Oct. 17, 1961 R. C. ADAMS 3,004,668

UNDERDRAINS

Filed Jan. 29, 1960 2 Sheets-Sheet 1

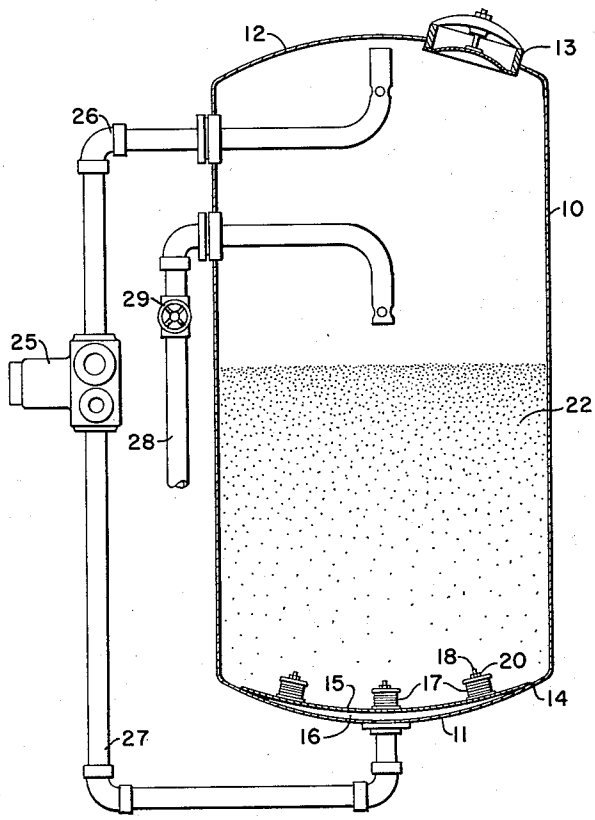


Fig. - 1

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UNDERDRAINS

Filed Jan. 29, 1960 2 Sheets-Sheet 2

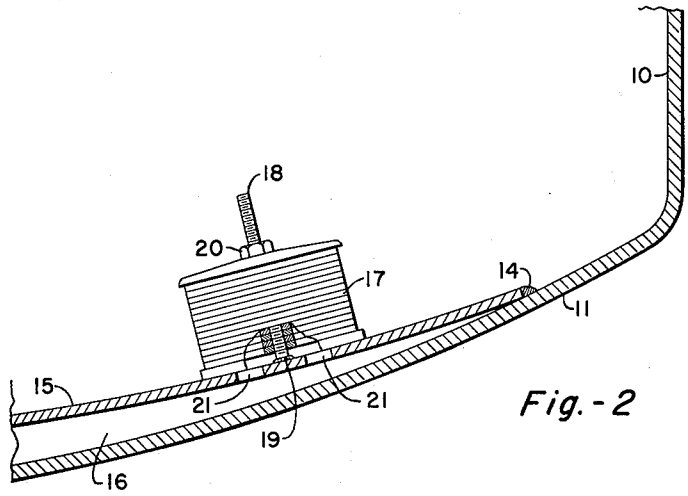


Fig.-2

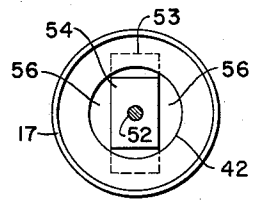


Fig.-4

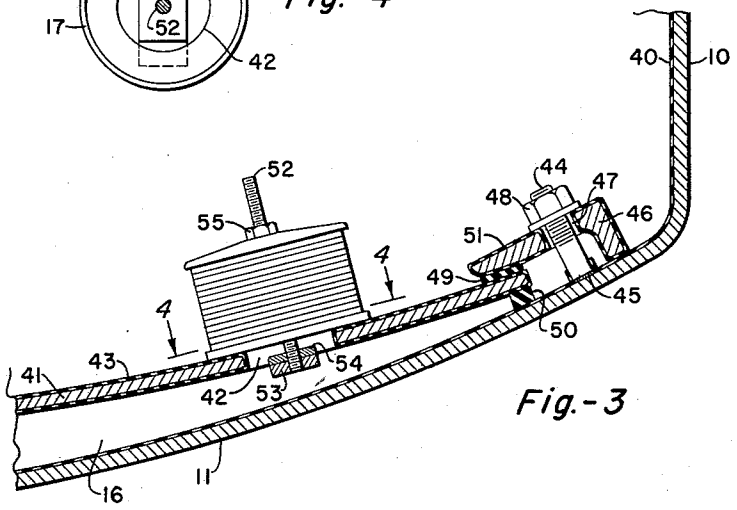


Fig.-3

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3,004,668

UNDERDRAINS

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1 Claim. (Cl. 210—293)

This application is a continuation-in-part of my copending application, Serial No. 812,965, filed May 13, 1959 and now abandoned.

This invention relates to underdrains for tanks having a dished tank bottom which comprises a dished false bottom having a spherical radius of curvature greater than the spherical radius of curvature of said tank bottom and an outside diameter smaller than the outside diameter of said tank bottom, means for fastening said false bottom to the top side of said tank bottom along the periphery of said false bottom, an underdrain space located between said tank bottom and said false bottom, a plurality of openings in said false bottom communicating with said underdrain space, and a pipe connected with said tank and communicating with said underdrain space, all as more fully described hereinafter and as claimed.

It is an object of this invention to provide an underdrain for filters, water softeners and other ion exchange units which is simple in design, relatively inexpensive in manufacture and effective as well as trouble free in operation.

The manner in which the foregoing object is achieved is shown in the appended drawings in which:

FIG. 1 is an elevational view, partly in cross section, of an apparatus in which my invention is incorporated;

FIG. 2 is a fractional view, on an enlarged scale, of the lower right hand portion of the apparatus shown in FIG. 1;

FIG. 3 is a view, similar to FIG. 2, of a modification of my invention; and

FIG. 4 is a plan view in section along line 4—4 of FIG. 3.

Referring now to FIG. 1, there is shown an ion exchange apparatus comprising a tank 10 having a dished tank bottom 11 and a dished tank top 12 fitted with a manhole and cover 13. The spherical radius of curvature of the tank bottom 11 and tank top 12 is usually made approximately equal to the diameter of the tank. Fastened to the top side of the tank bottom 11, as by welding 14, is a false bottom 15 having a spherical radius of curvature greater than that of the tank bottom 11 and an outside diameter smaller than that of the tank bottom 11, as shown. Thus, there is formed an underdrain space 16 located between the tank bottom 11 and the false bottom 15.

On the top side of the false bottom 15 is mounted a plurality of strainers 17 which, as shown, are of the disk type disclosed in Pick Patent 2,743,016 dated April 24, 1956. The strainers 17 are mounted by means of studs 18 welded to the false bottom 15 at 19, nuts 20 screwed onto the studs 18 holding the strainers 17 firmly against the false bottom 15. Openings 21 in the false bottom 15 (FIG. 2) serve to establish communication between the underdrain space 16 and the interior of the strainers 17. The lower portion of tank 10 holds a bed 22 of ion exchange material.

Flow through the apparatus is controlled by a multiport valve 25, such as shown in Staegemann Patent 2,051,155 dated August 18, 1936. The multiport valve 25 is connected by a pipe 26 with the top portion of tank 10 and by a pipe 27 with the underdrain space 16. A regenerant pipe 28 controlled by a valve 29 terminates above the bed 22 within the tank 10.

In operation of the apparatus shown in FIG. 1 the multiport valve is connected to a source of water to be treated, to a point of use and to a drain (not shown). In service water to be treated flows from the multiport valve 25 through pipe 26 to the top of the tank 10, down through the bed 22, thence through strainers 17 and openings 21 into the underdrain space 16, and out through pipe 27 to the multiport valve 25. When the bed 22 of ion exchange material has been exhausted in its capacity it is usually backwashed by a reversal of the flow of water just described effected by a change in position of the multiport valve 25. Then the bed is regenerated by admitting a regenerant solution through pipe 28 and open valve 29; this regenerant solution flows down through bed 22, and through strainers 17, openings 21, underdrain space 16, pipe 27 and multiport 25 to waste.

The modification shown in FIGS. 3 and 4 is especially suitable for units in which highly corrosive liquids are handled, as in the case of a bed of cation exchange material operating on the hydrogen cycle and regenerated with sulfuric or hydrochloric acid. Here the interior of tank 10, including tank bottom 11 and tank top 12 is protected by a lining 40 consisting of rubber, polyvinyl chloride or any other suitable material. In this construction there is a false bottom 41 provided with single openings 42 at the location of each strainer 17. The entire false bottom 41 is protected by a lining 43 which, as shown, also covers its peripheral edge and the sides of the openings 42. Adjacent the periphery of the false bottom 41 stainless steel studs 44 are welded to the tank bottom 11 at 45, and the lining 40 covers the weld 45 and extends partway up the shank of studs 44. The false bottom 41 is fastened to the tank bottom 11 by means of L-shaped brackets 46 having holes 47 fitting over the studs 44. Nuts 48 hold the brackets 46 down so that one end of each bracket 46 is pressed against the tank bottom 11 while the other end is pressed against the false bottom 41. Cushioning pads 49, are placed between the brackets 46 and the false bottom 41, and an annular gasket 50 is placed between the false bottom 41 and the tank bottom 11, the pads 49, and the gasket 50 being made of a soft, resilient material, such as pure gum. The brackets 46 are economically made from cast-iron and protected all over by lining 51, or they may also be made from stainless steel in which case lining is not necessary.

In the construction of FIGS. 3 and 4 the strainers 17 are mounted on the top side of the false bottom 41 by somewhat different means. Studs 52 have their lower ends screwed into cross bars 53 and rectangular spacers 54. The cross bars 53 are on the underside of the false bottom 41, the spacers 54 are located in the openings 42, and nuts 55 screwed onto studs 52 hold the strainers firmly but removably in place. Communication between the underdrain space 16 and the interior of strainers 17 is established by segmental areas 56 shown in FIG. 4. The studs 52, cross bars 53, spacers 54 and nuts 55 are made from corrosion resistant material, e.g. stainless steel.

In manufacturing the construction shown in FIG. 3, the false bottom 41 is placed loosely inside tank 10 before the tank heads 11 and 12 are welded on, then the lining 40 and 43 is applied to the interior of tank 10 and to the false bottom 41, respectively. For assembly a workman enters tank 10 through the manhole 13 and fastens the false bottom 41 to the tank bottom 11 by applying the brackets 46 and nuts 48. He then mounts the strainers 17 on the top side of the false bottom 41 by first loosening the nuts 55 a few turns. He inserts the crossbars 53 into the openings 42 by tilting them and then tightens the nuts 55, the spacers 54 automatically centering each strainer 17 over each hole 42.

As has been stated above, the spherical radius of curvature of the false bottom 15 or 41 is greater than that of

the tank bottom **11** in order to provide an underdrain space **16** of appropriate size. This space **16** must be large enough not to cause undue pressure loss to the flow of liquid therethrough which means that the vertical distance between the tank bottom **11** and the false bottom **15** or **41** at the center should not be less than one-quarter the internal diameter of pipe **27**; the space **16** must also be high enough to permit the insertion of the cross bars **52** in a tilted position when the modification of FIG. 3 is used. I have found that on relatively small tanks of about 3 feet in diameter the radius of curvature of the false bottom must be at least about 60 percent greater than the radius of curvature of the tank bottom whereas on relatively large tanks of about 10 feet in diameter it must be at least about 40 percent greater in order to meet the foregoing requirements. There is no critical upper limit for the radius of curvature of the false bottom, but in general it is not desirable to make such radius unnecessarily large because that makes it structurally less strong in its resistance to pressure differences between its two sides, and that also increases the volume of the underdrain space so that more water is required to flush out all regenerant at the end of regeneration.

It has also been stated above that the outside diameter of the false bottom **15** or **41** is smaller than the outside diameter of the tank bottom **11**. I have found it most advantageous to make the outside diameter of the false bottom about 0.80 to 0.96 times the outside diameter of the tank bottom, the smaller figure applying generally to relatively small diameter tanks, and the larger figure applying generally to relatively large diameter tanks. The fact that the false bottom is made substantially smaller than the tank bottom aids greatly in reducing the volume of the underdrain space **16**, a most desirable feature as explained in the preceding paragraph, and leaves also adequate room outside the periphery of the false bottom for fastening it to the tank bottom. The smaller diameter of the false bottom, furthermore, makes possible the relatively simple and inexpensive construction of a lined tank shown in FIG. 3; if the false bottom had an outside diameter approximately equal to the inside diameter of the tank, as in conventional prior art designs, it would be impossible to line the false bottom inside the tank, as described above, and a more complicated and expensive flanged construction would have to be used. On the other hand, the false bottom must not be so small that the outer strainers mounted on it cannot effectively distribute liquid to, or collect liquid from, the portions in tank **10** adjacent to its outer wall.

While I have shown what I consider the preferred embodiments of my novel underdrain as applied to a pressure type ion exchange unit it may of course be used in water filters, activated carbon purifiers and other liquid treating equipment employing a bed of treating material; it may also be used on gravity type units with tanks having an open top. In lieu of the strainers **17** a conventional subfill of graded gravel may be placed on the false bottom **15** or **41** to support the bed **22**, the openings **21** or **42** being made of a size suitable to effect uniform distribution of the flow. Other modifications may be made without departing from the spirit of my invention, and reference is, therefore, made to the following claim for a definition of the scope of my invention.

What I claim is:

An underdrain for a cylindrical tank having a spherically curved dished tank bottom, which comprises a dished false bottom having a spherical radius of curvature at least forty percent greater than the spherical radius of curvature of said tank bottom and an outside diameter equal to 0.80 to 0.96 times the outside diameter of said tank bottom, means spaced toward the inside from the periphery of said tank bottom for fastening said false bottom to the dished top side of said tank bottom along the periphery of said false bottom, an underdrain space located between said tank bottom and said false bottom, a plurality of openings in said false bottom communicating with said underdrain space, a plurality of strainers mounted on the top side of said false bottom and communicating with said openings, and a pipe connected with said tank and communicating with the central portion of said underdrain space.

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