

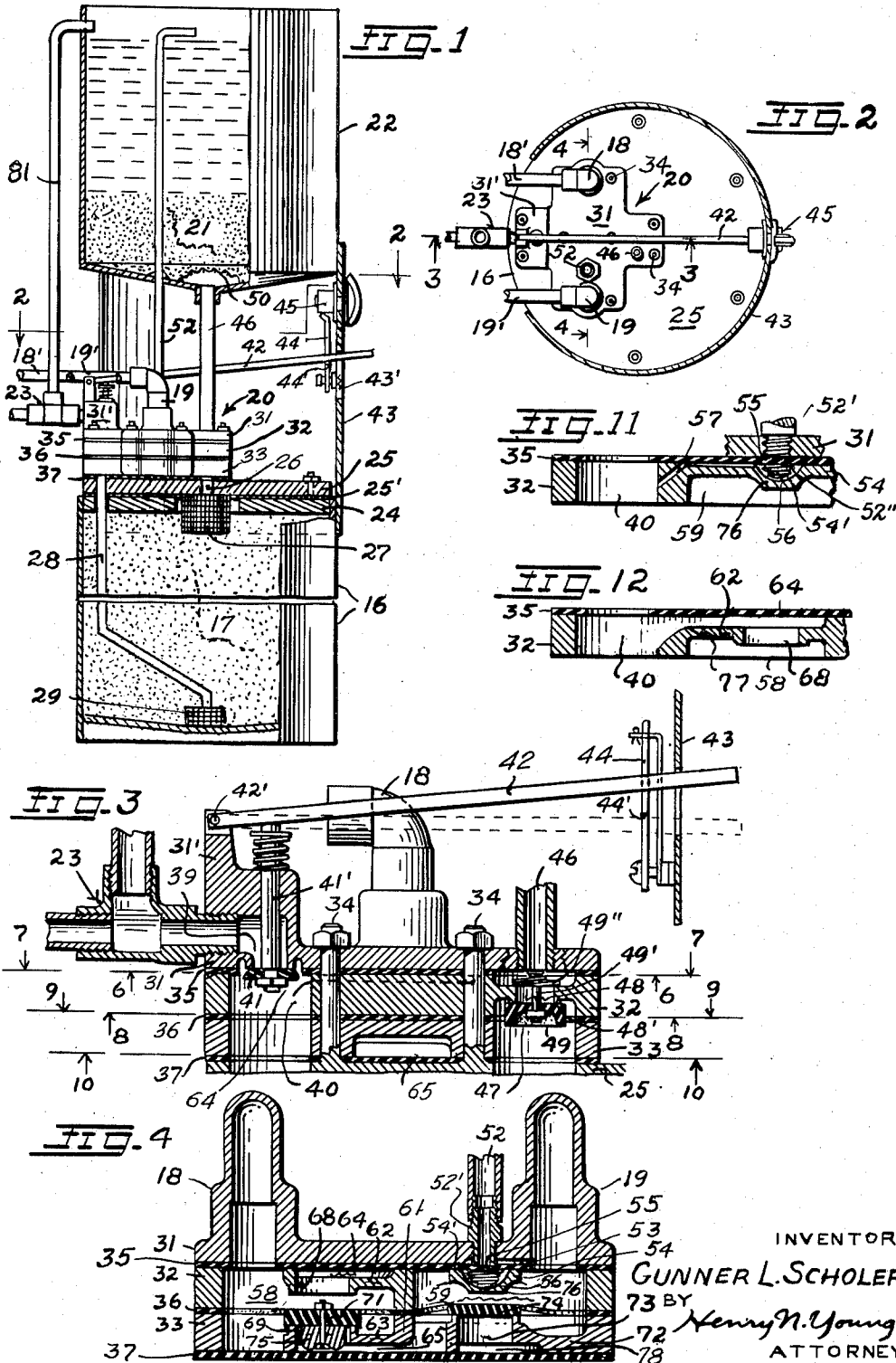
April 29, 1958

G. L. SCHOLER
LIQUID TREATING UNIT

2,832,373

Filed Jan. 22, 1954

3 Sheets-Sheet 1



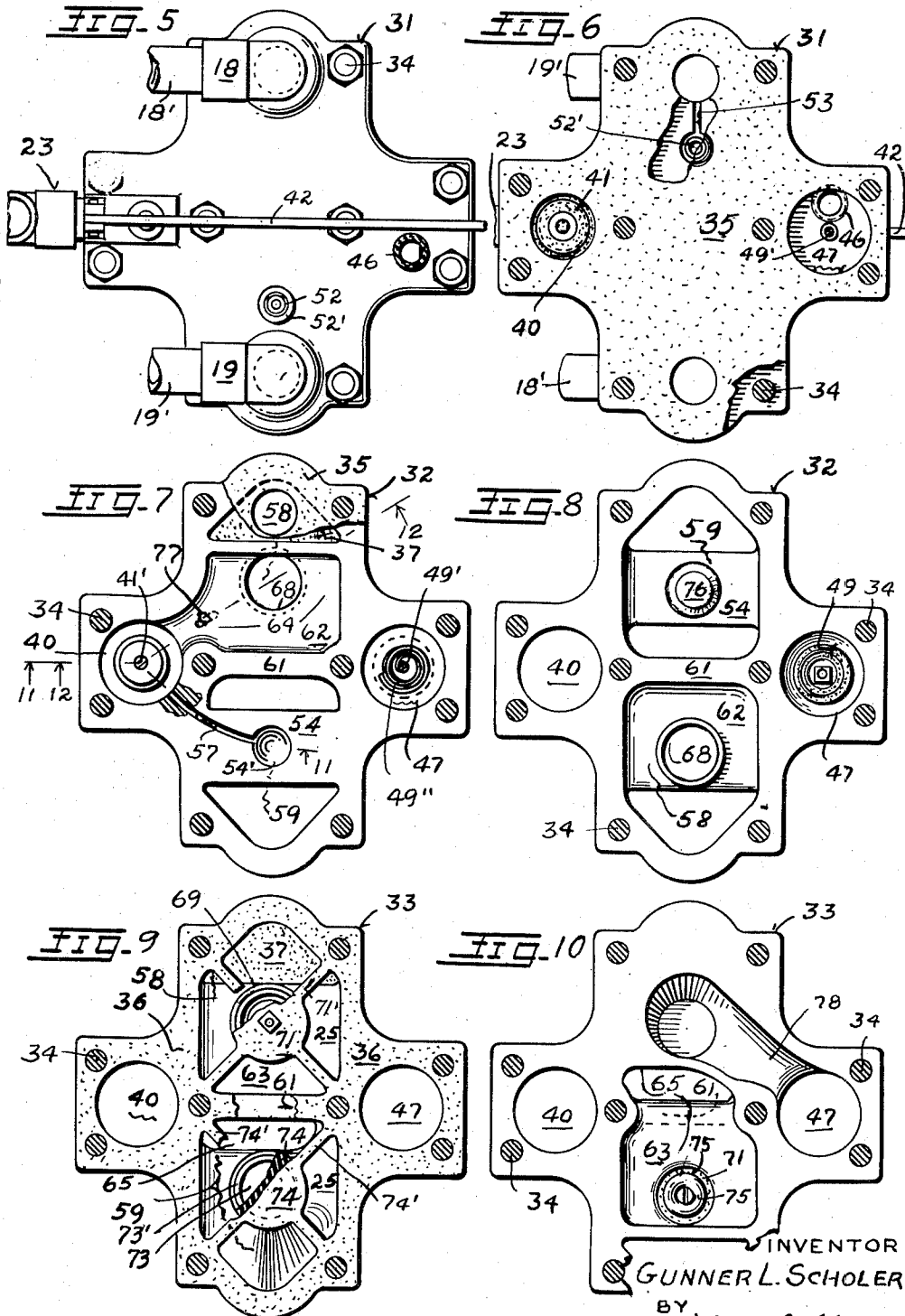
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FIG. 13

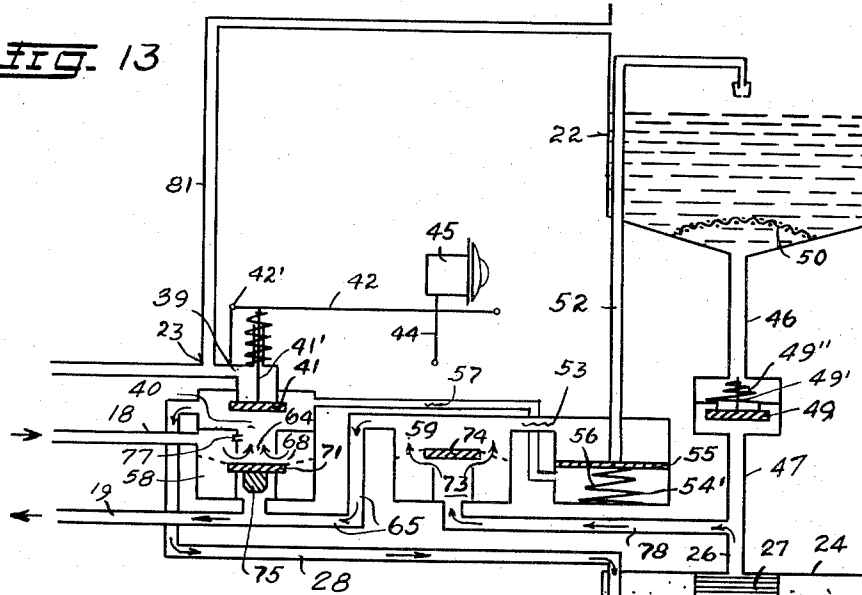
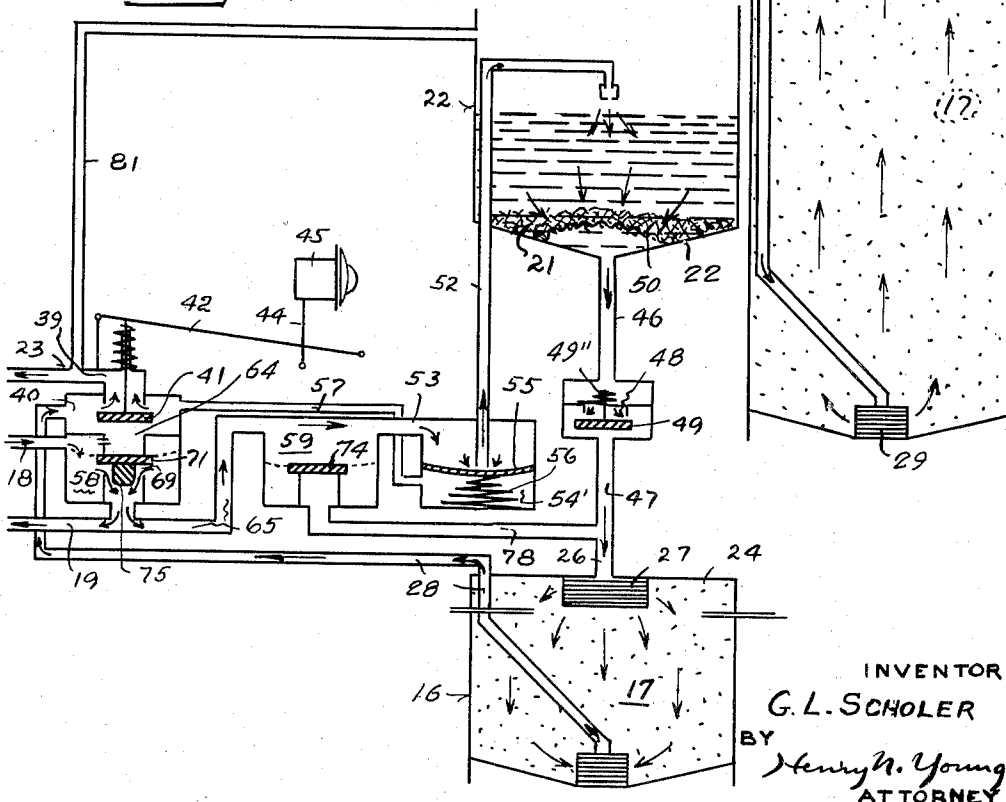


FIG. 14



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LIQUID TREATING UNIT

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4 Claims. (Cl. 137—632)

The invention relates to an apparatus for treating aqueous solutions, and more particularly to a unit for softening hard water in a pressure line thereof by directing it through a charge of a suitable ion exchange material.

An object of the invention is to provide an improved liquid treating unit of the character described which is arranged to provide for a regeneration of the ion exchange material as required under solely mechanical and hydraulic control.

Another object is to provide an improved liquid treating device of the character described having all of its flow controls comprising a minimum number of valves which are assembled in a particularly compact unit.

A further object is to provide a liquid treating unit which permits a flow of untreated liquid therethrough during a regeneration of the ion exchange material.

An added object is to provide a liquid treating unit of the present character which operates solely by the use of the forces of the liquid supply pressure and of atmospheric pressure and gravity.

Yet another object is to provide a liquid treating unit in which the mutually alternate treating and regeneration stages of its use are under the sole control of a pilot valve which is closed during a liquid treatment and may be temporarily opened for effecting a timed regeneration of the treating material.

A still further object is to provide a particularly simple and effective and inexpensive liquid treating unit for its purposes.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth or be apparent in the following description of a typical embodiment thereof, and in the accompanying drawings, in which,

Figure 1 is a partly sectional elevation of a liquid-treating unit embodying the features of my invention.

Figure 2 is a plan view taken below the line 2—2 in Figure 1.

Figure 3 is an enlarged fragmentary sectional view taken at the line 3—3 in Figure 2.

Figure 4 is an enlarged section taken at the line 4—4 in Figure 2.

Figure 5 is an enlarged view of a portion of the showing of Figure 2, the view being drawn at the scale of Figures 3 and 4.

Figure 6 is a view taken generally at the line 6—6 in Figure 3.

Figure 7 is a view taken generally at the line 7—7 in Figure 3.

Figure 8 is a view taken generally at the line 8—8 in Figure 3.

Figure 9 is a view taken generally at the line 9—9 of Figure 3.

Figure 10 is a view taken at the plane of the line 10—10 in Figure 3.

Figure 11 is a fragmentary section taken at the broken line 11—11 in Figure 7.

Figure 12 is a fragmentary section taken at the broken line 12—12 in Figure 7.

Figure 13 is a diagrammatic elevation, partly in cross-section, showing the apparatus of my invention in service condition.

Figure 14 is a view similar to Figure 13, but showing the apparatus in regenerating condition.

The present unitary liquid-treating apparatus of my invention has been particularly designed for the softening treatment of naturally hard waters for domestic and industrial use, and will, for descriptive convenience be so referred to, but without any implied limitation as to other liquid-treating uses for which it may be adapted. As particularly illustrated, the features of my invention are incorporated in an assembly comprising a tank 16 containing ion-exchange material 17 through which hard water under pipe line pressure may be circulated between supply and service connections 18 and 19 provided by a flow control head 20, and in which the regeneration or reactivation of the ion exchange material 17 may be periodically effected as needed by introducing thereto a solution of a regenerant material 21 which is provided by gravity flow from a container 22 and is arranged to effect a washing of the ion exchange material and a discharge of the resulting solution through a waste pipe connection 23 provided at the head 20. For the treatment of water which is hard because of various materials carried in solution therein, the tank 16 may contain a charge of insoluble particles of a zeolite while the container 22 may receive charges of sodium chloride (salt) comprising the regenerant material 21 for providing an aqueous solution to be circulated through the material 17 in the treating tank 16 when the regeneration thereof is needed; the general process, per se, is a usual one.

In the present unit, the treating tank 16 is cylindrical, has a built-in top 24 and is liquid-tight except for certain openings provided in its said top. The present regenerant container 22 has the same diameter as the tank 16, is of appreciably less capacity, and is suitably supported above the tank 16 in a spaced coaxial relation to it to provide a space between the container and tank to contain the flow controls of the apparatus, as well as to provide for a discharge of liquid from the container 22 at atmospheric pressure and under a measurable hydraulic head with respect to the tank. The head 20 is removably mounted on a base plate 25 which overlies the tank top 24 and is sealedly secured thereto by bolts extending from the top 24 through a sealing gasket 25' interposed between the plate and top. Centrally and transversely thereof, the plate 25 sealedly mounts a short pipe 26 extending upwardly from a strainer 27 of relatively fine mesh disposed at the top of the tank 16, and said plate also sealedly mounts a pipe 28 extending downwardly therefrom to a strainer 29 at the bottom of the tank 16; the tank top 24 is suitably perforated to freely receive the strainer 27 and the pipe 28 therethrough. The strainer 29 may be of coarser mesh than the strainer 27 which must function to prevent the escape of the finer zeolite particles with treated liquid flowing from the tank therethrough, it being noted that liquid to be treated is supplied to the tank interior through the pipe 28 and strainer 29, while the treated liquid is arranged to escape under the supply line pressure to the service connection 19 through the strainer 27 and pipe 26 and the flow control head 20.

It will now be noted that the flow control head 20 provides interior passages for variously connecting the pipes 26 and 28 with the supply and service and waste connections 18 and 19 and 23 respectively, and provides certain valves interiorly thereof for operation in the passages to provide the desired alternate treating and re-

generating actions with respect to the ion exchange material 17 in the tank 16. For reasons that will hereinafter appear, the flow control head 20 comprises three sections of like outline in plan, with said sections comprising a top section 31 and an intermediate section 32 and a bottom section 33, the assembly of said sections being fixed to the base plate 25 by bolts 34 extending upwardly from said plate and through the sections. Sealing gaskets 35 and 36 and 37 are provided beneath the sections 31 and 32 and 33 respectively, and at least the gaskets 35 and 36 are of such a material and otherwise so constituted that portions thereof may be utilized as disc or diaphragm valves in certain passages of the head. By particular reference to Figures 3 to 6 inclusive, it will be noted that the various sections of the present head 20 have a like plan outline of the general form of a Maltese cross, and that the top section 31 provides the supply and service pipe connections 18 and 19 respectively adjacent opposite arm ends thereof in the form of elbows which provide for the connection thereof of supply and service pipes 18' and 19' to extend horizontally from over the member, with the passages provided by the connections terminating at complementary openings through the upper gasket 35.

The waste connection 23 is provided at the end of another arm of the section 31, and comprises a T fitting having one arm thereof engaged in the end of an L-shaped passage or port 39 which terminates at a downwardly facing valve seat in the plane of the under face of the section 31. A cylindrical passage 40 extends downwardly beneath the port 39 and through the members 32 and 33 and 25 and the gaskets engaged between them, for registration with the upper end of the pipe 28 which depends from the plate 25 to the strainer 29 at the bottom of the tank 16. A valve disc 41 is carried at the end of a stem 41' extending downwardly through an upwardly extending portion 31' of the top section 31 above the upright part of the port 39, and said stem is spring-loaded to constantly urge a passage-closing seating of the valve disc against the port seat, this closed condition of the valve existing while the apparatus is not in use and during its liquid-treating use. Using, for descriptive convenience, the identifying number of a valve disc as designating a valve assembly, it will be noted that an opening of the valve 41 is arranged to effect a regeneration of the treating material in the tank 16 through effects produced on other valves of the flow circuit, and this valve will therefore be herein referred to as a pilot valve.

An opening of the valve 41 is arranged to be effected manually by and upon the downward rocking of a lever 42 extending across the section 31 between the connections 18 and 19, said lever having one end hinged to the upstanding section portion 31' at a pivot pin 42' and immediately bearing against the top of the valve stem 41' whereby a pressing down of the outer stem end will open the valve and provide for a continued regeneration action in a manner to be hereafter explained. As is brought out in Figures 1 and 2 and 3, the free end of the lever 42 extends through a vertical slot 43' provided in a C-shaped dust-shield member 43 fixed to and between the container 22 and the tank 16, and said member swingably mounts at its inner face a hook arm 44 which is resiliently held against the opposed lever portion thereat by a suitable spring means and provides a hook extension 44' for engagement with the lever 42 to hold the same in valve-opening position upon an appropriate manual depression of the lever. Although the hook arm 44 might be manually disengaged from the lever 42 when the regeneration of the liquid-treating material is complete, the latter usually takes considerable time, and a release of the lever from the hook arm may conveniently be effected automatically by the suitable action of a spring-operated timer 45 to mechanically displace the hook arm for releasing the lever at the end of a predetermined and appropriate time after its setting for a resumption of the treating of material in the tank 16.

It will now be noted that the bottom of the regenerant container 22 tapers downwardly to a central point from which a pipe or tube 46 depends to a threaded connection with a hole provided through the section 31 at the opposite side thereof from the valve 41. The lower end of the pipe 46 registers with one end of a passage 47 extending downwardly through the sections 32 and 33 and the plate 25 and the various gaskets in line therewith to register with the upper end of the pipe 26 which terminates at the strainer 27, and the portion of said passage in the intermediate section 32 is provided with a horizontal partition having a port 48 terminating in a downwardly facing valve seat 48' at its bottom and against which a valve disc 49 carried by a spring-loaded stem 49' which is constantly operative to urge a port-closing disposal of the disc by the action of a relatively weak spring 49''. The charge of regenerant (salt) provided in the container 22 is usually granular, and a strainer 50 of suitable mesh is preferably provided within the container at the top of the pipe 46 to prevent the escape of unduly large salt granules into the pipe 46 while assuring the flow of strong salt solution from the container.

From a point of the section 31 adjacent the connection 19, a tube 52 rises to and through the bottom of the container 22 to an open discharge and near the container top. As is brought out in Figure 4, the bottom end of a connecting fitting 52' for the tube 52 provides a valve seat at the bottom plane of the top section 31, and a duct 53 provided by a groove in the under face of the section 31 and having its under side defined by the gasket 35 extends radially from the passage of the service connection 19 and around the lower end of the fitting. At a point thereof opposite the fitting 52', the intermediate head section 32 has a part 54 securing the gasket 35 adjacent the fitting 52 and providing a basin-like concavity 54' larger than and opposite the valve seat provided by the fitting 52' whereby the portion 55 of the flexible gasket 35 which normally engages said seat 52' may be deflected as a diaphragm valve into the basin 54' to connect the tube 52 with the connection 19 when the effective valve-seating pressure in said basin is less than that about the tube bottom. A compression spring 56 is preferably installed in the basin 54' for urging the operative seating of the valve diaphragm 55 independently of the pressure in the basin. A duct 57 connects the basin 54' with the passage 40, and is defined in part by a groove in the upper face of the section 31 and the opposed under face of the gasket 35 in mutual cooperation, this structural feature being particularly brought out in Figures 7 and 11; the numeral 57 is applied to said groove in Figure 7 as designating the laterally closed duct which is defined in part by it.

It will now be noted by particular reference to Figures 4 and 8 and 9 that the passages of the connections 18 and 19 register axially thereof with end portions of chambers 58 and 59 which are jointly provided by the sections 32 and 33, and have generally rectangular portions extending toward each other from the first chamber portions to provide opposed parts of a common upright wall 61, including an interposed portion of the gasket 36 and laterally separating the chambers. Horizontal walls 62 and 63 respectively define the top and bottom of the inner part of the chamber 58, and said walls are respectively spaced downwardly and upwardly from the gaskets 35 and 37 engaging upper and lower faces of the sections 32 and 33 to provide spaces 64 and 65 comprising groove passages between them and the gaskets. The sides of the passages 64 and 65 respectively engage the gaskets 35 and 37 to seal the spaces thereat, and mutually aligned ports 68 and 69 of like size are provided through the walls 62 and 63, said ports providing mutually opposed annular valve seats for selective engagement by a common valve disc 71, whereby the discs 71 may function in a two-way valve arrangement with respect to the spaces 64 and 65 which are arranged to alternatively provide pas-

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sages in different flow lines through the control head 20 in accordance with whichever valve port 68 or 69 is open.

Referring to the position and form of the chamber 59, it will be noted that the rectangular portion of the same is defined generally between the plane of the upper face of the section 32 and a horizontal wall 72 extending upwardly from the bottom plane of the section 33, and having its inner edge spaced from the wall 61 to provide an upward continuation of the passage 65 from beneath the bottom wall 63 for the chamber 58, whereby to connect the chambers 58 and 59 when the port 69 at the bottom of the chamber 58 is open. The wall 72 is recessed from below adjacent the inner edge thereof, and is provided adjacent its said inner edge with an upstanding annular projection providing a valve seat for a port 73 thereat. A valve disc 74 is operative at the valve seat 73' for the port 73, which seat is flush with the upper face of the head section 33.

By particular reference to Figures 4 and 9, it will now be noted that the disc valves 71 and 74 comprise integral and downwardly thickened portions of the gasket member 36 which functions between the sections 32 and 33 in the head assembly 20, and that the discs are held centered opposite the seats solely by integral strips 71' and 74' of the gasket material which radiate as spider arms from the disc to corners of the gasket openings, said openings being otherwise complementary to the plan outlines of the corners of the rectangular parts of the chambers 58 and 59 respectively. For a reason to be hereinafter brought out, the valve disc 71 mounts a weight member 75 which extends freely in the port 69, it being understood that the disc normally closes the port 69 and may be raised from the port seat to close the port 68 while opening the port 69. The raising of the valve disc 74 from the upwardly-directed valve seat for the port 73 is preferably limited by its contact with a stop boss 76 depending from the part 54 of the section 32 providing the depression 54' at its upper side, it being noted that the part 54 extends as a bridging bar across the top of the chamber 59 as part of the section and has its longitudinal line substantially perpendicular to the common plane of the upwardly directed portions of the connections 18 and 19, whereby to provide for the duct 57 from the depression 54' to the passage 40 and a constant open flow connection between the passage of the connection 19 and the chamber 59; in the present structure, the pipe fitting 52' and the valve port 73 are mutually coaxial.

From a consideration of Figures 3 and 4 and 7 and 12, it will be seen that the space 64 provided above the upper wall 62 of the chamber 68 extends to the top of the passage 40 to provide a passage or duct for a flow of liquid between the passage 40 and the port 68 at the top of the chamber 58, it being understood that the gasket 35 defines the upper side of the passage 64 so provided. Preferably, and as shown, a constantly open and relatively small bleeder or relief duct 77 extends through the wall 62 to connect the passage 64 and the underlying chamber 58. The space 65 below the lower wall 63 of the chamber 58 comprises an open passage between the bottom port 69 of the chamber and the chamber 59, while the space beneath the lower wall 72 of the chamber 59 at the port 73 is bounded at its bottom by an imperforate portion of the gasket 37 and is extended as a connecting passage or duct 78 to the upright passage 47 which is connected at its bottom with the pipe 26.

Water treating operation

The present water conditioning apparatus is arranged to be interposed in a pipe line delivering water under pressure, by means of the supply connection 18 and the service connection 19. When the water of the piped stream is to be softened, it is arranged to so flow through the unitary flow control head 20 that it will enter and leave the zeolite charge 17 in the tank 16 through

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the pipes 28 and 26 which are connected with the present control head at its bottom. More specifically, water entering the connection 18 will flow under the supply pressure into the chamber 58, thence through the open port 68 and the passage 64 to the passage 40 which is directly connected to the upper end of the pipe 28. The treated water then flows from the tank 16 through the pipe 26 and passage 78 and the port 73 to open the valve 74 to flow into the service connection 19 by way of the chamber 59 and the passage 65 for its service delivery through the pipe 19, it being understood that the valve 74 functions as a check valve in the flow line thus provided through the head. It will also be noted that, under the pressure conditions provided in the head 20 during a water-treating use of the apparatus, the valves 49 and 55 are held shut by hydraulic pressure and the associated springs, while the valve 71 is held closed by gravity and hydraulic pressure. By reference to the flow diagram of Figure 13, it will be noted that no appreciable liquid flow occurs through the opening 77, and it is also to be noted that hydraulic pressure exists at both sides of the valve 55 by reason of the connection of the space 54' with the passage 40 and the connection of the passage 53 with the passage of the service connection 19 which has an open connection with the chamber 59 and therefore comprises, in effect, a part thereof.

Regeneration operation

The regeneration of the zeolite charge is initiated in the treating tank 16 by placing a charge of regenerant material 21 in the container 22, setting the timer 45 for the release of the depressed lever 42 after a desired period of time, and pulling down said lever to retainedly engage it beneath the hook extension of the hook arm 44 under control of the timer. The holding down of the lever 42 opens the pilot valve 41 to connect the passage 40 with the passage 39 to then provide for a waste escape of water through the connection 23 at substantially atmospheric pressure. This relief of the pressure in the passage 40 results in a pressure raising of the valve disc of the valve 71 to close the port 68 and open the port 69 whereby, as is brought out in Figure 14, water will flow from the space 58 through the open port 69 and the passage 65 and chamber 59 into the service connection 19 to maintain in the latter a service supply of untreated water for use during the regenerative treatment of the zeolite. Also the passage 57 connecting the passage 40 with the space 54' beneath the valve 55 relieves the pressure in the space 54' and thereby provides the opening of the valve 55.

The water under pressure in the chamber 59 now operates to hold the check valve 74 closed and to exert through the passage 53 such a downward pressure against the diaphragm of the valve 55 that water may flow from the chamber into and upwardly in the pipe 52 for continuous delivery into the regenerant container 22 for its flow through the regenerant charge and thence through the pipe 46 and the spring-loaded valve 49 which is now free to act as a check valve since the resistance to its opening is substantially only atmospheric as determined by the very slight resistance to the flow of the water stream to waste at the connection 23. The water discharging through the valve 49 may only flow downwardly through the pipes 47 and 26 into the top of the tank 16 and thence as a backwash through the zeolite 17 and upwardly through the pipe 28 and the chamber 40 and the open port of the passage 39 to the waste connection 23. As particularly shown, an overflow pipe 81 extends from the top of the container 22 to a connection with the upwardly-directed stem of the T fitting 23 to deliver to the waste line any excess of water which may be delivered into the container 22 during the regeneration process.

It will be understood that the present regenerant process provides a backwashing flow of all of the salt solution from the open container 22 through the zeolite and a

subsequent washing of any residual salt solution from the zeolite with fresh water received from the container after the charge of regenerant has been exhausted, the timer 45 being appropriately set to release the lever 42 for a closing of the pilot valve 51 in terms of the amount of regenerant which is placed in the container before a regeneration period is initiated. Since the regenerant container is open at the top, the delivery pressure of the liquid therefrom and through the zeolite and waste connection 23 is relatively low whereby the regenerant may most fully function during its passage through the zeolite charge in the tank by reason of its relatively slow flow there-through. When the timer disengages the hook 44 from the lever 42 to permit a closing of the valve 41 to prevent a further discharge from the waste passage 39, a relatively small stream of water passes through the bleeder opening 77 into the passage 40 to effect an equalizing of the pressure in all passages connected with the chamber 58 and all of the valves are automatically reconditioned for the described water-treating service by the assembly.

By particular reference to the unitary control assembly made up of the body sections 31 and 32 and 33 and the base plate 25, and the interposed gaskets 35 and 36 and 37, it will be understood that this assembly may be mounted or dismounted as a whole with respect to the treating tank 16, or be disassembled to the degree necessary to provide for any replacement of the gaskets 35 or 36 which provide valve disks. The aforesaid gaskets are formed of a suitable material, such as neoprene, having appropriate sealing qualities and resistance to chemical action, with portions of the gaskets 35 and 36 providing the valve discs or diaphragms. By providing all of the flow passages and valves of the present apparatus within the block assembly of the flow control head 20, it will be understood that piping and pipe fittings are avoided in the present compact assembly and that flow pressure losses are reduced to a minimum. It will also be noted that all of the required flow controls for the present system are provided by the pilot valve 41, the regenerant discharge valve 49, the container supply valve 55, the two-way valve 71, and the check valve 74, whereby all necessary fluid flow controls are provided by a minimum number of valves for the actions afforded, it being understood that all of such actions are essentially provided by the forces of the liquid supply pressure and atmospheric pressure and of gravity in a relatively simple and inexpensive flow control head.

From the foregoing description taken in connection with the accompanying drawings, the advantages of the present liquid treating unit will be readily understood by those skilled in the art to which the invention appertains. While I have herein described the construction and use features of a form of my invention which is now considered to comprise a preferred embodiment thereof, I desire to have it understood that the present disclosure is primarily illustrative, and that such changes and developments may be made, when desired, as fall within the scope of the following claims.

I claim:

1. A valve unit for use in a water softening device having a tank for a regenerant and a treating tank, the valve unit being constructed of laminated alternate metal plates and resilient gaskets, said plates and gaskets being formed to define a first chamber to be connected to a source of water under pressure, a first valve, a first port controlled by the first valve and connecting the first chamber to a first passage for pretreated water, a pilot valve controlling communication between the first pas-

sage and a drain passage, a second passage for treated water, a check valve in the second chamber controlling the second passage, a third passage opening at one end to the second chamber and adapted at its other end to be connected to service and connected intermediate its ends to a second port in the first chamber controlled by said first valve, a third chamber formed in the valve unit divided into upper and lower sections by a diaphragm valve, a fourth passage connecting the upper portion of the third chamber to the second chamber, a fifth passage connecting the lower portion of the third chamber with the second passage, a sixth passage opening at one end into said upper portion, means biasing the diaphragm valve to a position closing said end of the sixth passage, the other end of said sixth passage providing an outlet for water for a regenerating solution, whereby when said pilot valve is positioned to close communication between the first passage and the drain, pretreated water from the source is directed from the first chamber through the first port and first passages and treated water is directed through the second passage into the second chamber to the third passage to be delivered to service, said pilot valve being movable to a position opening communication between the first passage and the drain thereby reducing the pressure of water in the first passage and in the lower portion of the third chamber to move the first valve to a position closing communication between the first chamber and the first passage and establishing communication between the first chamber and the third passage, said reduction of pressure in the lower portion of the third chamber serving to open the diaphragm valve to direct water from the first chamber into the third passage for divided flow to service and into the second chamber to close the check valve therein and thence into the third chamber for flow through the sixth passage.

2. The valve unit of claim 1 in which said first valve is movable upwardly to close said first port and downwardly to close said second port and including a weight on said first valve to bias it to a position closing the second port.

3. The valve unit of claim 1 in which there are at least two gaskets and in which each of the valves is formed of a portion of one of said two gaskets.

4. A valve structure for a water softening system, comprising a valve unit constructed of laminated metal plates and a resilient gasket element therebetween, said plates being formed to provide a pair of chambers and a passage interconnecting the chambers, said gasket providing a seal along the edge of the plates and having a plurality of cut-out portions defining a valve portion controlling the passage and connected to the remainder of the gasket element only by thin strip portions of the gasket, said valve portion being movable by pressure differences in the chambers from a first position uncovering the passage to permit flow between the chambers through said cut-out portions to a second position closing the passage with such movement of the valve portion being restrained only by said strip portions.

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