtung nach einem der Ansprüche 1 bis 4, wobei der wassergetriebene Betriebszähler (16) ein bewegliches Betätigungselement aufweist, das für eine zyklische Bewegung als Reaktion auf den Fluss einer vorbestimmten Menge an enthärtetem Wasser angeordnet ist, die von einem der beiden Wasserenthärtungstanks (1, 2) zugeführt wird, wobei die beiden Regenerationsventile (29, 30) durch das Betätigungselement an den jeweiligen unterschiedlichen Positionen in seinem Bewegungszyklus betätigt werden, wobei die beiden Regenerationsventile (29, 30) zur Einleitung der Regeneration aktiv werden, wenn sie auf diese Weise betätigt wurden.

6. Die Wasserenthärtungsvorrichtung nach einem der Ansprüche 1 bis 4, wobei das Regenerationsmessgerät (23) ein bewegliches Betätigungselement aufweist, das für eine zyklische Bewegung als Reaktion auf den Fluss einer vorbestimmten Menge an enthärtetem Wasser angeordnet ist, die von einem der beiden Wasserenthärtungstanks (1, 2) zugeführt wird, wobei die beiden Regenerationsventile (29, 30) durch das Betätigungselement an den jeweiligen unterschiedlichen Positionen in seinem Bewegungszyklus betätigt werden, wobei die beiden Regenerationsventile (29, 30) zur Beendigung der Regeneration aktiv werden, wenn sie auf diese Weise betätigt wurden.

Revendications

1. Un appareil adoucisseur d'eau comprenant :

deux réservoirs d'adoucisseur d'eau (1, 2) contenant chacun une résine échangeuse d'ions (8) pour adoucir l'eau circulant à travers les réservoirs d'adoucisseur d'eau (1, 2) et ayant chacun un orifice supérieur (6) et un orifice inférieur (6), les orifices inférieurs (6) des deux réservoirs d'adoucisseur d'eau (1, 2) étant connectés à des chambres respectives (9, 10) d'un clapet-navette (11) fournissant une alimentation d'eau à adoucir à partir d'une connexion d'alimentation d'eau (12) du clapet-navette (11), le clapet-navette (11) ayant également une connexion (13) à un drain, les orifices supérieurs (6) des deux réservoirs d'adoucisseur d'eau (1, 2) étant connectés par des clapets anti-retour respectifs (14, 15) à une entrée commune d'un compteur de service actionné par l'eau (16) avec une sortie dudit compteur de service actionné par l'eau (16) menant par l'intermédiaire d'un tuyau de sortie d'eau adoucie (17) à une sortie d'eau adoucie de l'appareil adoucisseur d'eau ;
un réservoir de saumure (18) et une vanne de saumure (19) connectée à une entrée d'injection (20) d'un injecteur (21) doté d'un orifice d'entrée (22) connecté au tuyau de sortie d'eau adoucie (17) et un orifice de sortie (24) menant par l'intermédiaire d'autres clapets anti-retour respectifs (25, 26) aux orifices supérieurs (6) des deux réservoirs d'adoucisseur d'eau (1, 2), l'injecteur (21) étant formé pour que la saumure du réservoir de saumure (18) soit aspirée dans l'injecteur (21) et mélangée avec l'eau adoucie s'écoulant de l'orifice de sortie (24), ladite eau adoucie étant reçue à l'orifice d'entrée (22) de l'injecteur (21) depuis le tuyau de sortie d'eau adoucie (17) ;
le compteur de service actionné par l'eau (16) configuré pour commander deux vannes de service (27, 28) utilisables pour commander le clapet-navette (11) afin de rendre lesdits deux réservoirs d'adoucisseur d'eau (1, 2) inutilisables pour adoucir l'eau à différents intervalles respectifs de façon à ce qu'au moins un réservoir d'adoucisseur d'eau (1,2) soit rendu utilisable à tout moment ;
un système de régénération pour régénérer alternativement lesdits deux réservoirs d'adoucisseur d'eau (1, 2) lors desdits différents intervalles inutilisables respectifs, ledit système de régénération comportant un compteur de régénération actionné par l'eau (23) configuré pour commander deux vannes de régénération (29, 30) utilisables pour commander le clapet-navette (11) afin de faire cesser la régénération desdits deux réservoirs d'adoucisseur d'eau (1, 2) lors desdits différents intervalles inutilisables respectifs, les deux vannes de régénération (29, 30) étant connectées aux orifices de régulation respectifs (31, 32) du clapet-navette (11) ;

dans lequel le compteur de service actionné par l'eau (16) mesure le débit d'eau adoucie fourni par l'intermédiaire d'une vanne respective desdites vannes de service (27, 28) de telle façon qu'à chaque fois qu'une quantité prédéterminée d'eau adoucie a été fournie, la régénération d'un réservoir respectif des deux réservoirs d'adoucisseur d'eau (1, 2) est démarré ; et, lors de la régénération, le compteur de régénération actionné par l'eau (23) fonctionne par l'intermédiaire des vannes de régénération (29, 30) pour régler le passage d'une quantité prédéterminée d'eau à travers un réservoir respectif des deux réservoirs d'adoucisseur d'eau (1, 2) en cours de régénération ;
dans lequel ledit compteur de régénération actionné par l'eau (23) est positionné dans l'appareil en aval de l'orifice de sortie (24) de l'injecteur (21) où la saumure pour la régénération des deux réservoirs d'adoucisseur d'eau (1, 2) est injectée dans l'eau adoucie reçue à l'orifice d'entrée (22) de l'injecteur (21) de façon à ce que la saumure mélangée avec l'eau adoucie s'écoule dans un réservoir respectif des deux réservoirs d'adoucisseur d'eau (1, 2) lors de son intervalle inutilisable pour la régénération dudit réservoir respectif des deux réservoirs d'adoucisseur d'eau (1, 2) et de façon à ce que le compteur de régénération actionné par l'eau (23) mesure un volume d'eau adoucie y compris la saumure injectée utilisée pour régénérer le réservoir respectif des deux réservoirs d'adoucisseur d'eau (1, 2) et dans lequel, après que l'injection de saumure dans l'eau adoucie ait cessé, l'eau adoucie continue à s'écouler à travers l'injecteur (21) le compteur de régénération actionné par l'eau (23) lors d'une période restante de l'intervalle inutilisable du composant respectif des deux composants d'adoucisseur d'eau pour rincer toute saumure résiduelle du compteur de régénération actionné par l'eau (23) et le réservoir respectif des deux réservoirs d'adoucisseur d'eau (1, 2) pour évacuer le drain de l'appareil adoucisseur d'eau.

2. Appareil adoucisseur d'eau selon la revendication 1, dans lequel les deux vannes de service (27, 28) et les deux vannes de régénération (29, 30) sont des vannes contrôlées par le débit d'eau.

3. Appareil adoucisseur d'eau selon la revendication 1 ou la revendication 2, dans lequel ledit compteur de service actionné par l'eau (16) est configuré pour initialiser la régénération alternative desdits deux réservoirs d'adoucisseur (1, 2) lors desdits différents intervalles inutilisables respectifs.

4. Appareil adoucisseur d'eau selon l'une quelconque des revendications de 1 à 3, dans lequel le compteur de régénération (23) est connecté au clapet-navette (11) par la connexion à un drain (13).

5. Appareil adoucisseur d'eau selon l'une quelconque des revendications de 1 à 4, dans lequel le compteur de service actionné par l'eau (16) comprend un élément actionneur mobile prévu pour un mouvement cyclique en réponse au débit d'une quantité prédéterminée d'eau adoucie fournie par l'un des deux réservoirs d'adoucisseur d'eau (1, 2) dans lequel deux vannes de régénération (29, 30) sont actionnées par ledit élément actionneur à différentes positions respectives dans son cycle de mouvement, lesdites deux vannes de régénération (29, 30) étant utilisables lorsqu'ainsi actionnées pour initialiser ladite régénération.

6. Appareil adoucisseur d'eau selon l'une quelconque des revendications de 1 à 4, dans lequel le compteur de régénération (23) comprend un élément actionneur mobile prévu pour un mouvement cyclique en réponse au débit d'une quantité prédéterminée d'eau adoucie fournie par l'un des deux réservoirs d'adoucisseur d'eau (1, 2) dans lequel deux vannes de régénération (29, 30) sont actionnées par ledit élément actionneur à différentes positions respectives dans son cycle de mouvement, lesdites deux vannes de régénération (29, 30) étant utilisables lorsqu'ainsi actionnées pour faire cesser ladite régénération.

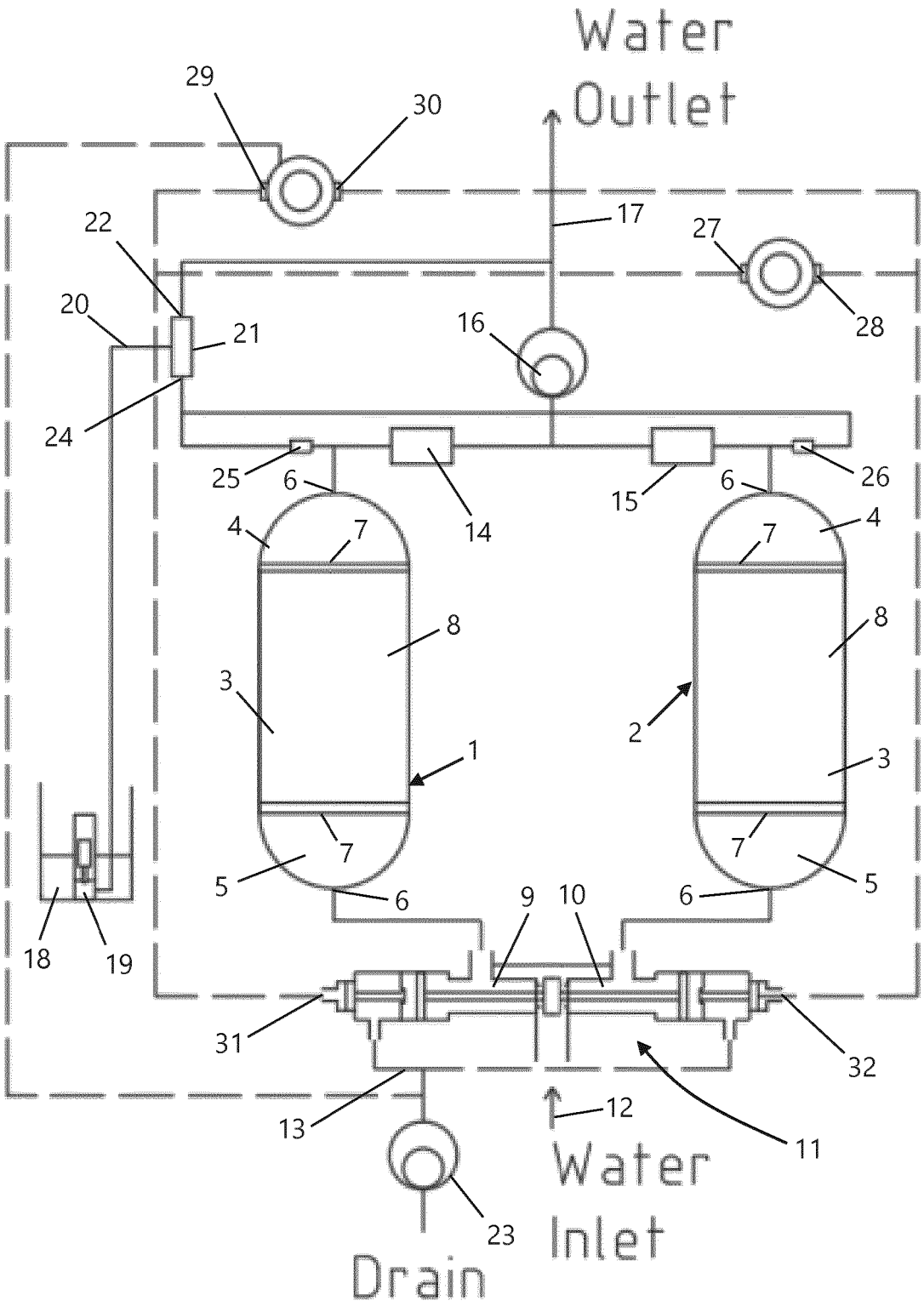
Water
Outlet
29
30
17
22
27
20
21
16
28
24
25
6
14
15
6
26
4
7
7
4
8
8
3
2
1
3
7
7
5
6
6
5
9
10
18
19
31
32
13
12
11
Water
Inlet
23
Drain

FIG. 1

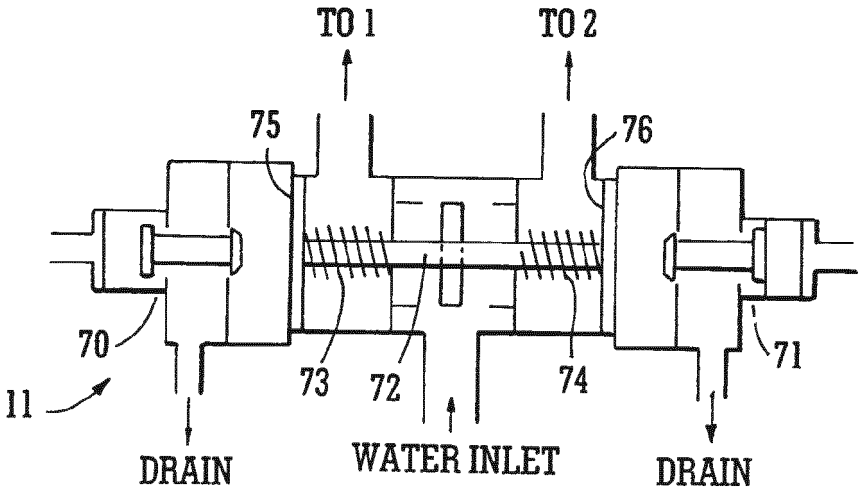
TO 1
TO 2
75
76
70
73
72
74
71
11
DRAIN
WATER INLET
DRAIN

FIG. 2

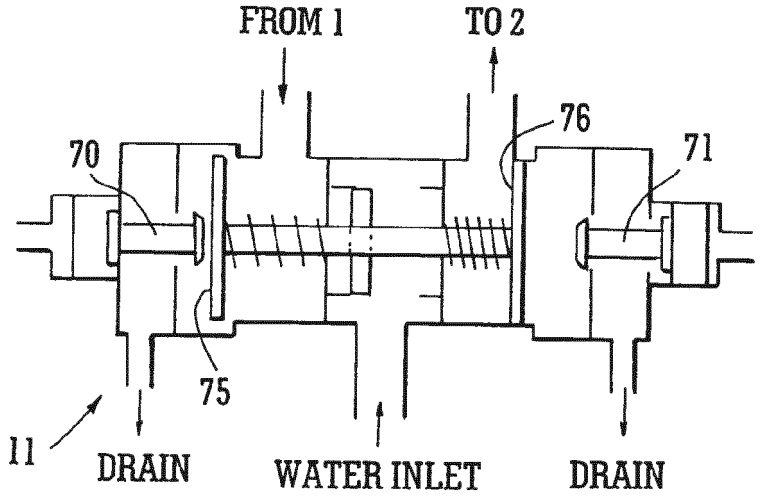
FROM 1
TO 2
76
70
71
75
11
DRAIN
WATER INLET
DRAIN

FIG. 3

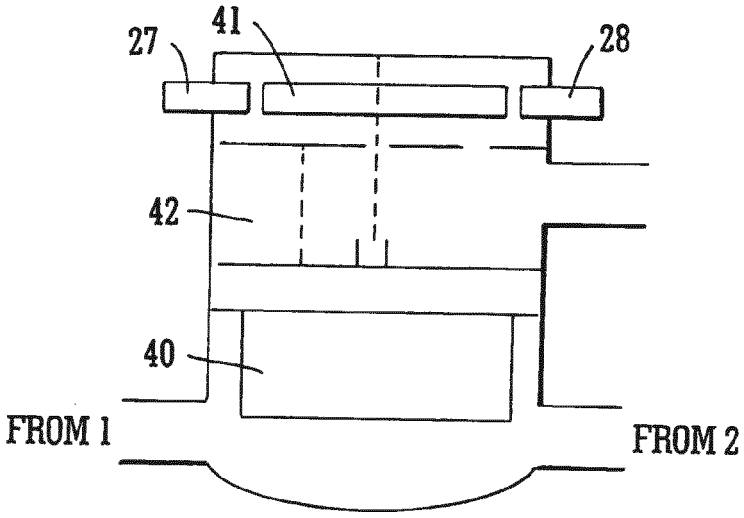

FIG. 4

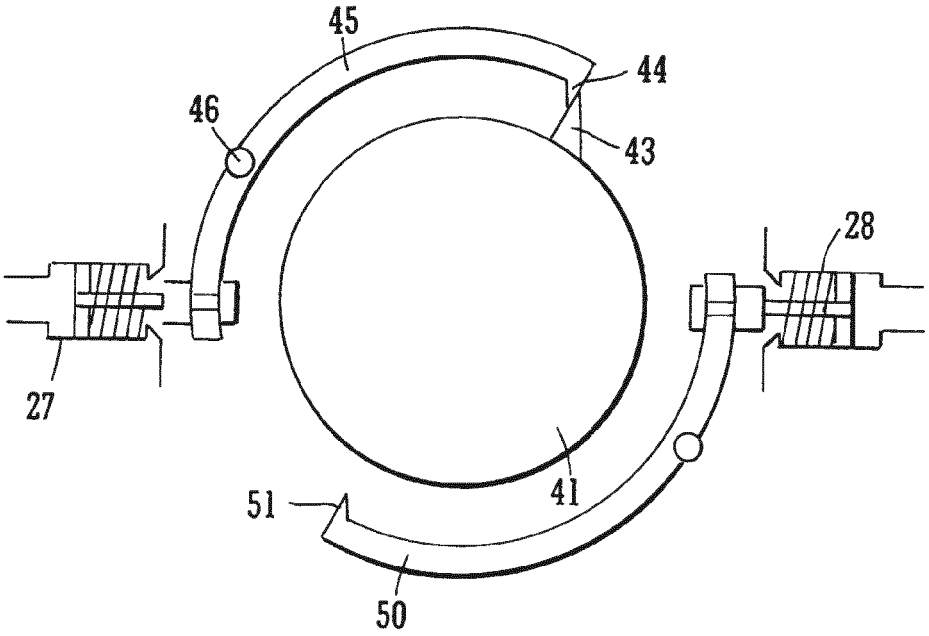

FIG. 5

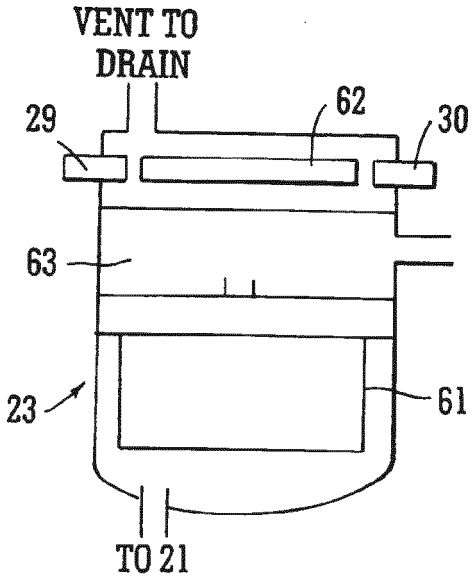

FIG. 6

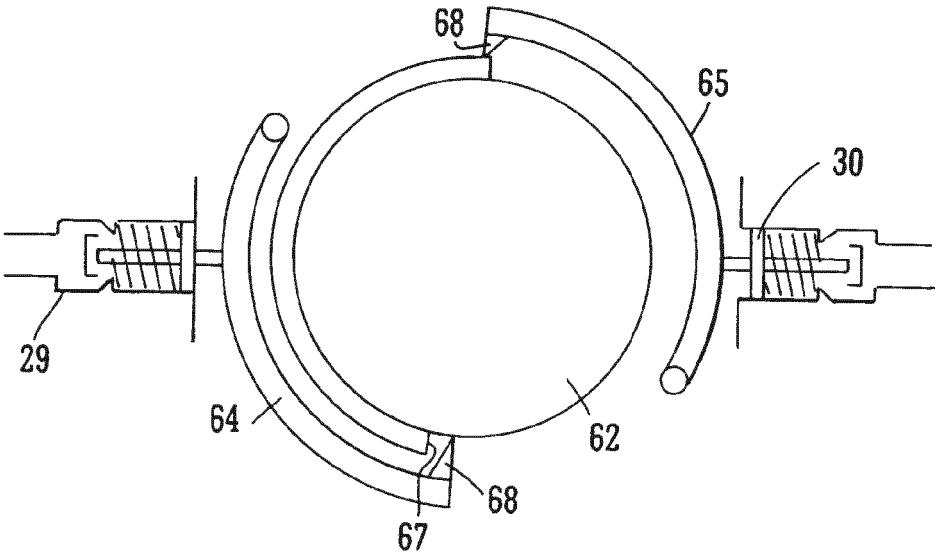

FIG. 7

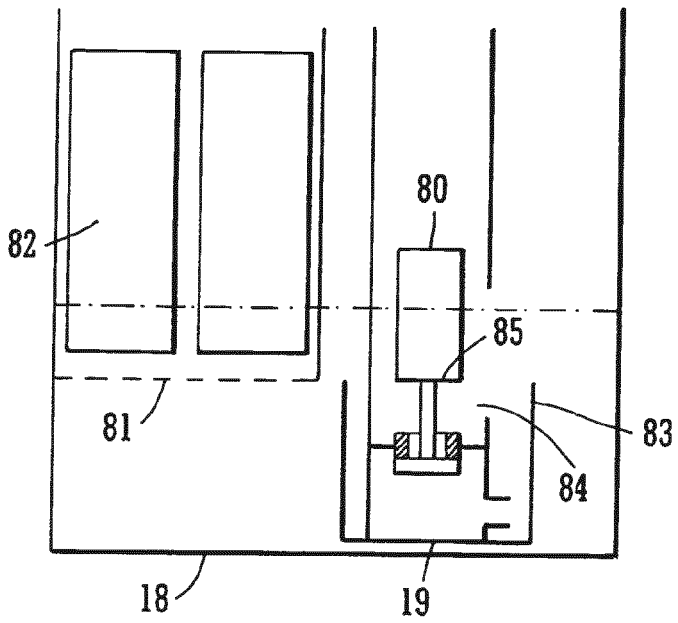

FIG. 8

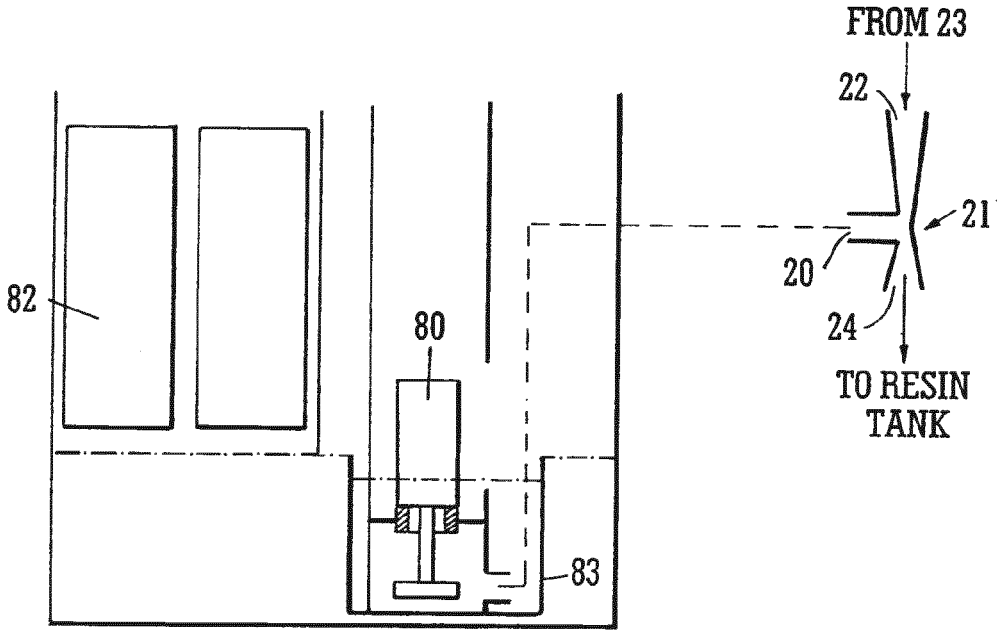

FIG. 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5273070 A **[0002]**
- US 5681454 A **[0003]**
- GB 2363114 A **[0004]**
- US 2011284434 A **[0005]**
- US 5310488 A **[0005]**
- US 4539106 A **[0005]**