United States Patent

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[54] **SOFTENER CONTROL ASSEMBLY**
5 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** **285/81,** 285/137, 285/305, 210/278
[51] **Int. Cl.** **F16l 37/14,** F16l 39/00
[50] **Field of Search** ..... 285/137, 81, 305, 91; 339/75 (M), 45 (M); 210/278 (Inquired), 190 (Inquired), 191 (Inquired); 137/315, 597 (Cursory)

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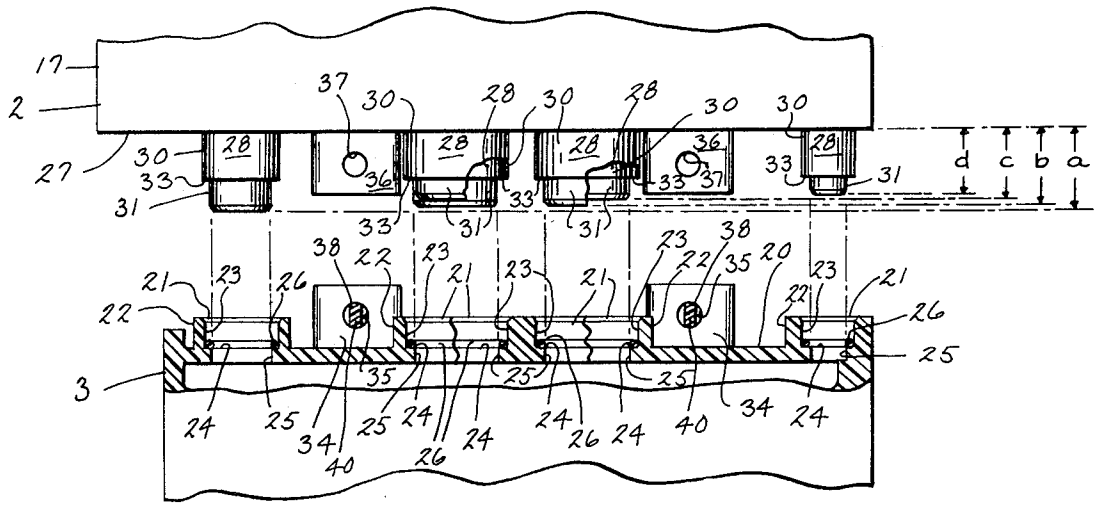
ABSTRACT: A water-softener control assembly for automatically controlling regeneration and adapted for connection to a water-softening tank. The assembly has a base unit connected to the tank and containing all the external pipe connections, and a separately removable control unit containing substantially all of the working control elements but none of the external pipe connections. The control unit is releasably connected to the base unit by a U-shaped locking member whose projecting arms are received in the aligned apertures of cooperating ribs projecting from adjacent opposed surfaces of the units.



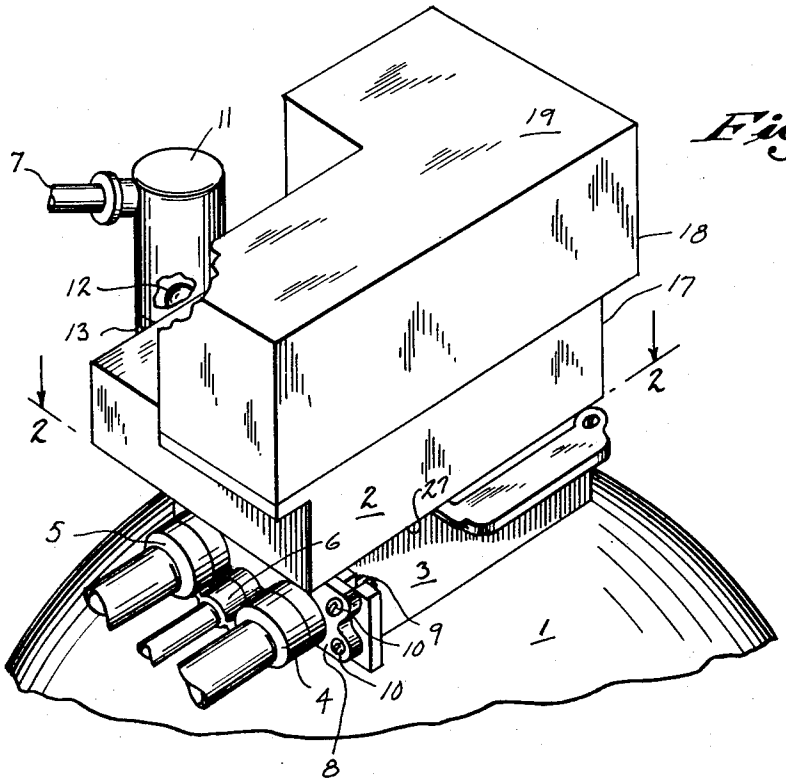


Fig. 1

Fig. 4

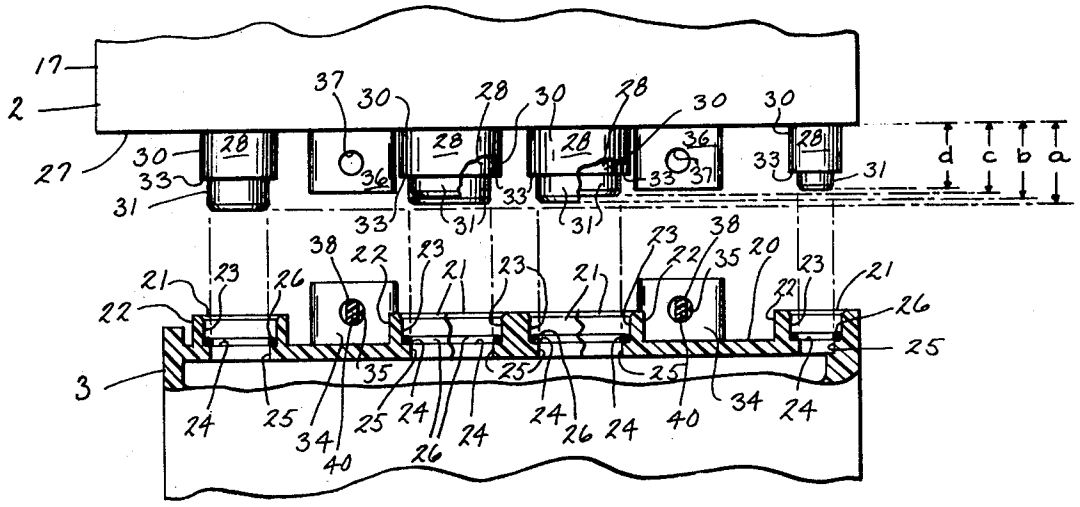


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Fig. 2

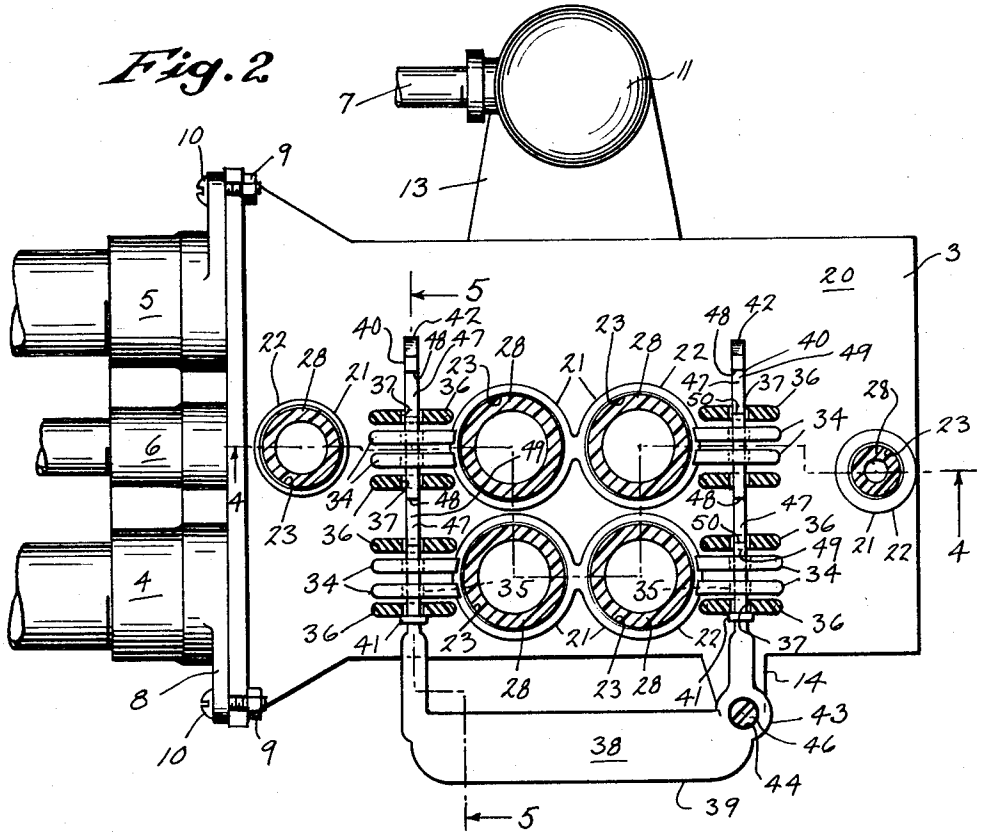

Fig. 3

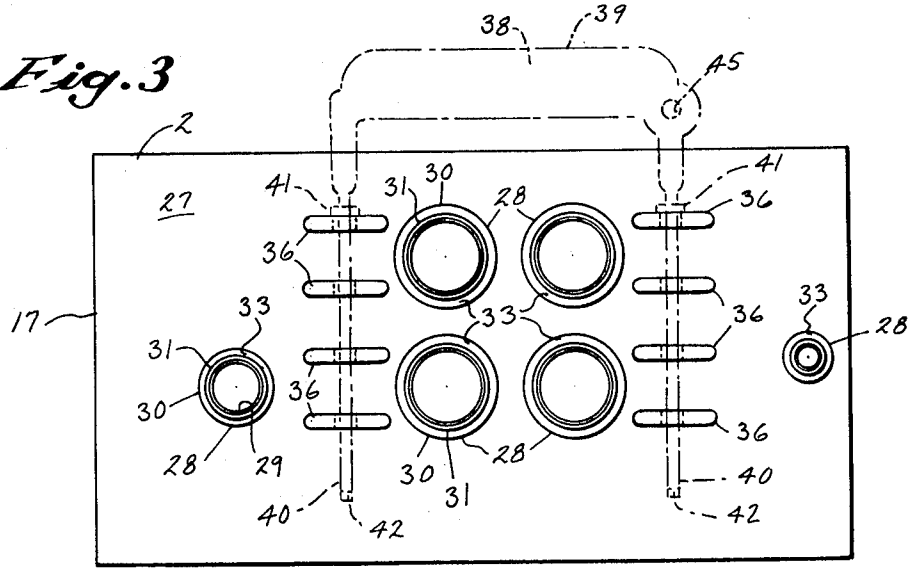

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Fig. 5

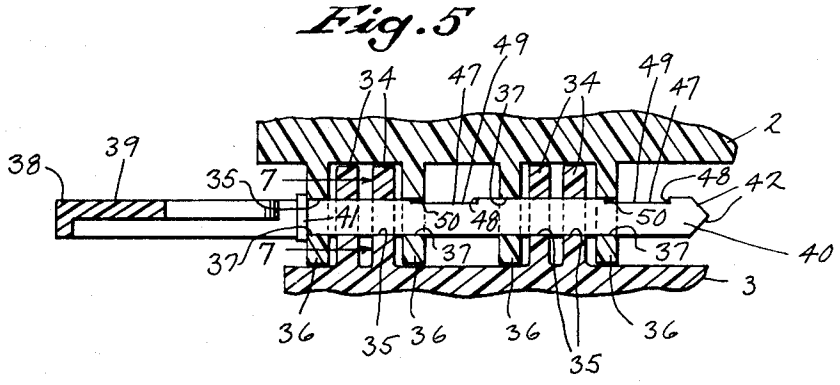


Fig. 6

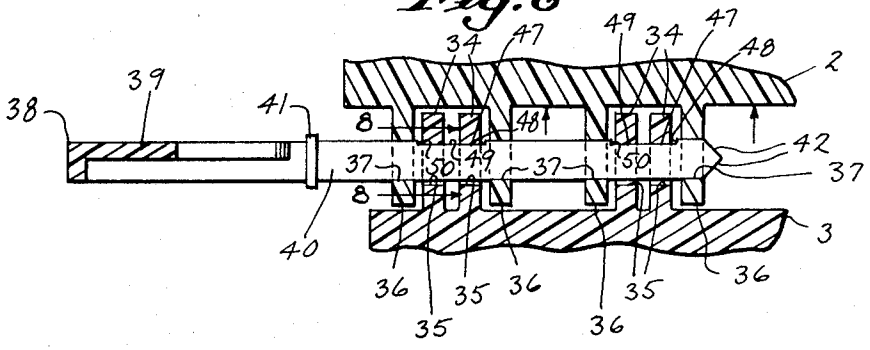


Fig. 7

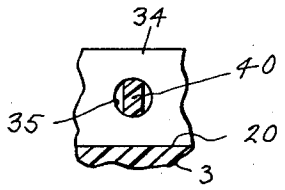


Fig. 8

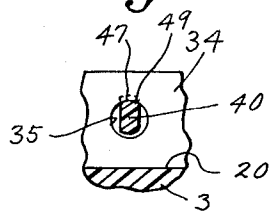
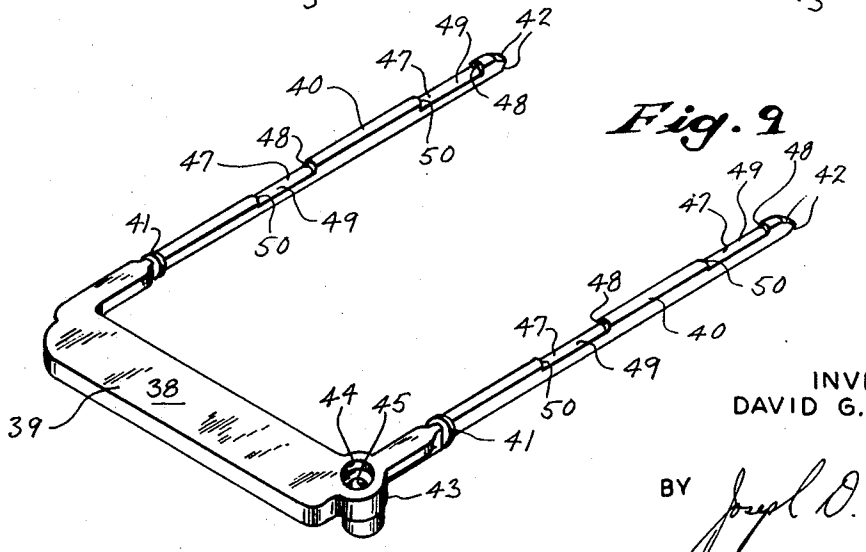


Fig. 9



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SOFTENER CONTROL ASSEMBLY

BACKGROUND OF THE INVENTION

This invention relates to a control assembly for automatically controlling the regeneration of a water softener. More particularly, it relates to a two-piece water-softener control assembly having a control unit containing the working control elements and no external pipe connections, a base unit adapted for connection to a softening tank and containing all of the external pipe connection, and means for separately removably joining the control unit to the base unit.

Heretofore, when servicing or inspection of the control-containing portions of water-softener control assemblies was necessary, a number of external pipes such as for hard water, softened water, discharge to drain, or regenerating liquid often had to be disconnected before one could have suitable access to said portions for servicing. If the control-containing portion had to be removed to a service center, for instance, to complete the servicing, either the user was inconveniently left without softened water for a period, or, if a replacement control portion was installed, further pipe connections had to be made and later disconnected when the original control portion was returned. This results in unnecessary duplication of work and expenditure of time and money, as well as making servicing more complicated and inconvenient.

It would be desirable to have a water-softener control assembly wherein substantially all of the working control elements are contained in a control unit which can be easily and simply removed from a base unit that is mounted on a tank without having to disconnect any pipe, and which also can be easily replaced during the servicing period by another control unit without having to make additional pipe connections and disconnections.

SUMMARY OF THE INVENTION

This invention provides a solution to the problems of prior art water-softener control assemblies heretofore mentioned. This is accomplished by a two-piece water-softener control assembly which includes a base unit adapted for mounting on a softening tank and containing all the external pipe connections such as to a hard water inlet, a softened water outlet, a discharge to drain, and a regenerating liquid inlet. The assembly of the invention also includes a control unit containing substantially all of the working control elements for automatically accomplishing a regeneration of the tank, and no external pipe connections, and means for releasably joining the two units together to permit quick and easy removal of the control unit without having to disconnect any pipe.

Some of the objects of the invention are: to provide improvements in softener control assembly constructions; to provide an improved softener control assembly structure which includes a first component containing substantially all the working control elements and a second component containing all of the external fluid ports and connections for pipe, and containing a softening tank connection, the first component being separately removably connected to the second component; to provide a softener control assembly of the foregoing type for automatically controlling the regeneration of a water softener in which the control-containing component can be separated from the external port-containing component without having to disconnect any pipe; and to provide a softener control assembly having the aforesaid features in which means are provided for releasably joining the two components together, said means incorporating a safety feature that blocks disengagement thereof from the associated assembly components when there is fluid under pressure in the control assembly.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a control assembly for a water softener embodying the invention and shown mounted on the top of a water-softening tank,

FIG. 2 is a top plan view of the bottom base unit of the softener control assembly taken in the plane of the line 2–2 of FIG. 1, together with locking ribs and port connectors of the mating upper control unit shown in section, and a releasable locking member shown in locking position,

FIG. 3 is a bottom plan view of the upper control unit of the softener control assembly shown in FIG. 1 and showing, by use of phantom lines, the releasable locking member of the control assembly in locking position,

FIG. 4 is an exploded fragmentary view in section of the base unit of FIG. 2 taken in the plane of the line 4–4 of FIG. 2, together with the control unit shown in FIG. 3 and having parts broken away for clarity,

FIG. 5 is a fragmentary view in section and on an enlarged scale of the releasable locking member and the cooperating ribs of the base unit and the control unit of the softener control assembly taken in the plane of the line 5–5 of FIG. 2, the view showing the locking member in normal locking position,

FIG. 6 is a fragmentary view on the same scale as, and of the structure shown in FIG. 5, this view further showing the locking member in the positive locking position resulting when attempted withdrawal of the member is made while there is operating pressure in the water softening system,

FIG. 7 is a fragmentary view in section of a rib on the base unit and the locking member through an aperture on the rib while the member is in normal locking position, taken on the plane of the line 7–7 of FIG. 5,

FIG. 8 is a fragmentary view in section taken on the plane of the line 8–8 of FIG. 6 of the structure shown in FIG. 7, but further showing the locking member in the blocked, attempted withdrawal position when there is operating pressure in the softening system, and

FIG. 9 is a view in perspective of the locking member of the softener control assembly shown in FIG. 1 for releasably connecting the assembly control unit to the assembly base unit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, there is shown in FIG. 1 a softener control assembly for automatically controlling the regeneration of a water softener. The control assembly is mounted on the top of a water-softening tank 1, and is provided with an upper control unit 2 and a lower base unit 3.

The base unit 3 includes suitable means (not shown) for operatively connecting said unit to the interior of tank 1. In addition, the assembly base unit 3 is provided with a hard-water inlet 4, a softened-water outlet 5, a discharge to drain 6 and a regenerating liquid inlet 7. The foregoing inlets, outlet and discharge are suitably connected to external conduits or pipes for carrying out the water-softening and regenerating operation.

The hard-water inlet 4, softened-water outlet 5 and discharge to drain 6 are arranged in a bank and suitably constructed of a unitary casting 8 which is secured to the rest of the base unit 3 by means of threaded nuts 9 and bolts 10. The regenerating liquid inlet 7 is an integral part of the housing 11 of a ball check valve 12. The valve 12 is mounted on a fluid-passage-containing ear 13 projecting from one side of the base unit 3. In FIG. 2, there is shown a second, smaller ear 14 projecting from the opposite side of the base unit 3. The ear 14 is provided with a threaded hole which is adapted to receive a screw releasably connecting a locking member to the assembly. The base unit 3 also contains fluid passages (not shown) which lead to and from the interior of the softening tank 1, to and from the control unit 2, and to and from the hard-water inlet 4, softened-water outlet 5, discharge to drain 6 and regenerating liquid inlet 7.

The upper control unit 2 includes a bottom fluid-passage-and-valve-containing portion 17 and a top automatic-control-containing portion 18. The top portion 18 houses controls (not shown) for automatically controlling water-softener regeneration. For example, a timing control such as described in U.S. Pat. No. 3,302,467 can be suitably employed to initiate

the driving of a control shaft which, in turn, operates to open and close a series of flow-control valves that govern the sequence and duration of the regeneration operation. A removable cover 19 fits over the automatic controls of the top portion 18 to completely enclose them.

The bottom portion 17 of the control unit 2 is provided with fluid passages (not shown) that lead to and from fluid passages in the base unit 3. The fluid passages in bottom portion 17 are also provided with flow-control valves (not shown) which are opened and closed in response to the automatic control devices in top portion 18.

Referring now to FIGS. 2–4, fluid passages in the assembly control unit 2 are joined to fluid passages in the assembly base unit 3 to permit fluid movement therebetween by means of mating ports located in adjacent opposing surfaces of the units. The top surface 20 of the base unit 3 is provided with a group of six ports 21. The ports 21 have annular walls 22 extending upwardly from the surface 20 that define openings 23. In addition, annular shoulders 24 are provided in the openings 23 which are offset from the walls 22 to define a still smaller opening 25. Such openings 25 extend downward from the inner margins of the shoulders 24 to join the fluid passages in the base unit 3. Seated on each of the shoulders 24 is an O-ring gasket 26 which is adapted to provide a seal between the mating ports. The walls 22 of each port 21 are suitably of the same height above the top surface 20, while the shoulders 24 are all at the same horizontal level.

The bottom surface 27 of the control unit 2 is provided with a group of six port connectors 28 having openings 29 which lead to the fluid passages in control unit 2. The connectors 28 are adapted to mate with cooperating ports 21 on the base unit 3 and to be received in the openings 23, 25 thereof. The port connectors 28 have an enlarged annular base portion 30 which extends downwardly from the surface 27, and a reduced annular stem portion 31 which depends from said enlarged portion 30. A shoulder 33 is formed outwardly on each connector 28 at the junction between the enlarged and reduced portions 30, 31.

The stem portions 31 of the port connectors 28 are adapted to be received in the openings 25 of the cooperating ports 21 below the shoulders 24 and gaskets 26. The enlarged base portions 30 are adapted to be received in the larger openings 23 of the ports 21, while the shoulders 33 of the port connectors 28 are adapted to seat on the gaskets 26 which, in turn, are seated on the port shoulders 24. This arrangement provides a fluidtight joinder of the ports 21 and port connectors 28.

In FIGS. 2 and 4, there are provided on the top surface 20 of the base unit 3 two spaced, parallel banks, each of four upstanding ribs 34. The longitudinal axes of the ribs 34 of one bank are aligned with the longitudinal axes of the ribs 34 of the other bank, said longitudinal axes paralleling the longitudinal axis of the base unit 3. The ribs 34 in each bank are themselves spaced from one another and arranged in two sets of two each. Apertures 35 are presented on each rib 34, the apertures 35 of the ribs 34 in each bank being in alignment and adapted to receive an arm of a locking member when the units 3, 2 are joined together.

FIGS. 3 and 4 show that the bottom surface 27 of the control unit 2 is also provided with ribs 36 that extend downwardly therefrom. The ribs 36 are arranged in two spaced, parallel banks of four each. The longitudinal axes of the ribs 36 of one bank are aligned with the longitudinal axes of the ribs of the other bank, said longitudinal axes paralleling the longitudinal axis of the control unit 2. The ribs 36 in each bank are themselves spaced from one another and arranged so that a pair will flank each set of base unit ribs 34 in a cooperating bank when the units 3, 2 are assembled such as shown in FIG. 2. Each control unit rib 36 is also provided with an aperture 37, each aperture 37 in a bank of ribs 36 being in alignment and adapted to receive an arm of a locking member. The ribs 36 are arranged to cooperate with the ribs 34 in an interdigitated manner so that the apertures 37, 35 respectively in each rib bank are in alignment when the control unit 2 is mounted on the base unit 3 for normal operation. Apertures 35, 37 preferably are identical in size.

There is shown in FIGS. 2, 3 and 9 a releasable locking member 38 which forms a principal part of the invention. The member 38 includes a generally U-shaped handle 39 and two spaced, parallel projecting arms 40. Preferably, the member 38 is of unitary construction.

Each projecting arm 40 at its end nearest the handle 39 is provided with a stop means 41 adapted to abut against an outermost flanking control unit rib 36 when the locking member 38 is fully inserted and in its proper operating position. At their free ends, the arms 40 present beveled surfaces 42 adapted for easy insertion through the two interdigitated banks of aligned rib apertures 35, 37. The height of each arm 40 is such that a relatively close fit will result when the arms 40 are inserted through the aligned apertures 37, 35 of an assembled control unit 2 and base unit 3 respectively.

The locking member 38 also includes an attachment shoulder 43. The shoulder 43 is provided with concentric holes 44 and 45, the latter hole having a reduced diameter. When the arms 40 of the locking member 38 are fully inserted in the cooperating aligned apertures 35, 37 and thus properly positioned for normal softener operation, the holes 44, 45 are aligned with the threaded hole on the small ear 14 of the base unit 3.

To assemble and mount the control assembly, the base unit 3 is first connected to the softening tank 1 through a suitable mounting on its underside (not shown). The necessary piping connections can then be made to the hard-water inlet 4, softened-water outlet 5, discharge t0 drain 6 and regenerating-liquid inlet 7.

Next, the control unit 2 is mounted on the base unit 3. To accomplish this, the stem portions 31 of the control unit port connectors 28 are inserted into the small openings 25 of the mating base unit ports 21. In so doing, the stem portions 31 must move past the O-ring gaskets 26 which provide a relatively tight fit therefor. If all the port connectors 28 were of equal length, it would require the simultaneous application of pressure over a broad area of the top surface of control unit 2 and against the six O-ring gaskets 26 to insert the stem portions 31 and cause the shoulders 33 to be seated on the gaskets 26. To alleviate this difficulty, the port connectors 28 are formed with unequal overall lengths thus permitting the easy application of relatively localized pressure.

While the enlarged connector portions 30 all have the same length, the reduced stem portions 31 are of unequal length, the connectors 28 being arranged somewhat sequentially on the bottom surface 27 from left to right as shown in FIG. 4 starting with the connector 28 having the greatest overall length indicated by the letter *a*. Proceeding to the right, one diagonally spaced pair of port connectors 28 of the middle cluster of four has a slightly smaller overall length indicated by the letter *b;* the other diagonally spaced pair of the middle connectors 28 has a still smaller overall length indicated by the letter *c;* and the connector 28 on the far right has the smallest overall length indicated by the letter *d*. By applying localized pressure successively from the left to the right over the control unit connectors 28 *a* to *d*, the stem portions 31 thereof can be easily inserted past the base unit gaskets 26. The enlarged base portions 30 are then received in the openings 23 and the shoulders 33 seated on the gaskets 26.

With the mating of the port connectors and ports 28, 21 respectively, the two banks of ribs 36 on the control unit 2 are in cooperative interdigitated relationship with the two banks of ribs 34 on the base unit 3 so as to present, in effect, two sleevelike passages through the resulting two banks of aligned rib apertures 37, 35.

The projecting arms 40 of the locking member 38 are then inserted into the sleevelike passages presented by the aligned apertures 37, 35 as can be seen in FIGS. 2 and 5. The arms 40 are inserted fully, i.e., to the right as viewed in FIG. 5, until the two control unit ribs 36 nearest the handle 39 block further insertion by engaging the arm-stop means 41. It is important that

the arms 40 are inserted their full length up to the stop means 41 as this will properly locate their normal position for operating the control assembly. As shown in FIGS. 5 and 7, the arms 40 are then in relatively close engagement with the aligned apertures 37 and 35 on ribs 36, 34 to prevent any upward movement of the control unit 2 when the softening-system pressure is on.

To further insure that the locking member 38 is properly located for normal softener operation, the holes 44, 45 are aligned with the threaded hole on the base unit ear 14 when the arms 40 are fully inserted. The locking member 38 can then be releasably connected to the base unit 3 and control unit 2 by a screw 46 or other suitable means passing through the holes 44, 45 and the threaded hole. This releasable connection also prevents loss or misplacement of the locking member 38 when the units 2, 3 are assembled for shipment.

From the foregoing discussion, it can be seen that the control unit 2 with substantially all of the working control elements advantageously can be quickly and easily removed from the mounted softener-control assembly for inspection and/or servicing without having to disconnect the base unit 3 or any pipes. All that is necessary is to remove the screw 46, withdraw the locking member 38, and lift off the control unit 2. However, it is very important not to remove the control unit 2 while the system or tank pressure is on. The natural tendency of the fluid pressure in the operating softening system is to force the control unit 2 up and away from the base unit 3. Obviously, the person removing the control unit 2 stands to be seriously injured in such a situation.

The invention includes an important feature designed to safeguard against this possibility of withdrawing the locking member 38 while there is pressure in the system. As shown in FIG. 9, each arm 40 is provided with two recesses 47 spaced therealong. The recesses 47 result in each arm 40 having a reduced height at those places compared with the nonrecessed portions of said arms 40 heretofore described. Each recess 47 includes an upstanding front wall portion 48, and is shown specifically to also include a bottom wall portion 49 as well as an upstanding rear wall portion 50.

Referring to FIG. 6, as withdrawal of the locking member 38 is attempted by pulling the handle 39 from right to left, the recesses 47 on each arm 40 simultaneously come into exclusive alignment with both sets of base-unit ribs 34 in a bank leaving a small space between the bottom wall portions 49 and the top of the apertures 35. The nonrecessed portions of each arm 40 are then in a close fit exclusively with the control-unit ribs 36 flanking each set of ribs 34 in a bank. At this point, the fluid pressure in the system will force the control unit 2 together with the locking member 38 upward a distance equal to the small space between the bottom wall portions 49 and the top of the apertures 35, thus causing the last two to come into engagement with each other as shown in FIGS. 6 and 8. Once this position is attained, further withdrawal of the arms 40 is prevented by the blocking action of the top portions of the rightmost ribs 34 of each set thereof in a bank which engage the front wall portions 48 of the arm recesses 47. Also, as can be seen in FIG. 6, the apertures 37, 35 in each interdigitated rib bank are no longer in alignment. In this blocking position, a small space exists between the underside of the arms 40 and the bottoms of the apertures 35 which is maintained so long as the system pressure is on. However, as soon as the pressure is turned off, the control unit 2 and arms 40 can be returned to their normal position in which the apertures 37, 35 are in alignment, similar to that shown in FIG. 5, thus allowing the locking member arms 40 to be withdrawn completely and safely.

Major portions of the control unit and base unit, including the ribs, can be fabricated of reinforced synthetic material such as a glass-reinforced thermoplastic. Such material offers high corrosion resistance, high physical properties, and ease of fabrication by molding. Such material has a tensile strength approximately equal to its yield strength so that the material cannot be deformed to any great extent before mechanical failure occurs. If the arms of the locking member were unyielding, misalignment of the ribs could cause one rib to carry substantially more than its share of the total load resulting from the internal water pressure. This could result in mechanical failure of one or more ribs. Accordingly, the locking member should be made of a relatively yieldable material as compared to the material of the ribs in the case where the ribs are made of a material having a tensile strength approximately equal to its yield strength. Then, the arms of the locking member can bend to accept moderate misalignment so that the load is distributed equally among all the ribs.

Thus, in keeping with the general provisions of the invention, a control assembly for automatically controlling the regeneration of a water softener is provided in which a separately removable upper section containing substantially all of the working control elements is releasably connected to a lower section which has all the external piping connections and is mounted on a softening tank 1. Highly effective means to join the two sections together are provided which can be quickly and easily released to permit removal of the upper control section without having to disconnect any pipe, but only when there is no fluid pressure in the system.

I claim:

1. A control assembly for a water-softening tank, comprising:

a base unit adapted for mounting on a water-softening tank and containing fluid passages leading to and from the interior of the tank, a hard-water inlet, a softened-water outlet, a discharge to drain, a regenerating-liquid inlet, and a set of ports arranged parallel to one another;

a control unit containing substantially all of the actuating and actuatable elements for accomplishing a regeneration of the tank and including fluid passages with port connectors parallel to one another that are adapted to connect only with said ports of the base unit; and

locking means for releasably joining the units together to hold the ports of the base unit in connection with the port connectors of the control unit such that unlocking said means permits disconnection of all of said port connectors on said control unit, said locking means having a portion thereof that prevents unlocking when there is fluid pressure in said base and control units.

2. A control assembly including

a base unit adapted for mounting on a water-softening tank and containing fluid passages leading to and from the interior of the tank, a hard-water inlet, a softened-water outlet, a discharge to drain, a regenerating-liquid inlet, and ports in a surface of the base unit,

a control unit containing substantially all of the actuating and actuatable elements for accomplishing a regeneration of the tank and including fluid passages leading to ports in a surface of the control unit which are adapted to mate with said ports of the base unit with said surfaces opposing one another, and

means for releasably joining the units together to connect the ports of the base unit with the ports of the control unit, said means including a locking member comprised of a handle and two spaced, parallel arms projecting therefrom, and said units are each provided with two, spaced, parallel banks of ribs projecting from their respective opposing surfaces, the rib banks of the control unit being in cooperating interdigitating relation with the rib banks of the base unit, and the cooperating ribs each presenting aligned apertures which receive the arms of said locking member.

3. The assembly of claim 2 wherein the locking-member arms each are of a height that will provide a relatively close fit when said arms are inserted through said aligned apertures, and each arm has a recessed portion of reduced height, which portion includes an upstanding wall portion adapted to engage a base unit rib upon attempted withdrawal of the arms while the control assembly is operating with fluid under pressure in said passages, thereby blocking withdrawal of said rms and

preventing disconnection of the control unit from the base unit.

4. The assembly of claim 3 wherein the ribs are formed of a relatively unyielding material having a tensile strength approximately equal to its yield strength, and wherein the arms of the locking member are formed of a relatively yieldable material which can bend to accommodate misalignment in the apertures of the ribs.

5. A water-softener control assembly for a water-softening tank comprising:

a control unit containing substantially all of the working control elements for accomplishing a regeneration of the tank;

a plurality of port connectors with fluid openings forming a part of said control unit;

a base unit for mounting on the tank and containing external pipe connections for the tank and control assembly;

a plurality of port members with fluid openings forming a part of said base unit and which are in facing relation to said port connectors for sealed interconnection therewith, said port connectors and said port members conducting fluid between said control unit and base unit under pressure that tends to force said units apart when the assembly is operating;

a plurality of members on said control and base units that interdigit with one another and that have apertures that become aligned when said members are interdigited; and

a removable locking member having a projecting arm which is received in said apertures when aligned and which includes means for engaging an interdigited member of one of said units to prevent removal of said locking member when said units tend to be forced apart by fluid pressure.