April 15, 1947. L. W. BIEKER ET AL 2,419,004

TANK STRUCTURE FOR LIQUID TREATMENT

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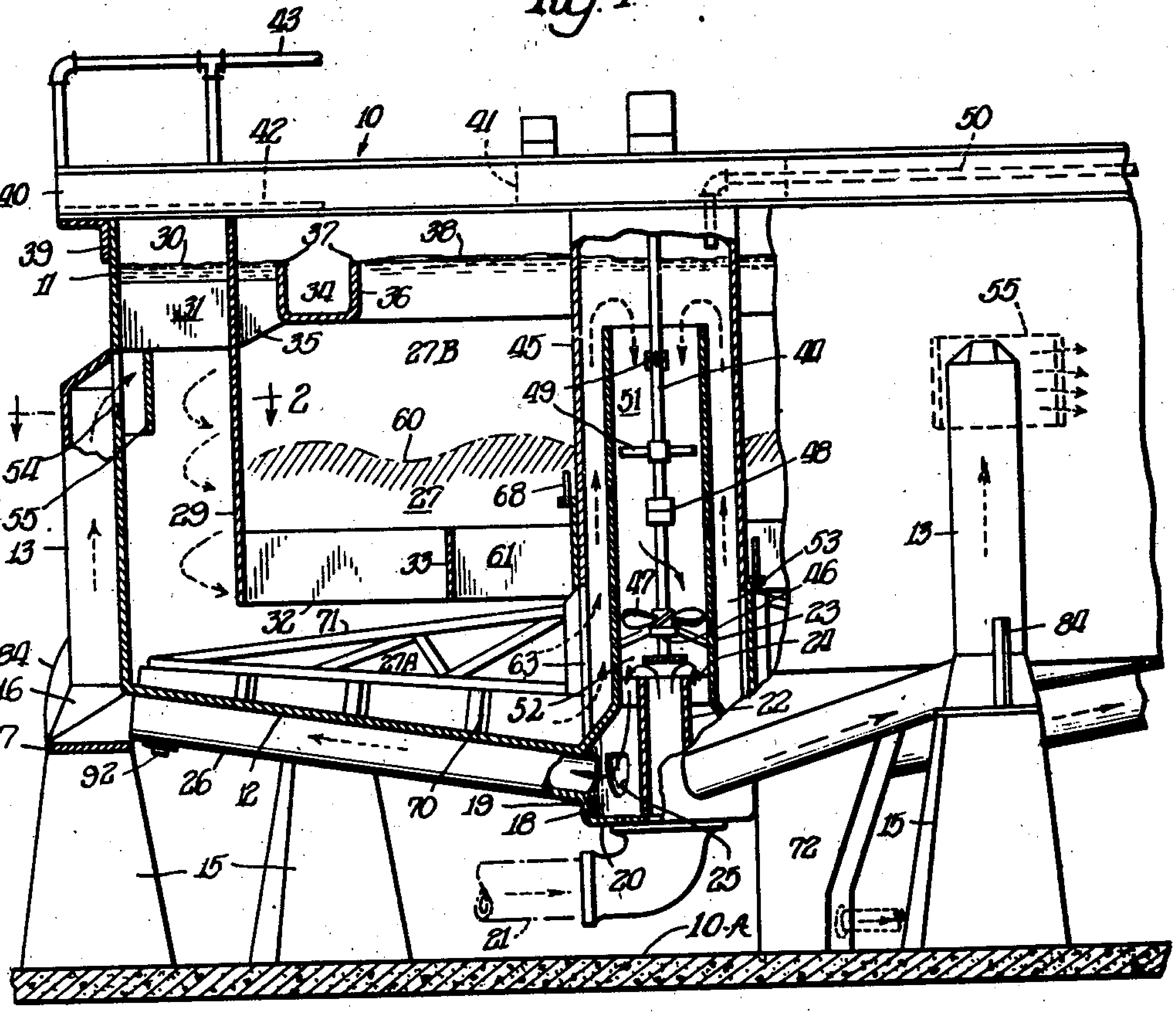
Fig. 1



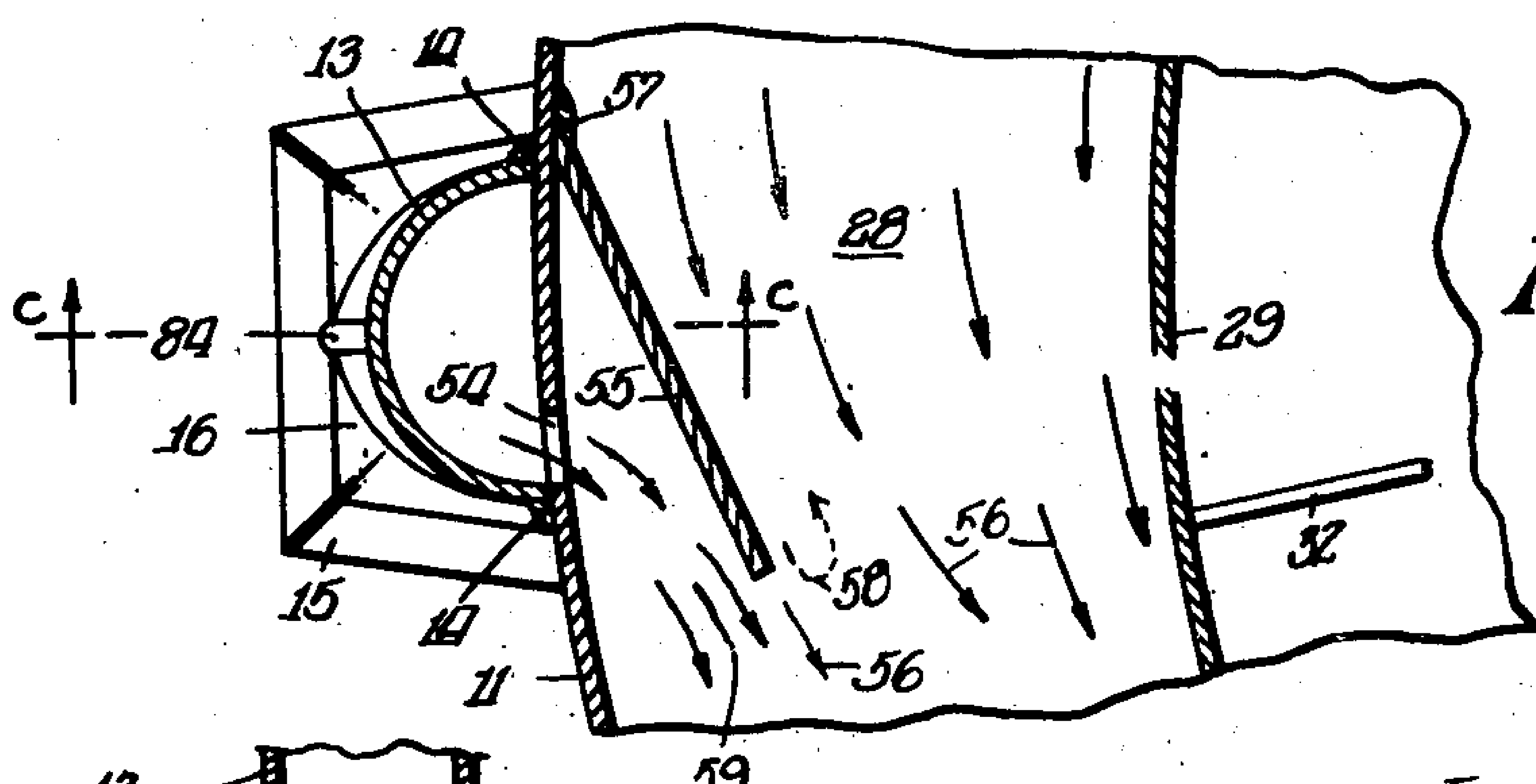


Fig. 2

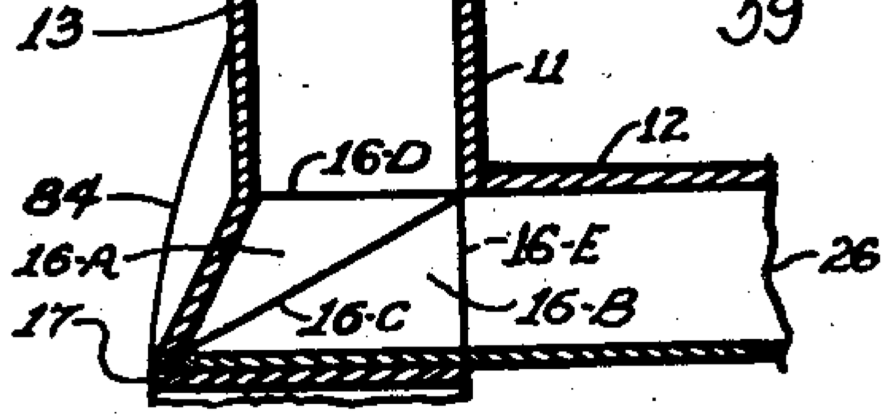


Fig. 2-C

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Fig. 3

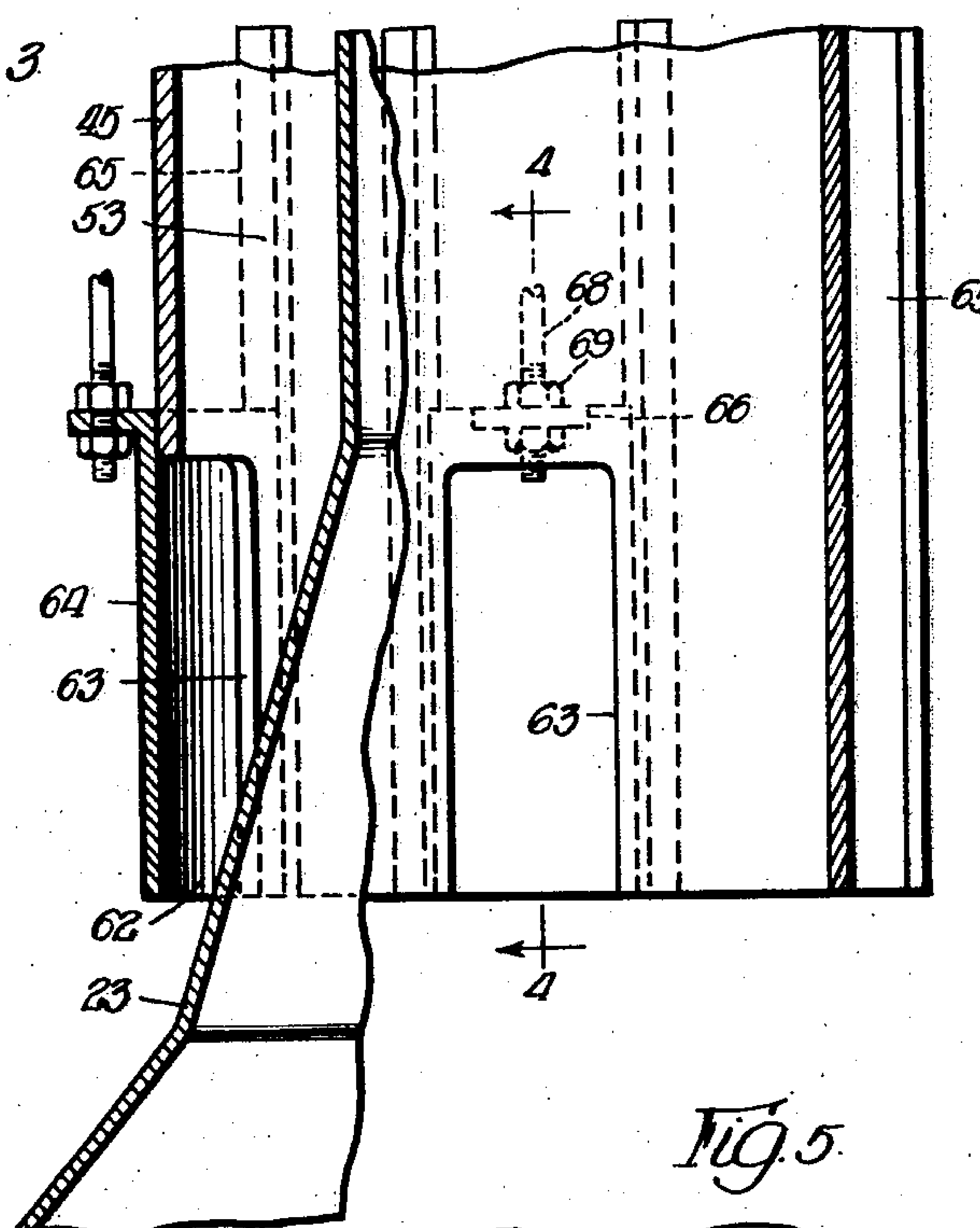


Fig. 4

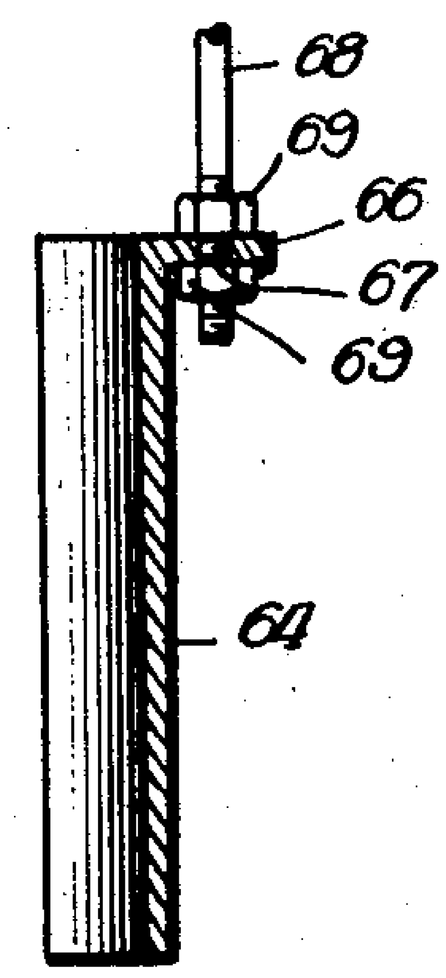


Fig. 5

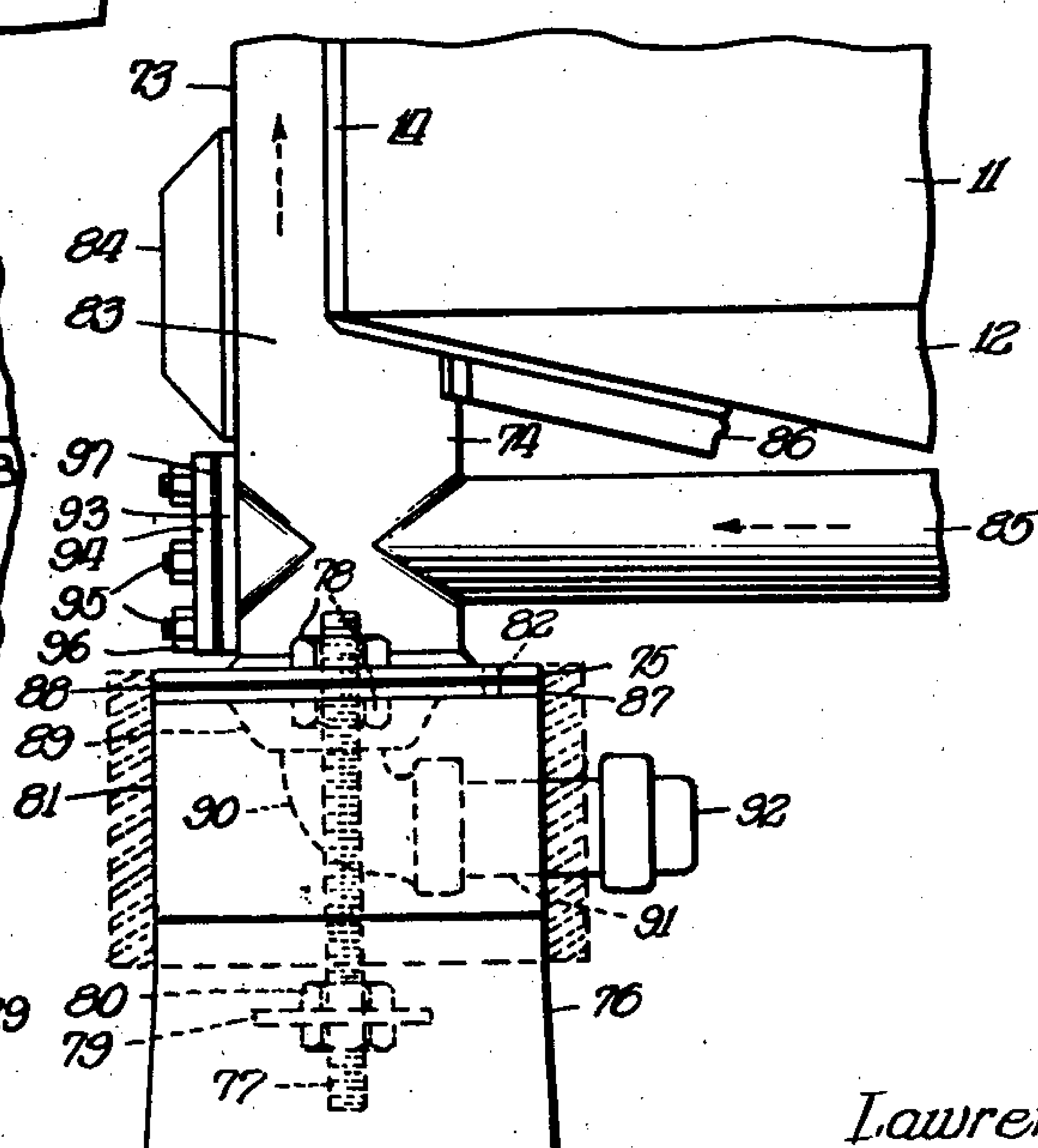


Fig. 2-A

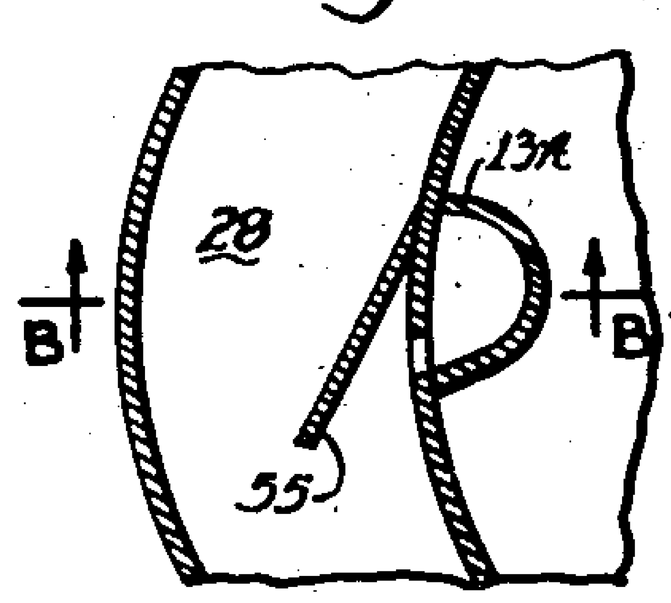
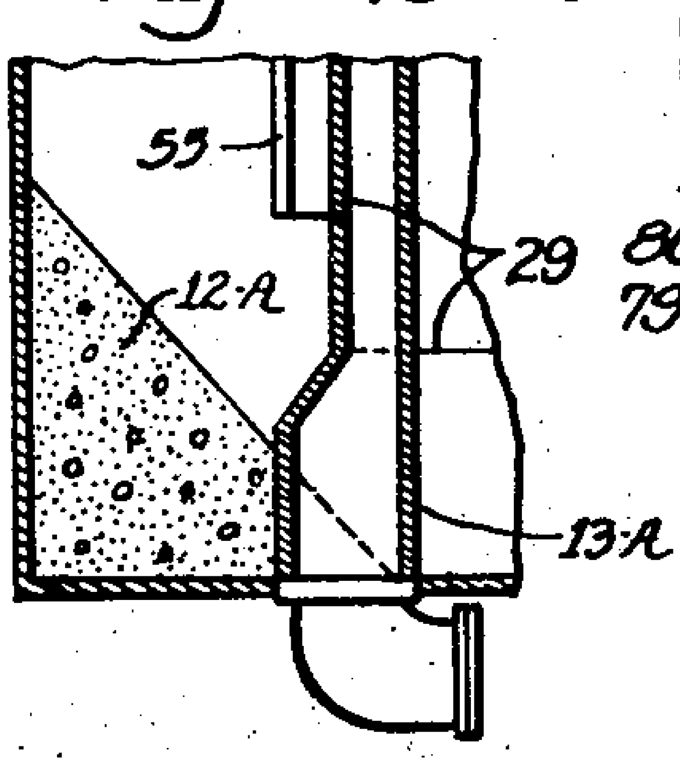


Fig. 2-B



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Patented Apr. 15, 1947

2,419,004

UNITED STATES PATENT OFFICE

2,419,004

TANK STRUCTURE FOR LIQUID TREATMENT

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Application June 9, 1944, Serial No. 539,524

3 Claims. (Cl. 210—16)

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This invention relates to liquid treatment apparatus, and particularly to a sludge blanket device for accelerated precipitation.

It is an important object of our invention to provide such a device which is efficient in operation and at the same time economical to build.

A specific object is to economize by using certain parts for a variety of structural and functional purposes at the same time.

Another specific object is to provide improved and simplified control means in such a device.

Still another object is to provide such a device with a maximum use of pre-fabricated parts.

In the drawing, Fig. 1 is an elevation, partly in section, of an embodiment of our invention. Fig. 2 is a partial, sectional view taken along lines 2—2 in Fig. 1 and showing details thereof. Fig. 2—A shows a slight modification of the details of Fig. 2, in a similar view. Fig. 2—B is a section through Fig. 2—A along lines B—B. Figure 2—C is a section through Figure 2 along lines C—C. Fig. 3 is an enlarged and slightly modified detail of further parts appearing in Fig. 1. Fig. 4 is a sectional detail from Fig. 3. The section is taken along lines 4—4 in Fig. 3. Fig. 5 is an enlarged detail of other parts in a modified embodiment.

Our tank 10 has an outer, cylindrical wall 11 of steel, and a steel bottom 12 in the form of an inverted cone with slight inward inclination. The top of the tank is open. Hollow, semi-cylindrical members 13 are provided on the outside of the wall 11, preferably at uniform distances from one another, and extending vertically from adjacent the bottom 12 to above the bottom and below the top of the tank, with the concave sides of the half-pipes facing the wall. These hollow, semi-cylindrical members extend along and are integrally secured to said wall by continuous fillets 14 of weld material so that the outside of the tank cooperates with said members to form conduits. They are conveniently made by flamecutting commercial steel pipes longitudinally, and are therefore referred to as half-pipes. At least three such half-pipes 13 must be provided, so that they can serve as structural supports. These half-pipes together with the tank form conduits, as mentioned, and four or six or more such conduits are desirable, in some instances. They are uniformly distributed around the tank. Our tank, in its preferred form as shown can be designated as an elevated liquid treatment tank, having members 13 which simultaneously serve as conduit members for the liquid treatment, and

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support the tank, its outer wall 11 and its contents above the ground 10—A.

Each half-pipe 13 rests on an individual column, concrete post or foundation member 15. Thus it can be said that the tank 10 has hollow pilasters 13, secured to the outside of its vertical side wall 11 and resting on columns 15, whereby the tank is supported. Welded elbow and support fittings 16 are interposed between the bottom end of each half-pipe 13 and the top of the respective post 15, and shims 17 may be inserted to level the tank 10. One part of each elbow fitting is welded to the respective half-pipe, while the other parts are directed toward the center of the tank. Each elbow 16 may consist of plate sections 16—A and 16—B suitably cut and formed and welded together along the line 16—C. The section 16—A may have its top or outlet port welded to the bottom of a half-pipe 13 along the line 16—D, while the section 16—B may have its free end or inlet port 16—E directed toward the center of the tank.

In the lower, central part of the tank, a distributing sump 18 is formed by a cylindrical, apertured steel wall 19, depending from the bottom 12 and surrounding this sump; the bottom 12 having a circular opening corresponding with this cylindrical wall. The lower end of the sump is closed by a steel plate 20. The raw water inlet pipe 21 enters the tank through the plate 20, and the discharge end 22 of this pipe, a vertical nipple, is welded to the inside of the plate 20. This nipple is surrounded by a conico-cylindrical guide member 23 of welded construction, which is secured to the bottom 12 adjacent the cylinder 19, and extends upwards to a point below the top of the tank. Radial, vertical vanes 24 are welded to the outside of the nipple 22 and to the inside of the guide 23, above the bottom plate 20, and below the top of the guide 23.

The apertures 25 in the cylindrical wall are semi-circular, with the diameters parallel to the plane of bottom 12 and adjacent thereto. These openings correspond to the half-pipes 13 in number and in angular location relative to the tank. Between each aperture 25 and corresponding half-pipe 13, a semi-cylindrical distributing steel duct 26 extends radially below and adjacent to the bottom 12, being welded to the cylindrical wall 19 at the inner end, to the free end 16—E of the fitting 16 at the outer end, and to the bottom 12 between these ends. These ducts 26, again, are half-pipes, and are made like the vertical ducts 13. Thus the central distributing sump communicates with the six vertical half-pipes by six more or less horizontal distributing members; and these, at the same time, serve to reinforce the tank bottom.

The tank 10 is subdivided into an inner clarification and sludge filtration zone 27 of great area and an outer, or peripheral flocculation zone or channel 28 of smaller area, by a cylindrical steel baffle or wall 29 installed concentrically with the tank and extending from the open top of the tank to above the bottom 12. Each of these two zones preferably fills at least the major part of the depth of the tank; however, only the clarification zone and not the flocculation zone, as shown, extends up to the very top, and the uppermost part of the outer channel functions as a scum release zone 30, by virtue of radial stilling baffles made of steel plates 31, spanning at least part of the depth of this top part, at close angular distances from one another.

These stilling baffle plates can serve or cooperate at the same time to center and to support the cylindrical baffle 29.

The cylindrical baffle, in turn, may carry flow deflecting baffles 32 radially projecting into a lower part of the clarification zone 27, above the bottom 12; the inner ends of such deflecting baffles being spaced from one another and held rigid by a cylindrical holding ring 33 welded thereto. The diameter of the holding ring 33 generally is about one-quarter to two-fifths that of the large baffle 29.

The inside of the large, cylindrical baffle 29 carries also an annular effluent launder 34, adjacent the top of the tank. This launder is supported by radial brackets or gusset plates 35, preferably welded to the large, cylindrical baffle 29 along lines opposite the weld seams connecting the outer, supporting plates 31 to the large, cylindrical baffle 29. The launder comprises upstanding walls 36, having top edges 37 which serve as overflows, determining the lowest level 38, to which the water in the clarification zone can fall after the tank has been filled; the uppermost water level being controlled in usual manner, by means not shown.

The top of the tank wall 11 is reinforced by an annular, flanged beam 39, and supports two straight, parallel, transverse beams 40 which span the tank. Between these transverse beams, in the center of the tank, we install a drive assembly 41, which need not be described in detail. These transverse beams may serve or cooperate, in some instances, to hold the large, cylindrical baffle 29 and parts mounted thereon. We provide access to the drive assembly by a walkway 42, installed between the beams and protected by handrails 43, as usual.

Depending from the drive assembly 41, we provide an agitator and circulator shaft 44 adapted to rotate rapidly, and a drum 45, concentrically surrounding this shaft and adapted to rotate slowly.

The rapid shaft 44 extends downwardly into the interior of the liquid guide member 23 to a point adjacent the discharge end of the nipple 22, where it is centered by a bearing 46; a pumping and circulating propeller 47 being carried by the shaft immediately above the bearing 46. A flexible coupling 48 is interposed on the shaft. The shaft also carries straight, radial stirring paddles 49, in the zone above the propeller 47 and within the drum 45 and guide member 23.

This zone receives the newly incoming chemical reagents, if any, through a pipe 50 entering at the top, and is identified as chemical mixing zone 51, the chemicals being mixed with recirculated sludge and liquid in this zone. The subjacent zone 52 within the guide 23, below the propeller 47, is identified as water mixing zone, being used to mix the newly incoming water from nipple 22, if any, with the chemicals and recirculated materials from zone 51. It will be understood that the pipe 50, and other parts such as members 23, 29, etc., are associated with the tank in order to provide for the necessary liquid treatment and to separate sludge from the liquid in the tank.

The drive 41 and propeller 47 are adapted to induce a downward fluid flow through the zone occupied by the propeller. A central transfer passage 53 is provided, between the open bottom end of the drum 45 and top of the guide 23, outside of this guide; and outer transfer passages 54 are provided between the top parts of the vertical half-pipes 13 and the channel 28, through the tank wall 11. Thus the propeller 47 is adapted to induce fluid circulations through a system of closed pathways passing from the zone of propeller 47 through the water mixing zone 52, distributing sump 18, distributing half-pipes 26, vertical half-pipes 13, outer transfer passages 54, flocculating channel 28, the bottom part 27—A of the sludge filtration zone 27, central transfer passage 53, and chemical mixing zone 51, back to the zone of propeller 47.

The aforementioned zones 53, 51, 52, 18, 26, 13, and 54 are generally dimensioned so that, on proper rotation of the propeller 47, a mixture of water and sludge which has been properly pretreated in a manner to be described, passes continuously through all of said zones at a velocity within the approximate range of one to two feet per second (720 to 1440 inches per minute) although in some instances, and at some points, limiting liquid velocities as low as about 6 inches per second or as high as about 5 feet per second (360 to 3600 inches per minute) may be reached. This general range of velocities of about 1000 inches per minute, more or less, is identified as mixing and transfer velocity. The complete passage 53, 51, 52, 18, 26, 13 and 54, wherein such a mixing and transfer velocity prevails, is identified as a mixing and transfer zone, with the propeller 47 located therein. The transfer and mixing zone, furthermore, is so dimensioned, with respect to the maximum amount of raw water issuing from the nipple 22 that such water, together with the recirculated sludge, is held in said mixing and transfer zone for about fifteen to sixty, or generally about thirty seconds, more or less, not counting the central passage 53 and the chemical mixing zone 51.

In front of the transfer passages 54, in the flocculating zone 28, guide baffles 55 are installed to deflect all of the incoming circulating fluid from the several distributing half-pipes 13 into a single, approximately circular or helical pathway coinciding with the annular flocculating zone 28, as indicated by the arrows 56 in Fig. 2. For this purpose, we provide rectangular baffle plates welded to the inside of the wall 11 adjacent to the outer transfer passages 54, as shown at 57, at an acute angle with the wall, so as to avoid any substantial restriction of the annular pathway 56 and to make sure that the local eddies 58, which are unavoidably formed past the baffles 55, are not so large as to unduly interfere with the desired, circular movement of the liquid in the annular channel zone 28. Preferably, we make the passages 54 rectangular, somewhat smaller in area than the half-pipes 13, and with the long side vertically disposed. We shape and place each deflector baffle 55 so that the passage 59 between the baffle and the wall 11 forms a nozzle having a gradually expanding area, to insure gradual recovery of head, and absence of excessive eddies 58. No horizontal guides for the liquid above or below the baffles 55 are generally required or desirable. In addition to the vertical half-pipes 13 supporting the outer wall 11 we may also provide similar half-pipes in weight supporting relationship with the large cylindrical baffle 29, as shown at 13—A in Figs. 2—A and 2—B.

In the embodiment modified in accordance with said figures, half-pipes 13—A are distributed around, vertically disposed along, and integrally welded to the inside of the annular wall or baffle 29. These half-pipes 13—A and the baffle 29 welded thereto may be supported, as well as supplied with circulating liquid, from the bottom of the tank adjacent the inside of the flocculation channel 28, as shown. As a result, it is of course impossible to scrape sediment from the bottom of the flocculation channel 28 by scrapers pivoted in the center of the tank. For this reason, a concrete cornerfill 12—A may be provided in the bottom of said channel, having sufficient inward slope to cause any sludge settling thereon to slide inwardly and downwardly into the bottom part of the clarification zone, where the scrapers operate.

The dimensions of the peripheral flocculating channel 28 are such that the liquid velocity, in the circular or helical pathway 56, is further diminished to a considerable extent, after the gradual decrease, in the passages 59, from the mixing and transfer velocity. Generally, we provide for a horizontal liquid circulation at a speed of about one to fifteen inches per second (60 to 900 inches per minute), with a preferred, average velocity of about 5 inches per second (300 inches per minute), in the horizontal plane adjacent the centers of the outer transfer passages 54. This range of liquid velocities, about 300 inches per minute, more or less, is identified as flocculating velocity, and is generally conducive to the formation of large and heavy flocs, in a liquid treatment as contemplated herein. Such flocculating velocity may also be conducive to the settling of at least some flocs, of greatest settleability, while the bulk of the flocs are generally entrained by the liquid horizontally circulating at such a rate. Of course, in a plane adjacent the bottom 12, in the flocculating zone 28, and parts of the clarification zone 27, somewhat slower velocities prevail, which however, are still in the range of flocculating velocities; a smooth, annular, substantially unobstructed passageway 56 being provided throughout at least a major portion of the flocculating zone 28. The flocculating zone is so dimensioned as to provide a detention period of about two to six minutes for the flow of liquid mixed with recirculated sludge; generally about five minutes.

The clarification and sludge filtration zone 27, as mentioned, has greater area than the flocculation channel 28. Any throughput flow through this clarification zone is generally upward, towards the weirs 37, and must be kept within a range of maximum rates of not more than about 2 or 4 inches per minute, depending on the specific type of treatment. This range of about 3 inches per minute, more or less, is identified as capacity rising rate. It is calculated by dividing the amount of water entering through the nipple 22, or leaving through the launder 34, by the area of the sludge bed zone 27, more particularly by the area of the upper clarification zone 27—B, forming the upper part of this zone 27 and which is substantially unobstructed by sludge. The rising rate must not be substantially higher than indicated, because otherwise, the top of the sludge bed, filter or blanket 60 would rise to a level dangerously close to the weirs 37, and in the body of the sludge bed, insufficient contact of water and sludge would be maintained. The clarification and sludge filtration zone is so dimensioned, with respect to the maximum or capacity amounts of raw liquid entering through the nipple 22, as to provide a detention time of about 40 to 120 minutes, with an average of about 60 minutes.

The throughput velocity, if any, is augmented by the circulation induced by the propeller 47; and this results in the aforementioned increased total velocities in certain parts of the clarification zone, as well as elsewhere.

This circulation passes through the bottom part 27—A of the clarification zone, over the bottom 12, in spiral directions, due to the previous circular or helical flow. The velocity of this spiral flow over the bottom 12 is approximately that prevailing in the bottom part of the flocculation channel; it is somewhat less in the outer parts of the zone 27—A, due to the slight loss of head and velocity incident to turning around the lower end of the annular baffle 29; and the linear velocity may be greater adjacent the center of the zone 27—A, where the propeller 47, through the central transfer passage 53, exerts a suction effect on this spiral flow, and where a vortex may be formed. The spiral flow in the zone 27—A serves the purpose of distributing the liquid to be treated throughout the bottom part of the sludge filter 60, and the said velocities of this spiral flow are identified as distributing velocities.

Parts of the spiral flows in the zone 27—A are vertically deflected by the radial baffles 32, resulting in upward flows in front of each baffle 32. If these baffles are closely spaced, such upward flows may be negligible, and the baffles are then referred to as stilling baffles. With increased distances between the baffles 32, a more substantial upward flow will occur in front of each baffle and the baffles are then identified as deflectors. These upward flows serve the function of suspending some of the sludge up to higher levels than would be reached otherwise in the sludge bed 60; their velocities are identified as sludge suspending velocities, and are generally maintained within a range of about 5 to 60 inches per minute, by a proper arrangement of the baffles 32. The actual velocity of each upward, sludge suspending flow tends to decrease rapidly as the flow proceeds upwardly, due to the dropping off of large and heavy sludge particles, and downward entrainment of liquid particles by the same. Thus an upward, sludge suspending flow, at a decreasing rate, in front of each baffle 32, is accompanied by a slower, downward flow, completing what is identified as a secondary, vertical circulation. Such secondary circulations take place between the baffles 32 and sometimes up to a level above these baffles. However, secondary circulations at appreciable velocities are prevented from reaching the top of the tank, by said arrangement of the baffles, and other factors. The precise directions and average velocities of these vertical circulations depend on the composition and temperature of the water and sludge in the spiral, distributing flow, as well as on the velocity thereof, and the distances between the baffles 32. The average velocity of the secondary circulations, called secondary circulating velocity, generally amounts to about 10 inches per minute, more or less, depending on the various factors mentioned, which must be selected and empirically controlled to suit the particular conditions of each treatment and locality. Higher secondary velocities can be used sometimes, especially where excess sludge is removed at an elevated point, and where the sludge has a high specific gravity.

The various average, approximate velocities and detention periods mentioned can be resumed and tabulated as follows:

Zone	Velocity	Detention Period
	in./min.	*min.*
Mixing and transfer	1000 (throughput and circulation).	.5 (throughput and circulation).
Flocculating	300 (throughput and circulation).	5.0 (throughput and circulation).
Distributing	300 (throughput and circulation).	
Sec. Circulating	10 (throughput and circulation).	60.0 (throughput alone).
Upper Clarification	3 (throughput alone)	

In operation, circulation is constantly induced and maintained by the propeller 47, and any throughput flow received is combined therewith in the water mixing zone 52. In many instances, the circulation is uniform and relatively rapid, and involves greater amounts of flow than are brought in even by the maximum or capacity input, in order to safely suspend a sludge bed regardless of variable throughput flows. The combined flows proceed through the transfer zone, at the rapid transfer velocity. This results in intimate admixture of the new water, recirculated water and sludge, and new chemicals. More intimate admixture could be achieved at still higher transfer velocities. However, this would lead to an excessive break-up of recirculated sludge particles. Actually, there is some break-up of recirculated sludge particles at the transfer velocities as stated; however, it is kept within moderate limits, whereby it actually serves to produce a particularly well settleable type of floc.

The building up of larger and heavier particles, with consequent elimination of smaller and lighter ones, occurs mainly in the flocculation zone 28, but also throughout the sludge bed 60. On the other hand, the largest particles are ultimately eliminated by gradual sedimentation, and this occurs mainly in the sludge bed 60, although sedimentation may start in the flocculation zone 28.

The aforementioned secondary circulating and capacity rising velocities are very critical, since for best results, they should (1) induce a maximum of sludge build-up in the sludge bed, but also (2) allow proper sedimentation in this bed, and finally, of course, (3) prevent objectionable boilups of dense clouds of sludge towards the overflow weirs. The velocities must and can be empirically balanced, by adjustment of the circulator drive, when a tank of this type is put in operation; and re-adjustments may be required from time to time, especially if the character of the raw water is subject to change.

Of course, this equilibrium of conditions and tendencies in the sludge bed must not be disturbed by excessive surges. However, surges do occur sometimes, in any water supply system. Any surges, inherently, tend to spread through the inlet nipple and transfer passages into the flocculation zone and from there, at a decreased but

positive rate, into the sludge bed. Normal surges, which must be expected, can be made harmless by holding the top level of the sludge bed at a safe elevation, by proper dimensions and flow rates.

Furthermore, the design involving the cylindrical baffle 33 is an aid towards avoiding bad effects of relatively major surges. When such surges arrive in the sludge bed, they are generally local in character, not uniformly distributed. They are felt most strongly in the central part, where the spiral distributing flow has a maximum velocity. The central cylindrical zone 61, defined by the cylindrical baffle 33, is unobstructed, and allows horizontal equalization of substantial surges, thereby preventing objectionable boilups.

In order to put our tank in operation, and to re-start it after a shutdown, we have to provide a sludge bed, in well-known manner. Such starting and re-starting operations are facilitated by the construction of the inlet to the central transfer passage 53, as shown in Figs. 3 and 4.

The drum 45 is open at the bottom, and provides a bottom inlet 62, between the inside of the drum and the outside of liquid guide member 23. As shown in Fig. 3, the outside of the conical portion of this liquid guide member is relatively close to the inside of the drum, adjacent this bottom inlet 62, so that the area of this bottom inlet is relatively small, and when all of the circulating liquid enters here, the quantity is limited but the velocity thereof is within a relatively high section of the range of transfer velocities.

The drum 45 also has side inlets 63 to the passage 53, and gates 64 to control these side inlets. These gates are guided by vertical tracks 65 secured to the drum 45. Each gate has a projecting lug 66, with a vertical hole 67 through the same, and a vertical rod 68 extending through and upwardly from this hole and secured to the lug by bolts 69; the bottom of the rod being threaded. The rods 68 are used to raise and lower the gates 64, in obvious manner, which need not be described as to mechanical details.

Preferably, all gates are lowered before and during a starting or re-starting operation. As a result, sludge can be picked up, recirculated and re-supplied to the flocculating and sludge filtration zones, soon after the beginning of a starting or re-starting operation, through the restricted opening 62 at the lowest point of the drum 45. All gates are preferably raised for normal operation, so that large amounts of suspended sludge can be recirculated through the enlarged passages 62 and 63, with a minimum of restriction, sludge break-up, and wastage of power.

These gates 64 can be used also to adjust the rate of sludge recirculation, which, as mentioned, is of great importance for a proper equilibrium of conditions in the sludge bed. With proper dimensions of the drum 45, guide 23, and side openings 63, the circulating velocity can be controlled over a wide range, with or without a variable drive in the unit 41.

The sludge settling on the bottom 12 is collected by scrapers 70 on trusses 71 secured to the slowly rotating drum 45. The collected sludge accumulates adjacent the center of the tank, in a conventional sludge sump 72 depending from the bottom 12, until it is ultimately withdrawn in well-known manner.

Certain parts of this device can be pre-fabricated with advantage. This applies mainly to the sub-assembly of the drum 45 with the gates 64; the sub-assembly of the liquid guide 23, vanes

24 and nipple 22; the sub-assembly of the cylinder 19 and plate 20; the fittings 16; and, of course, the drive unit, the agitator, the scraper trusses, and the sludge sump.

Various modifications can be applied.

For instance, Fig. 5 shows the tank supported by modified half-pipes 73, which at the bottom ends terminate in full pipe sections 74 having flanges 75 secured thereto. Such combined half-pipes and full pipes 73, 74 can be formed, for instance, by taking ordinary pipes and cutting off semi-cylindrical portions thereof over a portion of their length.

The flanges 75 distribute the weight supported by the half-pipes over wide concrete surfaces in the support posts 76, by means of vertical bolts 77 secured to the flanges 75 by nuts 78 and also having washes 79 secured thereto by bolts 80, submerged in the concrete. The nuts 78 on the bolts 77 and flanges 75 also serve to level the tank. Before the tank is loaded with water, the weight can be supported by the bolts, and the flanges 75 are spaced above the concrete posts 76. The units can then be turned up or down until the tank is properly positioned to insure horizontal rotation of the scrapers 70 and horizontal position of the weirs 37. Thereafter, the spaces between the flanges 75 and concrete posts 76 are shrouded by suitable forms as shown in dotted lines, and a fluid grout 81 is then forced into said spaces through openings 82 in the flanges 75. When this grout has solidified, the forms can be removed, and the tank loaded with water.

The full pipe section 74 can be so dimensioned and arranged as to properly support the weight of the tank when loaded. The half-pipes 73, alone, of course have only one-half of the strength of such full pipe sections, but are reinforced by being welded to the tank wall 11. The conduit sections 83 between the half-pipes 73 and full pipes 74, adjacent the lower end of the tank wall 11, are relatively poorly reinforced by the tank wall, and are therefore, desirably provided with reinforcing ribs 84 welded to the outside of such conduit sections opposite the wall 11.

In the embodiment of Fig. 5, the distributing conduits 85 are shown as full pipes horizontally installed between the central distributing sump and the vertical conduits, and communicating with the full pipe sections 74 of the latter, immediately above the flanges 75. The bottom 12 is reinforced by beams 86 welded thereto rather than by the distributing conduits. This modification is advantageous if and when distributing conduits of proper size to carry the flow at said mixing and transfer velocities are too feeble to reinforce the bottom sufficiently. The beams 86 are loaded largely with transverse bending stresses, whereas the vertical half-pipes are loaded mainly with longitudinal compression stresses, which are more readily absorbed by half-pipes.

The vertical full pipe sections 74 are preferably closed by plates 87 secured to the flanges 75 by the bolts 77 and nuts 78, with gaskets 88 interposed between the flanges and plates, and the plates having the same outer diameter as the flanges. The plates 87 are shown equipped with central weld fittings 89 having street ells 90 threaded into the same, and nipples 91 threaded into said street ells and closed by caps 92. These weld fittings and street ells may be disposed in the spaces between the flanges 75 and concrete posts 76, and submerged in the grout 81. The nipples 91 extend to the outside of said grout, and

provide clean-out openings for the distributing and supporting conduits.

Additional, larger openings, surrounded by flanges 93, may be provided in the vertical conduits opposite the distributing pipes 85, and closed by plates 94, held by bolts 95 and nuts 96, with gaskets 97 interposed between these flanges and plates, to provide access for inspection of the conduits, after the tank has been substantially drained through the smaller cleanouts 92.

Still other modifications may occur to persons skilled in this art.

We claim:

1. A liquid treatment tank comprising a bottom; a substantially cylindrical sidewall; an annular baffle in the tank, secured to said wall, extending downwardly to above said bottom and separating an outer flocculation chamber from an inner clarification and sludge filtration chamber in said tank; a series of hollow pilasters distributed around said wall on the outside thereof, secured thereto, and upwardly extending from adjacent said bottom; a series of conduits communicating with a central part of said tank through said bottom, each of said conduits leading to a lower inside part of one of said hollow pilasters, and each of said hollow pilasters having an upper inside part communicating through said wall with an upper part of said outer chamber; means to circulate liquid from said central part of the tank outwards through said conduits, upwards through said hollow pilasters, downwards through said outer chamber, and inwards over said bottoms in said inner chamber to suspend sludge therein for sludge filtration; means to introduce any required chemical reagents and the liquid to be treated thereby into said circulated liquid to form said sludge, and means to withdraw treated liquid from the top of said inner chamber.

2. An elevated liquid treatment tank according to claim 1, combined with a series of columns; each of said hollow pilasters being supported by one of said columns, and at least a substantial portion of the weight of said tank and its contents being supported by said columns and hollow pilasters.

3. A liquid treatment tank according to claim 1, wherein each of said conduits leading from the central part of the tank to the respective pilaster comprises a hollow member extending along and secured to the under side of said bottom.

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