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CONTINUOUS REGENERATION SYSTEM

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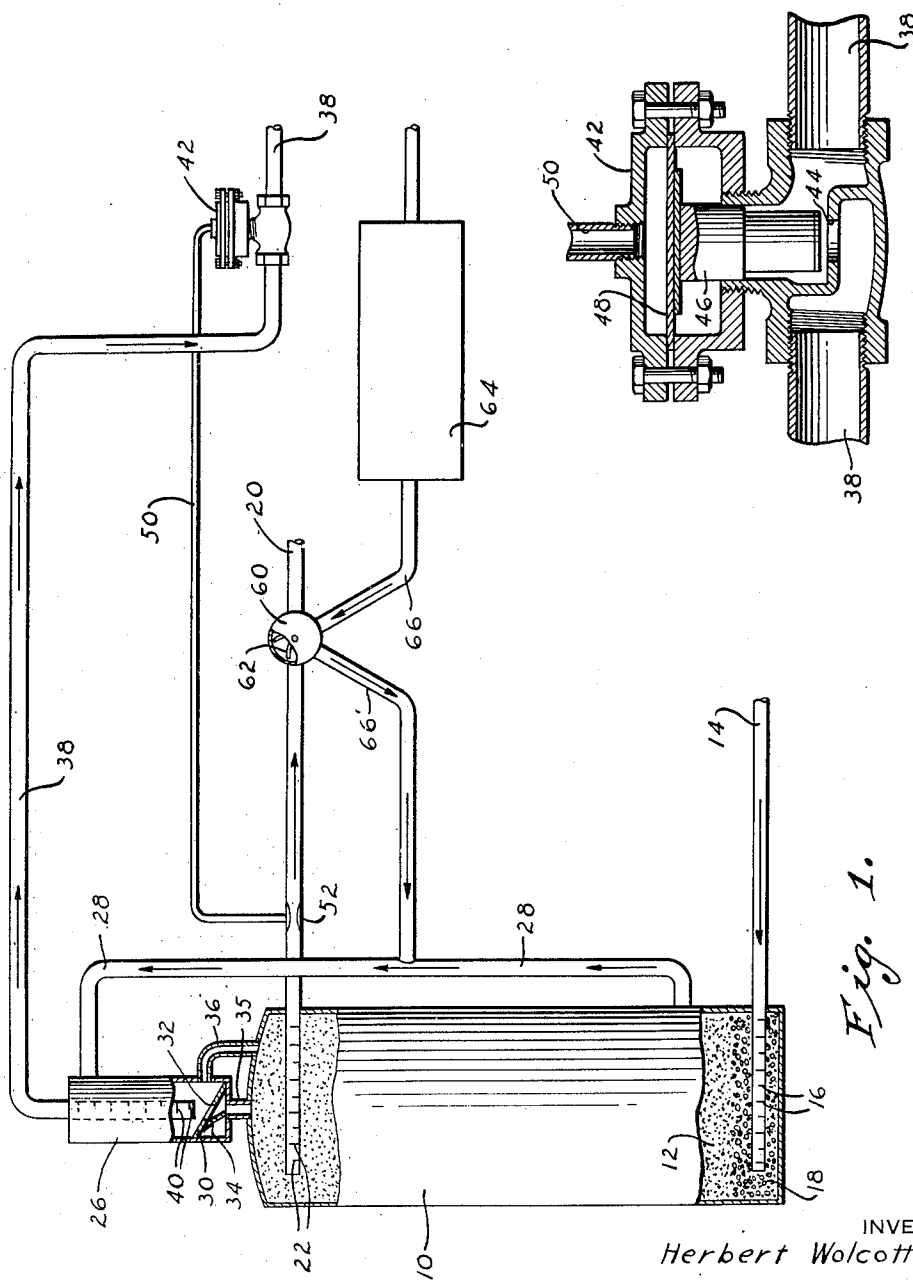


Fig. 2.

Fig. 1.

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CONTINUOUS REGENERATION SYSTEM

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The present invention relates to the means employed for the regeneration of the materials or compounds used for liquid-conditioning operations, such as, for example, the softening of water in water-softening apparatus or systems, and the primary object in view is to devise a means and method for the continuous regeneration of such materials or compounds, for the purpose of eliminating any set intervals or periods for such regenerating process, and hence avoiding any interruption of the service provided by the liquid-conditioning apparatus.

An important object of the invention, therefore, is to provide a regenerating process in which a fractional portion of the liquid-conditioning material is withdrawn or diverted, by each interval of the servicing operation, for regenerating purposes, and by the same servicing operation a corresponding amount of regenerative material is apportioned and fed to said diverted portion of the conditioning material for the necessary regenerative treatment thereof, and at the conclusion of such treatment a corresponding amount of the regenerated material is returned to the unit containing the principal supply of said liquid conditioning material.

For the accomplishment of said primary purpose of the invention, an auxiliary or accessory washing or rinsing chamber is maintained under a differential pressure responsive to the pressure conditions arising from the liquid flow as produced by the withdrawal of liquid for servicing operations and for drainage purposes, and in such relation that both liquid conditioning material undergoing regenerative treatment and wash water are by-passed through said chamber during the intervals of such servicing operations in which treated or conditioned liquid is withdrawn from the system.

A further salient feature of the invention consists in the means for intermittently feeding the regenerative material, in response to the action of such servicing operation, to said bypassing flow of water-softening material throughout the period of said servicing operation, at the end of which period a quantity of the regenerated material is automatically transferred back to the main water treating or softening chamber of the apparatus.

It is a further object of the invention to devise a simple and economical method of operation for accomplishing the necessary functions as regards continuous regeneration of the water-softening material, and requiring only commonplace mechanical devices involving no complications of

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the conventional apparatus employed for water-softening operations, and yet achieving the end purpose of providing a practically self-regenerating system requiring no periodical attention on the part of the owner of the apparatus.

With the foregoing general objects in view, the invention will now be described by reference to the accompanying drawing illustrating a practical and efficient embodiment of the proposed system, after which those features and combinations which are believed to be fundamentally new and patentable will be particularly set forth and claimed.

In the drawing—

Figure 1 is a general, schematic view illustrating a water-softening unit provided with the necessary connections and operative elements for the carrying out of the purposes and functions of the present invention; and

Figure 2 is a sectional detail view of the diaphragm valve device employed for controlling the drain outlet.

In prevailing types of water-softening systems, for both commercial and domestic operations, the water treating material, such as zeolite mineral or other chemical agent employed for imparting the desired softening characteristics to the water, requires periodic treatment by regenerative salts of known properties for restoring the water-softening properties of said water treating material.

In the usual practice, the regenerative treatment involves certain phases of operation, for impregnating the zeolite or other treating material of the unit and then flushing said material by means of a flow of wash water to remove the regenerative salts from the unit, before restoring the unit to normal operation. Obviously this requires a definite period of time during which the unit remains idle so far as normal operative service is concerned, so that the normal function of the unit is therefore interrupted for each regenerative period required for maintaining the unit in service.

It is therefore a primary and important object of the present invention to devise a practical and efficient system of operations in which the regenerative action required for any unit's operations is maintained as a substantially continuous function of the unit, or proportional to the extent of its servicing operations, by providing for a regenerative treatment of a fractional portion of the total supply of softening material of the unit which takes place concurrently or simultaneously with each period of service required of the unit.

For the accomplishment of this purpose I have devised apparatus as shown in the accompanying drawing which comprises a conventional form of water-softening unit such as a tank 10 providing a water-treating chamber which is filled with a supply of appropriate water-treating material such as zeolite mineral 12 or its equivalent. In this example of the construction, the same is illustrated as an upflow unit with an inlet pipe connection for the raw fluid, as indicated at 14, leading into the bottom of the tank, where the end portion of the pipe is provided with lateral orifices 16 adapted to discharge into a bed of granular material such as gravel 18 for promoting efficient distribution of the fluid. A similar outlet pipe 20, having interior lateral intake orifices 22, leads out from the upper portion of the tank for discharge of the treated effluent—it being understood, of course, that the unit may be adapted and employed for either upflow or down-flow operation as conditions may require.

The top of the tank 10 communicates through an outlet 35 with the lower end or bottom of an auxiliary or accessory tank providing washing or rinsing chamber 26, the upper portion of which is provided with a bypass pipe connection 28 leading from the lower portion of the tank 10. Inside the bottom portion of the chamber 26 is arranged an inclined partition or false bottom 30 provided with an outlet opening 32 which is controlled by a gravity check valve 34 designed to allow regenerated material to be returned to the tank 10 by way of the said outlet passage 35—the tank and chamber 26 being also provided with a pressure equalizing connection 36 communicating with said chamber at a point above the partition member 30, and serving also as a bypass for wash or rinse water flowing into the chamber 26 simultaneously with the drainage flow therefrom, as hereinafter explained.

The drain line for disposing of the waste water used for washing the regenerative material out of the zeolite mineral comprises a pipe 38 having its inlet end provided with a plurality of intake orifices 40 disposed centrally within the chamber 26 above the partition or false bottom 30 therein. The drain pipe line 38 is provided with a diaphragm type of control valve indicated generally by the reference numeral 42 and illustrated more specifically in Figure 2. This valve device comprises a valve seat 44 for a plunger valve element 46 for controlling the flow through the pipe 38, which plunger is adapted to be automatically actuated by a diaphragm element 48 which in turn is subject to pressure control as transmitted through a fluid pressure line 50 leading to a conventional Venturi device 52 located in the afore-said service pipe line 20 connected with the upper portion of the tank 10. The pattern or design of the valve unit 42 and its connection 50 are such as to cause the same to function with a relatively slow valve-closing action, as compared to its valve-opening action, for reasons hereinafter explained.

The flow of the treated effluent through the service pipe line 20 is also utilized for the operation of a conventional type of pump, which in the present instance is illustrated as a water driven motor 60 which includes a water driven wheel 62 in the path of the effluent and adapted to simultaneously feed a proportional supply of regenerative material, such as brine, from a suitable source (indicated at 64) having a feed line 66 leading to said motor 60, and continuing, as indicated at 66', from said motor to an intermediate

point of the bypass feed line 28 connecting the bottom of the tank 10 with the chamber 26.

In the arrangement of the tank 10 and its supply and servicing connections, together with the accessory regenerating unit, and the control means therefor, as above set forth, it will be evident that a differential pressure condition is set up with reference to any flow taking place upward through the tank, due to the various resistance factors interposed to any such upward flow (such as the opposing water head in the tank and the bed of material therein), the lower pressure of course prevailing in the top region of the tank, and the tendency being to produce an upward movement or flow and thereby resulting in the transfer of some portion of the zeolite mineral through the bypass tube 28 into the rinsing or washing chamber 26. Moreover, under operating conditions, this differential pressure is further increased by the drainage flow from said rinsing chamber, which is accompanied by a flow of wash or rinse water up through the bypass connection 36, during which operation the automatic check or gravity valve 34 will be maintained in closed position.

In the operation of the described system, resulting from the opening of the service pipe line 20 for withdrawal of the treated effluent, the Venturi device 52 automatically causes the diaphragm valve 42 to open the drain outlet, and the resultant drop in pressure through the system (the lower pressure being at the top of the unit as above indicated), induces an upward flow through the bypass or transfer pipe 28, whereby zeolite material is transferred from the tank 10 to the chamber 26, and as long as the drain outlet is open, wash water is also drawn into the chamber 26 through the bypass connection 36. During the period that such actual flow takes place, upward through the transfer or bypass pipe 28, as a result of the withdrawal of treated effluent, the motor 60 operates to feed regenerative material, such as brine, to said transfer pipe 28, which feeding action is of course in proportion to the quantity of zeolite material being transferred, or in an amount required for regenerative purposes. During the passage of said transferred zeolite material, along with the bypassing wash water flowing in from the bypass connection 36, through the chamber 26, such zeolite material is of course thoroughly washed, and is for the most part free of the regenerative material by the time the drain flow is drawn off through the orifices 40 into the drain line 38—the regenerated zeolite mineral settling and being retained in the chamber 26.

On completion of the servicing operation, the treated effluent line 20 is closed and the motor 60 is automatically stopped and the action of the Venturi device 52 likewise stops simultaneously, thereby automatically closing the diaphragm valve 42 and the outlet through the drain pipe 38. As a consequence of stoppage of the servicing operation, the pressure is equalized through the system and the check valve 34 is free to drop by gravity, opening the outlet 32, so that the regenerated material is thereby automatically discharged back into the top of the tank 10.

Any subsequent operation is of course simply a repetition of the steps just outlined.

It will thus be seen that the operation of a system or unit embodying the invention, as above described, is rendered entirely automatic, with the regenerating operation taking place only as required, or as a result of each servicing operation of the unit, and, what is just as important,

each regenerating phase is proportioned to the extent of the service operation, so that the interval of time as well as the amount of material supplied for each regenerating operation are made to accurately match the requirements of the unit, according to the extent of its operation, whether the same be light or heavy.

It is moreover apparent that the details of construction necessary for the embodiment of the proposed novel features and functions are extremely simple, with no complications of any sort as to the mechanical operation thereof, all the functions being entirely automatic, and having no critical operative elements likely to get out of order in any way. While I have illustrated and described what I now regard as the preferred form of construction and mode of operation of the proposed new system, it will be understood that the same is susceptible of various changes or modifications without materially departing from the spirit or scope or principle of operation of the invention; as for example, the same is adapted for either upflow or downflow operation and for any equivalent type of regenerating operation, using appropriate materials. I therefore desire to be understood as expressly reserving the right to make all such changes or variations as may fairly fall within the scope of my invention as defined by the appended claims.

Having described my invention, what I claim is:

1. Continuous regeneration apparatus for water-softening systems comprising, in combination with a water treating tank containing water treating and softening material and having water supply and servicing connections, an auxiliary washing or rinsing chamber mounted above said tank and communicating therewith and also having a drain outlet provided with an automatic control valve in fluid pressure control relation to said water servicing connection, a bypass connection affording passage for water treating material from the tank to said chamber, means actuated by the discharge flow of water through said servicing connection for feeding regenerative material to said bypass connection at approximately midway between the ends thereof, a second bypass connection for feeding rinse water from the top of said tank into the bottom portion of said auxiliary chamber, and a normally open gravity valve operative between servicing operations to permit regenerated material to gravitate from said chamber back into the top of said tank.

terial to said bypass connection, a second bypass connection for supplying rinse water from the top of said tank to the bottom portion of said chamber, and a gravity check valve operative between servicing operations to permit regenerated material to gravitate back from said chamber into the top of said tank.

2. Continuous regeneration apparatus for water-softening systems comprising, in combination with a water treating tank containing water treating and softening material and having water supply and servicing connections, an auxiliary washing or rinsing chamber mounted above said tank and communicating therewith and also having a drain outlet provided with an automatic control valve in fluid pressure control relation to said water servicing connection, a bypass connection affording passage for water treating material from the bottom portion of said tank to the top of said auxiliary chamber, means actuated by the discharge flow of water through said servicing connection for feeding regenerative material to said bypass connection at approximately midway between the ends thereof, a second bypass connection for feeding rinse water from the top of said tank into the bottom portion of said auxiliary chamber, and a normally open gravity valve operative between servicing operations to permit regenerated material to gravitate from said chamber back into the top of said tank.

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