A nozzle, for filter tanks and for ion exchangers, having a movable body which automatically sets the flow cross section in operation according to the particular flow direction.

3 Claims, 4 Drawing Figures
The number of nozzles that can be arranged per square meter of filter area is limited. The flow rates in normal operation may vary within a wide range, according to the dimensioning of the system, and the same nozzle is used for the whole range of possible flow rates. The nozzle 5 is so designed that it presents a very low flow resistance even in heavy load conditions. The desired flow rates in counterflow regeneration, in the direction from the bottom upwards, are substantially smaller than those in normal operation. An ordinary nozzle would therefore not be suitable, as in comparison it has too large a cross section and presents too little resistance. This would result in an uneven penetration of the resin 3 with regeneration chemicals and, accordingly, in lower efficiency. The nozzle 5, on the other hand, ensures optimum conditions in both flow directions, as the cross section automatically adjusts itself to requirements.

In normal operation, the liquid to be treated, such as water, flows through the ion exchange material, i.e., the resin 3, between the laminations 16, through the channels 25 and the slots 24 into the central tube 17, whence the water, using the full cross section of the central orifice 20, flows downwards and then out through the lateral ports 19 of the housing 7. The path of the water is indicated by broken arrows.

In counterflow regeneration, however, the water charged with chemicals flows into the lateral ports 19 from the bottom and lifts the buoyant control body 11 into the dash-dotted position shown, as the said control body has a lower specific gravity than the water. In that position, the control body closes the central orifice 30 of the housing 7 and only leaves open its inner orifice 22 to allow the water arriving from the bottom to pass through. The water then rises through the central tube 17, leaves it through the slots 24 and passes through the channels 25 between the laminations 16 into the ion exchange material 3. The chemicals added to the water are selected according to the type of the material 3 to be regenerated.

The reduction of the cross section for counterflow regeneration results in increased resistance, ensuring a better distribution in the nozzles 5, e.g., a more even coverage of all the nozzles. In deciding the size of the reduced cross section of the bore 22, allowance must be made for the fact that the filter must be thoroughly back-flushed at certain intervals. In back-flushing also, the flow rates are lower than in normal operation. The maximum back-flushing rate averages about 10 meters/h.

The flow rate in counterflow regeneration would be too small to lift the control body 11 for the purpose of closing the orifice 20. The control body must therefore have a specific gravity which is below that of the liquid, in particular below 1 gram/cm. The control body will then automatically reach its upper closing position. The greater flow rate in normal operation causes the control body 11 to be pushed down and thus clear the greater cross section of the orifice 20.

FIG. 2 shows the lower part of a valve analogous to nozzle 5, comprising a housing 30, a nozzle head 31 and an inset 33 which is screwed into the housing and which presents bores 35 spaced round its circumference. Fixed to the inset 33 by a bolt 37 is a flexible nozzle plate 36 which presents bores 39 which are aligned with the bores 35 of the inset 33, but which have a smaller cross section.

In normal operation, the water flows through the nozzle head 31 from the top downwards, as explained with reference to FIG. 1. The path is indicated by the broken arrows. The water passes into the bores 35. Depending on the pressure of the water, the plate 36 is deflected from the inset 33, as shown by a dash-dotted line, thus clearing a correspondingly large cross section through which the treated water can flow off.

In counterflow regeneration, the regeneration medium flows in the direction of the unbroken arrows. The medium presses the plate 36 against the inset 33, so that it must flow through the narrower bores 39 into the bores 35 and thence continue its flow through the nozzle head 31. In other words, the resistance presented by this nozzle to the flow of the regeneration medium flowing from the bottom upwards is much smaller than that presented to the water flow in normal...
operation, because of the considerably reduced openings in the form of the bores 39.

Another embodiment of such a nozzle part is shown in FIG. 3; in this case, a housing 45 is provided with a nozzle head 46. Movable arranged inside the housing 45 is a control body 48, which is biased downwardly with respect to the housing 45 by a spring 49. The said control body presents a central bore 50 and an inner channel 52 and also outer channels 53 spaced round the circumference. The control body 48 is held in the housing 45 by a retainer 55, which is designed as a screwed ring and is covered towards outside by a hood 56. The hood 56 has lateral ports 57 and serves as a receptacle for a ball 59 whose specific gravity is lower than that of the treatment liquid.

In normal operation, the water flows from the top downwards, as shown by the broken arrows. In this, the spring 49 presses the control body 48 against the retainer 55. The water flows through the central bore 50 and the inner channel 52 into the hood 56 and out through the lateral ports 57.

In regeneration, the medium flows through the ports 57 into the hood 56 and lifts the ball 59 and, as indicated by the dash-dotted line, presses it against the control body 48 and thus closes the central bore 50 thereof. The treatment liquid can then flow through the only orifice open to it, viz the inner channel 52, upwards into the ion exchange material.

Since back-flushing requires more liquid than regeneration, the pressure in the lower space is increased during back-flushing and the control body 48 is therefore lifted in opposition to the spring 49. As a result, the outer channels 53 are also cleared, and the liquid volume required for back-flushing is increased. However, the central bore 50 of the control body 48 remains closed in this case also, as even in back-flushing the liquid quantity is desirable smaller than in normal operation.

FIG. 4 shows a housing 65 with a nozzle head 66. Inside the housing 65 is a bell 68 with apertures 69 and 70, below which is a control body 72 with an outer ring 73 and an inner ring 74, which rings are provided with corresponding lateral bores 76 and 77. As may be seen from FIG. 4, the said bores are covered by elastic means such as flaps or tongues 78 and 79.

The control body 72 is held by a retaining ring 81 which presents a central bore 82 and outer bores 83.

In normal operation, the water flows in the direction of the broken arrows from the top down. In the bell 68, it finds its way through all the bores 69 and 70, presses open the tongues 79 on the outer ring 73 and flows out through the outer bores 83 and, coming from the aperture 69, also flows out through the central bore 82.

In regeneration, the treatment liquid flows from the bottom up through the bores 82 and 83 and presses the tongues 79 against the lateral bores 77 of the outer ring 73 to prevent passage through such bores 77. The treatment liquid therefore takes the only path open to it, leading through the very narrow aperture 69 of the bell 68. Its pressure is too low to open the tongues 78 of the inner ring 74 and force its way through the outer apertures of the bell 68.

Back-flushing, however, requires a larger flow quantity, calling for a higher pressure of the back-flushing medium, to permit the back-flushing medium to lift the inner tongues 78 and thus open the lateral bores 76, as shown in the dash-dotted position. The flow cross section is thus enlarged accordingly.

Instead of having individual tongues 78 and 79, it is of course possible to install continuous rubber covers in order to close and open the apertures provided.

The feature common to all the variants described is the automatic cross section adjustment in one and the same nozzle, for both normal operation and regeneration of the filter and for ion exchanger, although it will be understood that the embodiments disclosed may be changed without departing from the generic invention.

What is claimed is:

1. A nozzle for the passage of liquids in two opposite directions each with different flow cross sections comprising a housing having a flow path therethrough, a movable float having a bore passing therethrough, said bore being of smaller cross section than said flow path, whereby liquid movement in one direction passes through said flow path of greater cross section and liquid movement in the opposite direction automatically moves said float so that said flow path is through said bore of smaller cross section.

2. A nozzle according to claim 1, further comprising a recess in said housing at the bottom thereof for said float so that said float clears the whole cross section of said flow path during downflow, while in the other direction it closes the said cross section of said flow path with the exception of that of its own bore.

3. A nozzle for the passage of liquids in two opposite directions each with different flow cross sections comprising a housing section having flow paths therethrough with different flow cross sections, a plurality of annularly disposed tongues which automatically set the flow cross section in operation according to the particular flow direction, said tongues comprising a first set adapted to open under downward flow and close under upward flow, and a second set coaxially disposed with respect to said first set of tongues and adapted to open under upward flow of a predetermined pressure.