(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 January 2014 (23.01.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/012167 A1

(51) International Patent Classification:
B01D 39/02 (2006.01) *B01D 24/02* (2006.01)

(21) International Application Number:
PCT/CA2013/000648

(22) International Filing Date:
16 July 2013 (16.07.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/672,098 16 July 2012 (16.07.2012) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

[Continued on next page]

(54) Title: MEDIA BED FILTERS FOR FILTERING FINE PARTICLES FROM A RAW LIQUID FLOW AND METHOD OF USING THE SAME

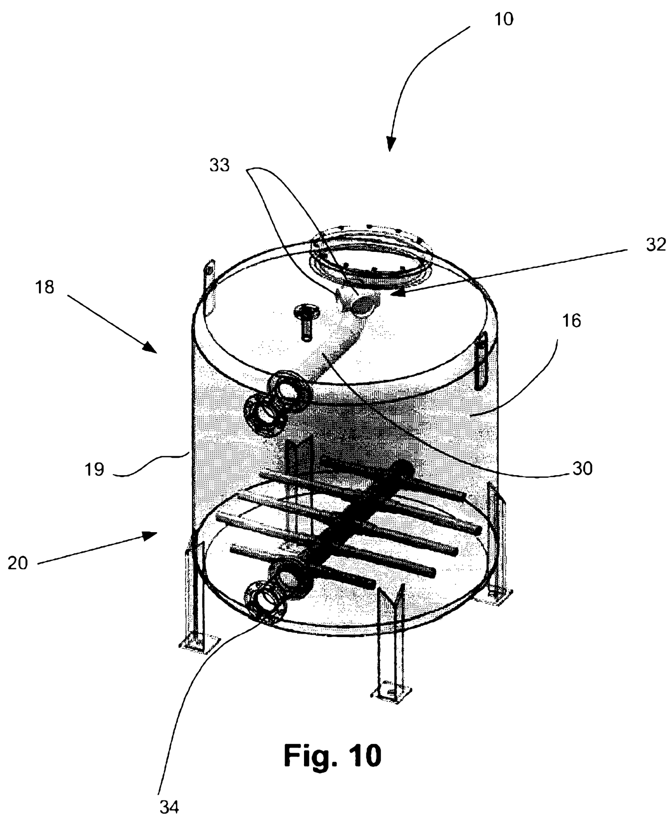


Fig. 10

(57) Abstract: The present document describes a media bed filter for filtering fine particles from a raw liquid flow, the media bed filter comprising: a tank having: a top portion; a bottom portion defining a bottom surface for receiving a media bed, the media bed having a supporting media to be disposed on the bottom surface and a filtering media for covering the supporting media, the top portion of the tank being above the filtering media of the media bed; a raw liquid inlet in fluid communication with a nozzle configuration located in the top portion of the tank for providing the raw liquid flow in the tank in the form of a plurality of jets at a directional velocity substantially equal or greater to a disengagement velocity of the filtering media.

WO 2014/012167 A1

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

MEDIA BED FILTERS FOR FILTERING FINE PARTICLES FROM A RAW LIQUID FLOW AND METHOD OF USING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority of US provisional patent application 61/672,098 filed on July 16, 2012.

BACKGROUND

(a) Field

[0002] The subject matter disclosed generally relates to filtering apparatus and methods of using the same. More particularly, the subject matter relates to media bed filters for filtering fine particles from a raw liquid flow.

(b) Related Prior Art

[0003] Media bed filters work by providing the solid particles with many opportunities to be captured on the surface and within a filtering media bed. As fluid is evenly distributed at the top of the filter, it gently flows through the porous sand (i.e., filtering media) along a tortuous route, the particles come close and in contact with the media bed. They can be captured by one of several mechanisms such as, direct collision, Van der Waals or London force attraction, surface charge attraction, diffusion, and the like.

[0004] In addition, solid particles can be prevented from being captured by surface charge repulsion if the surface charge of the filtering media is of the same sign (i.e., positive or negative) as that of the particulate solid. Furthermore, it is possible to dislodge captured solid particles although they may be re-captured at a greater depth within the media bed.

[0005] Filtering media beds can be operated either with upward flowing fluids or downward flowing fluids the latter being much more usual. For downward flowing filtering media beds, the fluid can flow under pressure or by gravity alone. Pressure media bed filters tend to be used in industrial applications. Gravity fed units are used in water purification especially in large application such as drinking water.

[0006] Overall, there are several categories of filtering media beds such as, without limitation, gravity media bed filters, pressure media bed filters, upflow media bed filters, slow media bed filters, multimedia bed filters and the like.

[0007] All of these apparatus and methods are used extensively in the water industry throughout the world.

[0008] For example, water from cooling tower attracts and absorbs most dirt and airborne on a continuous basis. The majority of suspended solids in circulating cooling water loops are from about 0-5 micron in size, mainly because of chemical dispersing agents that are designed to limit circulating (i.e., dust and minerals kept in suspension by dispersing chemical agents) dirt from agglomerating on heat exchange surfaces. Dirt does negatively affect heat exchange surfaces and cooling tower fill efficiency. Traditional filters, strainers and separators will not remove significantly these very fine contaminants before they settle out in low flow areas, clog strainers, nozzles, and bio-fouled heat exchangers. Usually, most media bed filters of this kind are not able to significantly retain suspended solid of less than 5 microns in size. There is therefore a need to provide a media bed filter designed to provide an improved filtration for fine particles down to 0.5 microns. For example, a traditional multi-layers media bed filter having 3 layers including garnet is able to filter particles only down to 10 or 20 microns.

[0009] For example and referring now to Prior Art Figs. 1A, 1B, 1C, 1D and 1E, there are shown traditional sand filters. These traditional sand filters offer a plurality of disadvantages. One of them is that, a slope is created by the raw liquid fluid entering the tank. The prior art configuration will allow the raw liquid flow to dig at one place only on the media bed. Thus, according to the traditional media bed filter, only a portion of the media bed is utilized as the filtering surface.

One of the other disadvantages is that traditional sand filters cannot be used at greater flow rates. When using traditional sand filters, water needs to enter the tank at a substantially small velocity and cannot include many flow rate variations. Additionally, such configurations proposed by traditional media bed filters may lead the particles to form a cake layer on the top portion of the media bed and may also block the media bed filter. Thus, the maintenance of such media bed filters needs to be made on a regular basis for reducing formation of cakes with the media bed. For example, is Fig. 1A, the raw liquid flow which enters the tank follows a laminar flow (i.e., without or with reduced turbulence areas).

[0010] Many filters are already known in many applications, such as, without limitation, chilled and hot water loops, condensate return, cooling tower make up, iron removal, ion exchange resin pre-filtration, membrane pre-filtration, potable water and beverage filtration, process rinse water, process water intake, water reuse, welder water loops and the like.

[0011] Moreover, traditional filters will require coagulants or polymers to improve their efficiency towards smaller particles. Existing vortex filters have the disadvantage of having poor backwash efficiency, resulting in higher water consumption, wastewater and important energy costs.

[0012] Traditional vortex filters do not allow good backwash efficiency and are prompt to short-circuiting even when clean. In fact, the single injector located at a significant distance from the apex of the tank creates a significant distortion of the fine sand surface (Fig. 1B) (i.e., also called microsand or ultrafine sand) with one side of the media bed being significantly deeper than its opposite side creating a significant slope in the filtering media of about 30 to about 40°. This slope creates a distortion in the hydraulic distribution of the fluid at the surface and in the depth of the media bed. This phenomenon does not allow the known vortex filter to use efficiently the filtration surface area. This is especially true for filters of larger surface such as 30 inches of diameter and above. As for the backwash process, the typical single injector, located at a significant distance from the apex of the tank, does not allow for a good capture of the particles (or fine particles) to be removed as this design does not allow for a plug flow removal process. It is to be noted that the configuration as shown in Fig. 1B would not result in a good hydraulic flow. The media bed, and more particularly the filtering media is significantly deformed by the water flow which enters the tank at a significant distance from the apex of the tank.

[0013] Furthermore, open-tank media bed filters include a raw liquid flow inlet which is configured so to lead the water gently above the filtering media so that the particles flow gently within the filtering media, and the filtering media surface is not in motion nor disturbed.

[0014] There is therefore a need for improved media bed filters for filtering and backwashing fine particles from a raw liquid flow and for methods of using the same.

SUMMARY

[0015] According to an embodiment, there is provided a media bed filter for filtering fine particles from a raw liquid flow, the media bed filter comprising: a tank having: a top portion; a bottom portion defining a bottom surface for receiving a media bed, the media bed having a supporting media to be disposed on the bottom surface and a filtering media for covering the supporting media, the top portion of the tank being above the filtering media of the media bed; a raw liquid inlet in fluid communication with a nozzle configuration located in the top portion of the tank for providing the raw liquid flow in the tank in the form of a plurality of jets at a directional velocity substantially equal or greater to a disengagement velocity of the filtering media.

[0016] According to another embodiment, the nozzle configuration comprises a plurality of nozzles, each one of the plurality of nozzles for providing

the raw liquid flow in the tank in the form of a respective one of the plurality of jets at the directional velocity towards the filtering media.

[0017] According to a further embodiment, the plurality of nozzles is oriented in opposite directions.

[0018] According to yet another embodiment, the top portion of the tank defines a top portion surface and further wherein the nozzle configuration is oriented for providing the plurality of jets towards the top portion surface of the tank, thereby providing the raw liquid flow in the tank at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media.

[0019] According to another embodiment, the nozzle configuration is one of: located above the raw liquid inlet within the top portion of the tank and located below the raw liquid inlet within the top portion of the tank.

[0020] According to a further embodiment, the nozzle configuration is oriented for providing the plurality of jets perpendicularly towards the filtering media of the media bed.

[0021] According to yet another embodiment, the media bed filter further comprises a baffle located in the top portion of the tank and between the nozzle configuration and the filtering media.

[0022] According to another embodiment, the baffle is located substantially above the filtering media, thereby providing the raw liquid flow in the tank at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media.

[0023] According to a further embodiment, the raw liquid inlet comprises a plurality of raw liquid inlets, each one of the plurality of raw liquid inlets being in fluid communication with a respective nozzle configuration.

[0024] According to yet another embodiment, the nozzle configuration is one of: oriented in an upward direction for providing the plurality of jets to enter the tank in an upwardly direction and oriented in a downwardly direction for providing the plurality of jets to enter the tank in a downwardly direction.

[0025] According to another embodiment, the nozzle configuration is oriented for providing the plurality of jets horizontally towards the filtering media of the media bed, the nozzle configuration being located in the top portion of the tank at substantially the same level of the filtering media.

[0026] According to a further embodiment, each one of the plurality of nozzles defines a shape comprising at least one of: an elbow-like shape, a straight-like shape, a curved-like shape, a regular polygonal-like shape, a segmented-like shape, an irregular polygonal-like shape, a circular-like shape, an angular-like shape and any combination thereof.

[0027] According to yet another embodiment, the media bed filter of claim 1, further comprising a baffle within the top portion of the tank for receiving the plurality of jets, thereby providing the raw liquid flow in the tank at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media.

[0028] According to another embodiment, the baffle comprises a plurality of baffles, each one of the plurality of baffles being located substantially above the filtering media, parallel and laterally distant from another one of the plurality of baffles.

[0029] According to a further embodiment, the plurality of baffles comprises displaceable baffles.

[0030] According to another embodiment, there is provided a method for filtering fine particles from a raw liquid flow in a tank supporting a filtering media, the tank having a top portion, the method comprising the steps of: receiving the raw liquid flow with fine particles; and providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets at a directional velocity substantially equal or greater to a disengagement velocity of the filtering media.

[0031] According to a further embodiment, the providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets comprises providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets oriented in opposite directions, thereby providing the raw liquid flow in the tank at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media.

[0032] According to yet another embodiment, the providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets comprises providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets towards a top portion surface of the tank, thereby providing the raw liquid flow in the tank at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media.

[0033] According to another embodiment, the providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets comprises providing the plurality of jets perpendicularly towards the filtering media of the media bed.

[0034] According to a further embodiment, the providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets comprises providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets at substantially the same level of the filtering media, thereby providing the raw liquid flow in the tank at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media.

[0035] The following terms are defined below.

[0036] The term "top portion of the tank" is intended to mean the portion defined by the tank which is above the filtering media of the media bed.

[0037] The term "bottom portion of the tank" is intended to mean the portion defined by the tank from the bottom surface of the tank to the filtering media of the media bed.

[0038] The term "filtering media" is intended to mean the fine granular filtering media covering the supporting media and/or in movement inside the tank and above the media bed.

[0039] The term "fine particle" is intended to mean the particles in the raw liquid flow to be filtered by the media bed filter.

[0040] The term "media bed" is intended to mean a bed which includes the filtering media of the media bed filter which covers the supporting media and the supporting media.

[0041] The term "supporting media" is intended to mean a portion of the supporting media bed which supports the filtering media of the media bed filter or which is covered by the filtering media of the media bed. The supporting media may be a rigid bottom compact media, such as a metallic supporting bed with openings or the supporting media may include a plurality of layers of granular materials including, without limitations rock, sand, river sand and/or rocks, and the like. The "supporting media" may also include a false floor to be installed above the bottom surface of the tank.

[0042] The term "nozzle configuration" is intended to mean an end portion of the raw liquid inlet which is located in the top portion the tank and which forms a plurality of jets to enter the tank. The nozzle configuration may include a plurality of nozzles. The nozzle configuration may allow the plurality of jets to circulate towards a top portion surface of the tank, towards the filtering media of the media bed and/or towards a baffle which is located in the tank (or the like).

[0043] Features and advantages of the subject matter hereof will become more apparent in light of the following detailed description of selected embodiments, as illustrated in the accompanying figures. As will be realized, the subject matter disclosed and claimed is capable of modifications in various respects, all without departing from the scope of the claims. Accordingly, the drawings and the description are to be regarded as illustrative in nature, and not as restrictive and the full scope of the subject matter is set forth in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0044] Further features and advantages of the present disclosure will become apparent from the following detailed description, taken in combination with the appended drawings, in which:

[0045] Fig. 1A illustrates the media bed of a sand filter in accordance with the prior art;

[0046] Fig. 1B illustrates the media bed of a sand filter in accordance with the prior art;

[0047] Fig. 1C illustrates a sand filter in accordance with the prior art which includes one and only one raw liquid inlet located in the top portion of the tank;

[0048] Fig. 1D illustrates a sand filter in accordance with the prior art which includes one and only one raw liquid inlet located in the top portion of the tank;

[0049] Fig. 1E illustrates a top view of the sand filter of Fig. 1C;

[0050] Fig. 2A is a schematic perspective view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with an embodiment;

[0051] Fig. 2B is another perspective view of the media bed filter of Fig. 2A;

[0052] Fig. 2C is a top plan view of the media bed filter of Fig. 2A;

[0053] Fig. 2D is a side elevation view of the media bed filter of Fig. 2A;

[0054] Fig. 3A is a schematic perspective view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment;

[0055] Fig. 3B is another perspective view of the media bed filter of Fig. 3A;

[0056] Fig. 3C is an elevation view of the media bed filter of Fig. 3A;

[0057] Fig. 3D is a top plan view of the media bed filter of Fig. 3A;

[0058] Fig. 4A is a schematic perspective view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment;

[0059] Fig. 4B is another perspective view of the media bed filter of Fig. 4A;

[0060] Fig. 4C is an elevation view of the media bed filter of Fig. 4A;

[0061] Fig. 4D is a top plan view of the media bed filter of Fig. 4A;

[0062] Fig. 5A is a schematic perspective view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment;

[0063] Fig. 5B is another perspective view of the media bed filter of Fig. 5A;

[0064] Fig. 5C is an elevation view of the media bed filter of Fig. 5A;

[0065] Fig. 5D is a top plan view of the media bed filter of Fig. 5A;

[0066] Fig. 6A is a schematic perspective view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment;

[0067] Fig. 6B is another perspective view of the media bed filter of Fig. 6A;

[0068] Fig. 6C is an elevation view of the media bed filter of Fig. 6A;

[0069] Fig. 6D is a top plan view of the media bed filter of Fig. 6A;

[0070] Fig. 7A is a schematic perspective view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment;

[0071] Fig. 7B is another perspective view of the media bed filter of Fig. 7A;

[0072] Fig. 7C is an elevation view of the media bed filter of Fig. 7A;

[0073] Fig. 7D is another elevation view of the media bed filter of Fig. 7A;

[0074] Fig. 7E is a side elevation view of the media bed filter of Fig. 7A;

[0075] Fig. 8 is a side elevation view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment;

[0076] Fig. 9 is a side view of a media bed filter for filtering fine particles from a raw liquid flow showing the supporting media bed as a rigid bed with openings in accordance with another embodiment;

[0077] Fig. 10 is a schematic perspective view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment;

[0078] Fig. 11 is a schematic perspective view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment;

[0079] Fig. 12A is a schematic perspective view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment;

[0080] Fig. 12B is a top plan view of the media bed filter of Fig. 12A;

[0081] Fig. 12C is a side plan view of the media bed filter of Fig. 12A;

[0082] Fig. 13 is a schematic perspective view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment;

[0083] Fig. 14 is a perspective view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment, where the tank is an open-tank;

[0084] Fig. 15 is a schematic perspective view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment, where the tank is an open-tank;

[0085] Fig. 16 is a schematic perspective view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment, where the tank is an open-tank

[0086] Fig. 17 is a schematic perspective view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment, where the tank is an open-tank

[0087] Fig. 18 is a schematic perspective view of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment, where the tank is an open-tank;

[0088] Fig. 19 is a schematic elevation view of a nozzle configuration of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment;

[0089] Fig. 20 is a schematic elevation view of a nozzle configuration of a media bed filter for filtering fine particles from a raw liquid flow in accordance with another embodiment;

[0090] Fig. 21 is a graph showing elution for a media bed filter which includes four nozzles in accordance with another embodiment compared with a media bed filter system which includes one and only one nozzle; and

[0091] Fig. 22 is a graph which illustrates flow speeds (cm/s) of particles of the filtering media according to the diameter of these particles in accordance with another embodiment.

[0092] It will be noted that throughout the appended drawings, like features are identified by like reference numerals.

DETAILED DESCRIPTION

[0093] In embodiments, there are disclosed media bed filters for filtering fine particles from a raw liquid flow and method of filtering fine particles from a raw liquid flow.

[0094] Referring now to the drawings and more particularly from Figs. 2A-20, there is shown media bed filters **10** for filtering fine particles (not shown) from a raw liquid flow. The media bed filters **10** each includes a tank **16** which has a top portion **18** and a bottom portion **20**. The bottom portion **20** defines a bottom surface **22** for receiving a media bed **24**. The media bed 24 includes a supporting media **28** to be disposed on the bottom surface **22** and a filtering media **26** for covering the supporting media **28**. It is to be noted, as described above, that the top portion **18** of the tank **16** is being above the filtering media **26** of the media bed **24**. The media bed filter **10** further includes a raw liquid inlet **30** in fluid communication with a nozzle configuration **32** which is located in the top portion **18** of the tank **16**. The nozzle configuration **32** provides the raw liquid flow in the tank **16** in the form of a plurality of jets (not shown) at a directional velocity substantially equal or greater to a disengagement velocity of the filtering media **26**.

[0095] Referring now to Figs. 4A-4D, 5A-5D, 10, 11, 12A-12C, 13, 15, 16, 17, 18, 19 and 20, there is shown that the nozzle configuration **32** comprises a plurality of nozzles **33**, where each one of the plurality of nozzles **33** is for providing the raw liquid flow in the tank **16** in the form of a respective one of the plurality of jets at the directional velocity towards the filtering media **26**.

[0096] Referring now to Figs. 4A-4D, 5A-5D, 10, 11, 12A-12C, 13, 16, 17, 18, 19 and 20, there is shown that the plurality of nozzles **33** of the media bed filter **10** are oriented in opposite directions.

[0097] Referring now to Figs. 2A-2D, 4A-4D, 5A-5D, 6A-6D, 8, 10, 11, 12A-12C and 13), there is shown that the top portion **18** of the tank **16** defines a top portion surface **19** and that the nozzle configuration **32** is oriented for providing the plurality of jets towards the top portion surface **19** of the tank **16**. This nozzle configuration **32** provides the raw liquid flow in the tank **16** at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**.

[0098] Referring now to Figs. 2A-2D, 3A-3D, 4A-4D, 5A-5D, 6A-6D, 8, 9, 10, 11, 13, and 15-20, there is shown that the nozzle configuration **32** is located above the raw liquid inlet **30** within the top portion **18** of the tank **16** (Figs. 10 and 13) or located below the raw liquid inlet **30** within the top portion **18** of the tank **16** (Figs. 2A-2D, 3A-3D, 4A-4D, 5A-5D, 6A-6D, 8, 9, 11 and 15-20).

[0099] Referring now to Figs. 3A-3D, there is shown that the nozzle configuration **32** of the media bed filter **10** is oriented for providing the plurality of jets perpendicularly towards the filtering media **26** of the media bed **24**.

[00100] Referring now to Figs. 19-20, the media bed filter **10** includes a baffle **90** located in the top portion **18** of the tank **16** and between the nozzle configuration **32** and the filtering media **26**. More particularly, the baffle **90** is located substantially above the filtering media **26**. This configuration of the nozzle configuration **32** and the baffle **90** provides the raw liquid flow to enter the tank **16** at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**.

[00101] Referring now to Figs. 2A-2D, 3A-3D, 6A-6D, 8 and 9, there is shown that the media bed filter **10** includes a plurality of raw liquid inlets **30**. Each one of the plurality of raw liquid inlets **30** is in fluid communication with a respective nozzle configuration **32**.

[00102] Referring now to Figs. 3A-3D, 4A-4D, 5A-5D and 9, there is shown that the nozzle configuration **32** of the media bed filter **10** is oriented in an upward direction for providing the plurality of jets to enter the tank **16** in an upwardly direction and/or oriented in a downwardly direction for providing the plurality of jets to enter the tank **16** in a downwardly direction (Figs. 3A-3D, 4A-4D, 5A-5D and 9).

[00103] Referring now to Figs. 6A-6D, 7A-7E and 15-20, there is shown that the nozzle configuration **32** of the media bed filter **10** is oriented for providing the plurality of jets horizontally towards the filtering media **26** of the media bed **24**. Indeed, the nozzle configuration **32** is located in the top portion **18** of the tank **16** at substantially the same level of the filtering media **26**.

[00104] According to an embodiment, the nozzles **33** may define a shape which includes at least one of, without limitation, an elbow-like shape, a straight-like shape, a curved-like shape, a regular polygonal-like shape, a segmented-like shape, an irregular polygonal-like shape, a circular-like shape, an angular-like shape, any combination and the like.

[00105] Referring now to Figs. 9, 14, 19 and 20, there is shown that the media bed filter **10** includes one or more baffles **90** within the top portion **18** of the tank **16** for receiving the plurality of jets. The configuration of the baffle(s) **90** and of the nozzle configuration **32** thereby provides the raw liquid flow in the tank **16** at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**. As shown in Fig. 14, the baffles **90** of the media bed filter **10** are located substantially above the filtering media **26**, parallel and laterally distant from each other. Moreover, the plurality of baffles **90** (Fig. 14) are displaceable baffles (i.e., electrically displaceable).

[00106] More particularly and according to an embodiment, Figs. 2A-2D show a media bed filter **10** which includes two raw liquid inlets **30**. Each one of the raw liquid inlets **30** is in fluid communication with a respective nozzle configuration **32**. The nozzle configurations **32** are oriented in the same direction and substantially towards the top portion surface **19** of the tank **16**. This configuration may allow the plurality of jets to circulate towards the top portion surface **19** of the tank **16**, then to circulate along the top portion surface **19**, which thereby allows at least a portion of the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **24**. The nozzles **33** define a curved-like shape for allowing the raw liquid flow to circulate towards the top portion surface **19**.

[00107] According to another embodiment, Figs. 3A-3D show a media bed filter **10** which includes four raw liquid inlets **30**. Each one of the raw liquid inlets **30** is in fluid communication with a respective nozzle configuration **32**. The nozzle configurations **30** are oriented in the same direction and substantially towards the filtering media **26** of the tank **16** at a specific distance (i.e., a distance such that the plurality of jets will not dig into the filtering media **26**) from the filtering media **26**. This configuration may allow the plurality of jets to circulate towards the filtering media **26** of the tank **16**, which thereby allows at least a portion of the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**. The nozzles **33** define a straight-like shape for allowing the raw liquid flow to circulate towards the filtering media **26**.

[00108] According to another embodiment, Figs. 4A-4D show a media bed filter **10** which includes one raw liquid inlet **30**. The raw liquid inlet **30** is in fluid communication with a respective nozzle configuration **32**. The nozzle configuration **32** includes three nozzles **33** which are oriented in opposite directions and substantially towards the top portion surface **19** of the tank **16**. This configuration may allow the plurality of jets to circulate towards the top portion surface **19** of the tank **16**, then to circulate along the top portion surface **19**, which thereby allows at least a portion of the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**. Since the nozzles **33** are substantially at the same level of the filtering media **26**, this configuration may also allow the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26** when they exit the nozzles **33**. The nozzles **33**

define an angular-like shape for allowing the raw liquid flow to circulate towards the top portion surface **19** and/or the filtering media **26**.

[00109] According to another embodiment, Figs. 5A-5D show a media bed filter **10** which includes one raw liquid inlet **30**. The raw liquid inlet **30** is in fluid communication with a respective nozzle configuration **32**. The nozzle configuration **32** includes two nozzles **33** which are oriented in opposite directions and substantially towards the top portion surface **19** of the tank **16**. This configuration may allow the plurality of jets to circulate towards the top portion surface **19** of the tank **16**, then to circulate along the top portion surface **19**, which thereby allows at least a portion of the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**. Since the nozzles **33** are substantially at the same level of the filtering media **26**, this configuration may also allow the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26** when they exit the nozzles **33**. The nozzles **33** define an angular-like shape for allowing the raw liquid flow to circulate towards the top portion surface **19** and/or the filtering media **26**.

[00110] According to another embodiment, Figs. 6A-6D show a media bed filter **10** which includes a plurality of raw liquid inlets **30**. The raw liquid inlets **30** are in fluid communication with a respective nozzle configuration **32**. The nozzle configurations **32** are oriented in a direction such that it allows the raw liquid flow to circulate within a tank **16** having a donough-like shape. The nozzle configurations **32** are also substantially oriented towards the top portion surface **19** of the tank **16**. This configuration may allow the plurality of jets to circulate towards the top portion surface **19** of the tank **16**, then to circulate along the top portion surface **19**, which thereby allows at least a portion of the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**. Since the nozzle configurations **32** are substantially at the same level of the filtering media **26**, this configuration may also allow the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26** when they exit the nozzle configurations **32**. The nozzles **33** define a straight-like shape for allowing the raw liquid flow to circulate towards the top portion surface **19** and/or the filtering media **26**.

[00111] According to another embodiment, Figs. 7A-7E show a media bed filter **10** which includes one raw liquid inlet **30**. The raw liquid inlet **30** is in fluid communication with a respective nozzle configuration **32**. Since the nozzle configuration **32** is substantially at the same level of the filtering media **26**, this configuration may also allow the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26** when they exit the nozzle configuration **32**. The nozzles **33** define a straight-like shape for allowing the raw liquid flow to circulate along the filtering media **26**. It is to be noted that the filtering media **26** that is utilized in this filtering media filter **10** may be recycled via an adapted piping system. It is to be noted that on Fig. 7B, there is shown that the filtering media **26** adopts a longitudinal movement in the tank **16**. The filtering media **26** (i.e., micro sand) may be recuperated at the end of the tank **16** via a hydraulic mechanism or a mechanic mechanism (not shown). Thus, the filtering media **26** is brought back to another filtering media inlet.

[00112] According to another embodiment, Fig. 8 shows a media bed filter **10** which includes two raw liquid inlets **30**. The raw liquid inlets **30** are in fluid communication with a respective nozzle configuration **32**. The nozzle configurations **32** are oriented in opposite directions and substantially towards the top portion surface **19** of the tank **16**. This configuration may allow the plurality of jets to circulate towards the top portion surface **19** of the tank **16**, then to circulate along the top portion surface **19**, which thereby allows at least a portion of the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**. The nozzles define an angular-like shape for allowing the raw liquid flow to circulate towards the top portion surface **19** and/or the filtering media **26**.

[00113] According to another embodiment, Fig. 9 shows a media bed filter **10** which includes two raw liquid inlets **30**. The raw liquid inlets **30** are in fluid communication with a respective nozzle configuration **32**. The nozzle configurations **32** are oriented in opposite directions and substantially towards the top portion surface **19** of the tank **16**. This configuration may allow the plurality of jets to circulate towards the top portion surface **19** of the tank, then to circulate along the top portion surface **19**, which thereby allows at least a portion of the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**. The nozzles **33** define an angular-like shape for allowing the raw liquid flow to circulate towards the top portion surface **19** and/or the filtering media **26**. The media bed filter **10** of Fig. 9 also includes two baffles **90** for allowing the filtering media **26** to move in an optimized manner for allowing filtration of the fine particles and venturi portions **80** around at least a portion of the nozzle configurations **32**. The venturi portions **80** may recycle the filtering media faster and/or more efficiently (i.e., the venturi portions **80** may optimize recycling of the filtering media **26**).

[00114] In Fig. 9, the supporting media **28** is a rigid supporting layer defining openings (i.e., such as a false floor).

[00115] According to another embodiment, Figs. 10 and 11 shows media bed filters **10** which includes one raw liquid inlet **30**. The raw liquid inlet **30** is in fluid communication with a respective nozzle configuration **32**. The nozzle configuration **32** includes four upwardly (Fig. 10) or downwardly (Fig. 11) oriented nozzles **33** which are oriented in opposite directions and substantially towards the top portion surface **19** of the tank **16**. This configuration may allow the plurality of jets to circulate towards the top portion surface **19** of the tank **16**, then to circulate along the top portion surface **19**, which thereby allows at least a portion of the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**. The nozzles **33** define a straight-like shape for allowing the raw liquid flow to circulate towards the top portion surface **19** and/or the filtering media **26**. Additionally, since the nozzle configuration **33** is substantially at the same level of the filtering media **26**, this configuration may also allow the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26** when they exit the nozzle configuration **32**.

[00116] According to another embodiment, Figs. 12A-12C show a media bed filter **10** which includes one raw liquid inlet **30**. The raw liquid inlet **30** is in fluid communication with a respective nozzle configuration **32**. The nozzle configuration **32** includes two nozzles **33** which are oriented in opposite directions and substantially towards the top portion surface **19** of the tank **16**. This configuration may allow the plurality of jets to circulate towards the top portion surface **19** of the tank **16**, then to circulate along the top portion surface **19**, which thereby allows at least a portion of the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**. The nozzles **33** define a straight-like shape for allowing the raw liquid flow to circulate towards the top portion surface **19** and/or the filtering media **26**.

[00117] According to another embodiment, Fig. 13 shows a media bed filter **10** which includes one raw liquid inlet **30**. The raw liquid inlet **30** is in fluid communication with a respective nozzle configuration **32**. The nozzle configuration **32** includes two upwardly oriented nozzles **33** which are oriented in opposite directions and substantially towards the top portion surface **19** of the tank **16**. This configuration may allow the plurality of jets to circulate towards the top portion surface **19** of the tank **16**, then to circulate along the top portion surface **19**, which thereby allows at least a portion of the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**. The nozzles **33** define a straight-like shape for allowing the raw liquid flow to circulate towards the top portion surface **19** and/or the filtering media **26**.

[00118] According to another embodiment, Fig. 14 shows a media bed filter **10** which includes an opened tank **16**. The media bed filter **10** includes one raw liquid inlet **30**. The raw liquid inlet **30** is in fluid communication with a respective nozzle configuration **32**. The nozzle configuration **32** is oriented substantially towards the top portion surface **19** of the tank **16**. The media bed filter **10** further includes a plurality of baffles **90**. Each one of the plurality of baffles **90** are located substantially above the filtering media **26**, parallel, and laterally distant from each other. This configuration may allow the plurality of jets to circulate towards the baffles **90** of the tank **16**, then to circulate along the baffle walls **91**, which thereby allows at least a portion of the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**.

[00119] According to other embodiments, Figs. 15-18 show media bed filters **10** which include one raw liquid inlet **30**. The raw liquid inlet **30** is in fluid communication with a plurality of nozzle configurations **32**. In Fig. 15, the nozzles **33** are oriented in the same direction and substantially at the same level of the filtering media **26**. This configuration may also allow the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26** when they exit the nozzles **33**. In Figs. 16-18, the nozzles **33** are oriented in opposite directions and substantially at the same level of the filtering media **26**. This configuration may also allow the plurality of jets to circulate at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26** when they exit the nozzles **33**. As further shown in Fig. 15, the nozzles **33** are proximate to the filtering media **26**. As shown in Fig. 16, the nozzles **33** are proximate to the filtering media **26** and are arranged in the middle of the tank **16** such as to allow the plurality of jets to circulate towards opposite directions. As shown in Fig. 17, the nozzles **33** are proximate to the filtering media **26** and are arranged in the middle of the tank **16** and along the length of the tank **16** such as to allow the plurality of jets to circulate towards opposite directions and along the length of the tank **16**. As shown in Fig. 18, the nozzles **33** are proximate to the filtering media **26** and are arranged in the middle of the tank **16** such as to allow the plurality of jets to circulate towards a plurality of directions (i.e., the nozzle configurations **32** includes circular nozzles **33**).

[00120] Referring now to Figs. 19-20, the media bed filter includes a baffle **90** located in the top portion of the tank and between the nozzle configuration **32** and the filtering media **26**. More particularly, the baffle **90** is located substantially above the filtering media **26** for providing the raw liquid flow in the tank **16** at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**.

[00121] It is to be noted that the filter media filter **10** as described above includes one or a plurality of a filtered liquid outlets **34**. The filtered liquid outlets **34** are located in proximity to the bottom portion **20** of the tank **16** and allow a filtered liquid flow to exit the tank **16**. The media bed filter **10** may further include at least one backwash liquid outlet **99** which is located in the top portion **18** of the tank **16** for removing the fines particles from the tank **16** during a backwash sequence. It is to be mentioned that the backwash liquid outlet **99** and the raw liquid inlet **30** may be the same for allowing the raw liquid inlets **30** to provide the plurality of jets in the tank **16** and also to remove the fine particles from the tank **16** during the backwash sequence (Figs. 2A-2D, 3A-3D, 4A-4D, 5A-5B, 6A-6B, 8, 9, 10, 12A-12B and 13).

[00122] According to another embodiment, there is provided a method for filtering fine particles from a raw liquid flow in a tank **16** supporting a filtering media **26**. The method includes the steps of 1- receiving the raw liquid flow with fine particles; and 2- providing the raw liquid flow in the top portion **18** of the tank

16 in the form of a plurality of jets at a directional velocity substantially equal or greater to a disengagement velocity of the filtering media **26**.

[00123] According to another embodiment, the step of providing the raw liquid flow in the top portion **18** of the tank **16** in the form of a plurality of jets comprises the step of providing the raw liquid flow in the top portion **18** of the tank **16** in the form of a plurality of jets oriented in opposite directions, thereby providing the raw liquid flow in the tank **16** at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**.

[00124] According to another embodiment, the step of the providing the raw liquid flow in the top portion **18** of the tank **16** in the form of a plurality of jets comprises the step of providing the raw liquid flow in the top portion **18** of the tank **16** in the form of a plurality of jets towards a top portion surface **19** of the tank **16**, thereby providing the raw liquid flow in the tank **16** at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**.

[00125] According to another embodiment, the step of providing the raw liquid flow in the top portion **18** of the tank **16** in the form of a plurality of jets comprises the step of providing the plurality of jets perpendicularly towards the filtering media **26** of the media bed **24**.

[00126] According to a further embodiment, the step of the providing the raw liquid flow in the top portion **18** of the tank **16** in the form of a plurality of jets comprises the step of providing the raw liquid flow in the top portion **18** of the tank **16** in the form of a plurality of jets at substantially the same level of the filtering media **26**, thereby providing the raw liquid flow in the tank **16** at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**.

[00127] It is also to be noted that these configurations of the media bed filters **10** may provide a surface filtration which keeps the fine particles above the filtering media **26** of the media bed **24** without exposing the supporting media **28**. It is to be noted that the filtering media **26** is returning more rapidly towards the bottom portion **20** of the tank **16** than the fine particles themselves for allowing an optimized filtration of the raw liquid flow and to allow suspension of the fine particles to facilitate their removal. The media bed filters **10** as described above further allow a suspension of a part of the fine particles which are removed from the tank **16** during the backwash sequence.

[00128] According to an embodiment, the media bed **24** may include a supporting media **28** at the bottom surface **22** of the tank **16** for supporting the filtering media **26**. It is to be noted that the supporting media **28** is below the filtering media **26**. Additionally, the filtering media **26** and the supporting media **28** may each comprise an aggregate material. The aggregate material may be included in the group consisting of, without limitation, a rock material, a mesh particles material, a sand material, a course sand material, a fine sand material, a river sand, a garnet material (i.e., density of 4 for example), any combination of material and the like. It is to be noted that the sphericity of the filtering media **26** and of the supporting media **28** may be important for providing an improved filtration of the fine particles within the raw liquid flow. The supporting media **28** may include a plurality of supporting media layers (not shown). The plurality of supporting media layers is disposed in layers from the bottom surface **22** of the tank **16** and with the coarser supporting media layer at the bottom surface **22** of the tank **16**. For example, a supporting media layer having a smaller diameter would be layered above another supporting media layer having a wider diameter. The filtering media **26** of the media bed **24** may comprise 0.15 mm silica sand (effective size). For example, the media bed filter **10** may include two supporting media layers of different materials.

[00129] It is to be noted that the media bed filter **10** may filter fine particles down to submicron (about 0.25 micron – 1 micron) and keep them above the media bed **24** (i.e., at least in part) and in the tank **16**. It is also to be noted that the media bed filter **10** may use fine media (i.e., or granular media) less than 0.3 mm for allowing filtering particles down to less than one micron, 0.5 microns for example.

[00130] According to an embodiment, the tank **16** may define a vertical axis, an horizontal axis, a combination of axis or any other axis. Also, the tank **16** may define one of, without limitation, a spherical shape, a cylindrical shape, a prismatic shape, a regular polygonal prismatic shape, an irregular polygonal prismatic shape, an open tank shape, a doughnut-like shape, any combination, and the like.

[00131] According to another embodiment, the media bed filter **10** may further include a control unit (not shown) for electrically controlling one of the velocity of the plurality of jets exiting the nozzle configurations **32** and the orientation of the nozzle configurations **32** and the raw liquid inlets **30**. It is to be mentioned that other parameter within or outside the tank **16** may be controlled via the control unit of the media bed filter **10**.

[00132] Most preferably, the raw fluid flow to be filtered is a raw water flow, but it can be any other raw fluid flow depending on the application of the filtration. For instance, the media bed filter **10** may be used, without limitations, in chilled and hot water loops, in condensate return, in cooling tower make up, in iron removal, in water and wastewater treatment applications, in ion exchange resin pre-filtration, in membrane pre-filtration, in post clarifier discharge, in potable water treatments, in beverage treatments, in process rinse water, in process water intake, water reuse, welder water loops, and the like.

[00133] According to another embodiment, the velocity and the disengagement velocity may be in the range of 0.4 to 1.6 ft/s or greater depending on the disengagement velocity of the utilized filtering media **26** of the media bed **24**.

[00134] The media bed filters **10** described above provide the raw liquid flow to circulate towards to filtering media **26** at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media **26**. As a result, the filtering media **26** of the media bed **24** can be used without clogging rapidly the media bed **24**, and the filtered fluid flow which may be largely free of impurities, is then filtered through the media bed **24** and subsequently collected. Contaminants trapped above the media bed **24** may be removed using an automatic backwash sequence, which requires less water and a shorter operating time. The backwash time is therefore half of the normal time. The media bed filters **10** can remove down to sub-micron levels at 5 times the flow rate of other media filters, while requiring 50% less water during backwash sequences.

[00135] It is to be noted that the media bed filters **10** as described above may provide with a better utilization of the surface area of the filtering media **26** and with a larger surface of filtration (i.e., since the nozzle configurations **32** allow the plurality of jets to circulate at a directional velocity substantially equal or greater to the disengagement velocity of the filtering media **26**). The flow of raw liquid entering the media bed filter **10** may then be improved and/or optimized and the slope of the media bed **24** would be reduced compared to the one created during filtration within a traditional media bed filter (i.e., a slope having an angle of about 40° and over for a traditional media bed filter compared to a slope having an angle of about less than 30° for the media bed filters **10** as described above).

[00136] The media bed filters (i.e., crossflow media bed filters) as described above use nozzle configurations (i.e., injector designs) which sweeps actively the whole surface of the filtering media (i.e., microsand) for wich a portion is put in suspension in the raw liquid (i.e., water) above the filtering media. The filtering media (i.e., microsand) settles back on the filtration surface faster than the fine particles to be removed from the tank of the media bed filter. This surface sweeping action effect keeps the surface filtering media from plugging quickly and keeps a portion of the fine particles to be removed in the water above the filtering media. The nozzles or injectors are located and designed within the tank such as to allow for the returning filtering media (i.e., microsand) to settle back on the surface in an evenly manner, thereby avoiding the traditional slope found in larger traditional vortex bed filters. This concept allows for a greater efficiency and avoids hydraulic short-circuiting in the media bed. The surface of the filtering media (i.e., microsand) of the media bed filters as described above has minimal deformation with riddles at its surface instead of the traditional slope created by the traditional injector design.

[00137] The present invention will be more readily understood by referring to the following examples which are given to illustrate the invention rather than to limit its scope.

EXAMPLE 1

Surfaces and angles depending on the diameter of the tank

[00138] The media bed filter may define different angles of the filtering media depending on their diameter. For example, the angle of a 30" tank at its nominal raw water flow and water velocity injection is 40°.

[00139] The media bed filter and method may be applied in different size and shape of tanks with the numbers of nozzles and media bed adapted to the tank condition and the filtration area. The media bed filter has to reflect the water velocity at the filtration surface. The media bed filter may use a 0.15 mm sand particle horizontal critic speed at a density of about 2,65 to adjust the process. The critical speed (i.e., the disengagement velocity), at the filtration surface for the actual models, are in the range of 0.4 to 1.2 ft/s.

EXAMPLE 2

Supporting media bed for 20" tank

[00140] The supporting media bed may consist of several layers (Media from bags). After installing a layer, it must be leveled and compacted before to proceed to the next layer: (A bag of 50 lbs. has a volume of 0.5 ft^3)

Layer 1: ½ x ¼" Rock, 2 bags 1 ft^3

Layer 2: ¼ x 1/8" Rock, 1 bag 0.5 ft^3

Layer 3: 20 mesh (1 mm), 1 bag 0.5 ft^3

Layer 4: Course sand # 40 (0.50 mm), 2 bags 1 ft^3

Layer 5: Fine sand # 70 (0.15 mm), up to 6" below the upper raw liquid inlet, 3 bags 1.5 ft^3

EXAMPLE 3

Table 1

Performance of different media bed filters in relation with the nozzle configuration, the inlet flow rate and the kaolin concentration

Injector Configuration	Freeboard (inch)	Flow (gpm)	Flow (m^3/h)	ΔP start (psi)	ΔP End (psi)	1-2 µm Kaolin (kg)	Dosage Type	Inlet Concentration (mg/L)	Outlet average Concentration (mg/L)	Removal Performance
Prior Art - 1 inj.	7,5	300	68	3	5	1	slug	140	71	49%
Prior Art - 1 inj.	7,5	300	68	4	4,5	1	slug	185	77	58%
Prior Art - 1 inj.	7,5	300	68	3,5	5	2	slug	319	146	54%
Prior Art Traditionnal	7,25	300	68	7,5	9,5	1	slug	186	69	63%
3	7,25	300	68	7	13	8	interval	-	-	-
3	7,25	300	68	7,5	12,5	4	interval	-	-	-
4 down	7,25	300	68	7,5	9	1	slug	224	81	82%
4 down	7,25	300	68	7,5	9,5	1	slug	206	49	76%
4 up	7,25	300	68	8,5	13,5	4	interval	-	-	-
4 up	7,25	300	68	8,25	10,25	1	slug	251	57	77%
4 up	7,25	300	68	8,5	11	2	slug	404	150	63%
4 up	7,25	300	68	7,75	9,25	1	slug	193	69	64%
4 up	7,5	350	79	7	8,5	1	slug	163	55	66%
4 up	7,5	300	68	6	13,5	6	slug	1058	478	55%
4 up	7,5	360	82	8,5	10,5	1,2	slug	250	60	76%
4 up	7,5	360	82	8	10	1	slug	191	37	81%
4 up	7,5	400	91	9	11	1	slug	203	53	74%
4 up	7,5	400	91	10,5	13	1	slug	235	41	83%

* Performance of the media bed filter = (Concentration of fine particles IN – Concentration of fine particles OUT) / Concentration of fine particles IN

[00141] Referring now to Table 1 above, there is shown that the performance of a media bed filter is increased when the configuration of the media bed filter includes four nozzles (i.e., 4 up) oriented in an upwardly direction within the tank and when the flow rate is increased (i.e., up to a performance of 83% when the flow rate reaches 400gpm) (Figs. 10 and 11).

[00142] Fig. 21 is a graph showing elution for a media bed filter which includes four nozzles in accordance with another embodiment compared with a media bed filter system which includes one and only one nozzle.

[00143] Fig. 22 is a graph which illustrates flow speeds (cm/s) of particles of the filtering media according to the diameter of these particles in accordance with another embodiment. Fig. 18 may be used to establish the disengagement velocity of the filtering media which covers the supporting media.

[00144] While preferred embodiments have been described above and illustrated in the accompanying drawings, it will be evident to those skilled in the art that modifications may be made without departing from this disclosure. Such modifications are considered as possible variants comprised in the scope of the disclosure.

CLAIMS:

1. A media bed filter for filtering fine particles from a raw liquid flow, the media bed filter comprising:

- a tank having:
  - a top portion;
  - a bottom portion defining a bottom surface for receiving a media bed, the media bed having a supporting media to be disposed on the bottom surface and a filtering media for covering the supporting media, the top portion of the tank being above the filtering media of the media bed;
- a raw liquid inlet in fluid communication with a nozzle configuration located in the top portion of the tank for providing the raw liquid flow in the tank in the form of a plurality of jets at a directional velocity substantially equal or greater to a disengagement velocity of the filtering media.

2. The media bed filter of claim 1, wherein the nozzle configuration comprises a plurality of nozzles, each one of the plurality of nozzles for providing the raw liquid flow in the tank in the form of a respective one of the plurality of jets at the directional velocity towards the filtering media.

3. The media bed filter of claim 2, wherein the plurality of nozzles are oriented in opposite directions.

4. The media bed filter of claim 1, wherein the top portion of the tank defines a top portion surface and further wherein the nozzle configuration is oriented for providing the plurality of jets towards the top portion surface of the tank, thereby

providing the raw liquid flow in the tank at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media.

5. The media bed filter of claim 4, wherein the nozzle configuration is one of: located above the raw liquid inlet within the top portion of the tank and located below the raw liquid inlet within the top portion of the tank.

6. The media bed filter of claim 1, wherein the nozzle configuration is oriented for providing the plurality of jets perpendicularly towards the filtering media of the media bed.

7. The media bed filter of claim 6, further comprising a baffle located in the top portion of the tank and between the nozzle configuration and the filtering media.

8. The media bed filter of claim 7, wherein the baffle is located substantially above the filtering media, thereby providing the raw liquid flow in the tank at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media.

9. The media bed filter of claim 1, wherein the raw liquid inlet comprises a plurality of raw liquid inlets, each one of the plurality of raw liquid inlets being in fluid communication with a respective nozzle configuration.

10. The media bed filter of claim 1, wherein the nozzle configuration is one of: oriented in an upward direction for providing the plurality of jets to enter the tank

in an upwardly direction and oriented in a downwardly direction for providing the plurality of jets to enter the tank in a downwardly direction.

11. The media bed filter of claim 1, wherein the nozzle configuration is oriented for providing the plurality of jets horizontally towards the filtering media of the media bed, the nozzle configuration being located in the top portion of the tank at substantially the same level of the filtering media.

12. The media bed filter of claim 2, wherein each one of the plurality of nozzles defines a shape comprising at least one of: an elbow-like shape, a straight-like shape, a curved-like shape, a regular polygonal-like shape, a segmented-like shape, an irregular polygonal-like shape, a circular-like shape, an angular-like shape, and any combination thereof.

13. The media bed filter of claim 1, further comprising a baffle within the top portion of the tank for receiving the plurality of jets, thereby providing the raw liquid flow in the tank at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media.

14. The media bed filter of claim 13, wherein the baffle comprises a plurality of baffles, each one of the plurality of baffles being located substantially above the filtering media, parallel and laterally distant from another one of the plurality of baffles.

15. The media bed filter of claim 14, wherein the plurality of baffles comprises displaceable baffles.

16. A method for filtering fine particles from a raw liquid flow in a tank supporting a filtering media, the tank having a top portion, the method comprising the steps of:

- receiving the raw liquid flow with fine particles; and
- providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets at a directional velocity substantially equal or greater to a disengagement velocity of the filtering media.

17. The method of claim 16, wherein the providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets comprises providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets oriented in opposite directions, thereby providing the raw liquid flow in the tank at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media.

18. The method of claim 16, wherein the providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets comprises providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets towards a top portion surface of the tank, thereby providing the raw liquid flow in the tank at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media.

19. The method of claim 16, wherein the providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets comprises providing the plurality of jets perpendicularly towards the filtering media of the media bed.

20. The method of claim 16, wherein the providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets comprises providing the raw liquid flow in the top portion of the tank in the form of a plurality of jets at substantially the same level of the filtering media, thereby providing the raw liquid flow in the tank at a parallel velocity substantially equal or greater to the disengagement velocity of the filtering media.

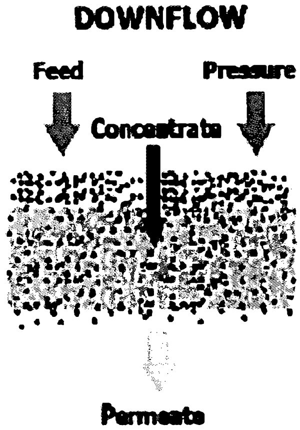


Fig. 1A
PRIOR ART

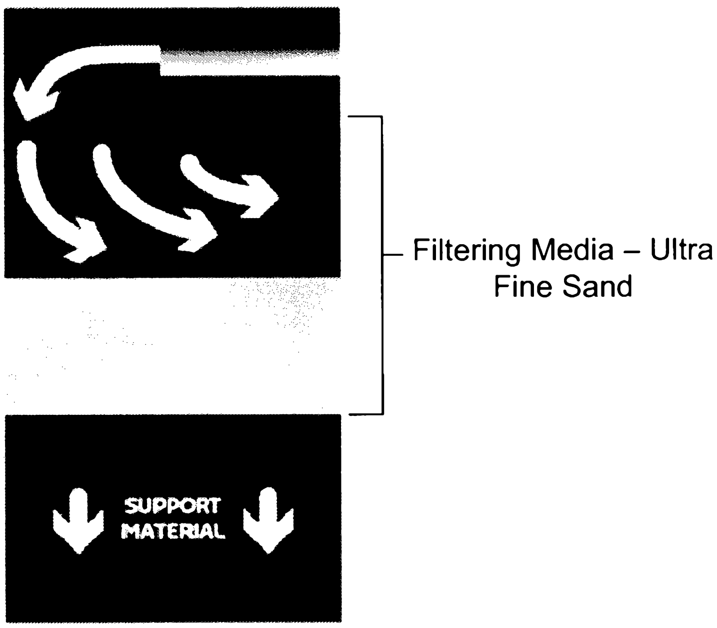


Fig. 1B
PRIOR ART

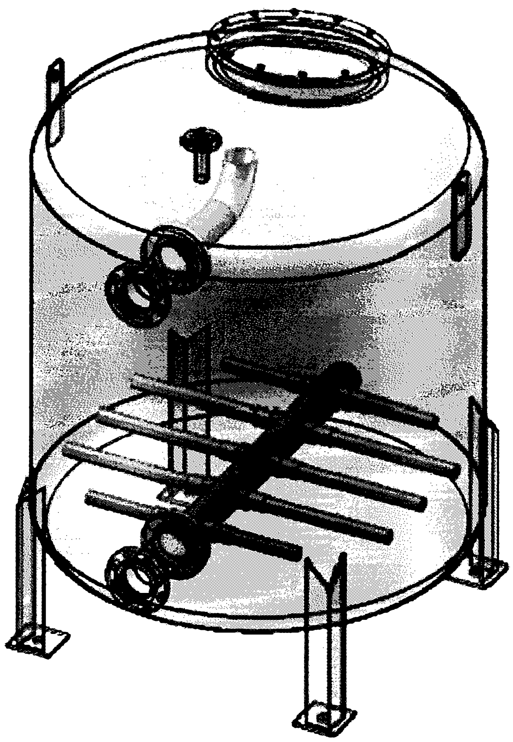


Fig. 1C
PRIOR ART

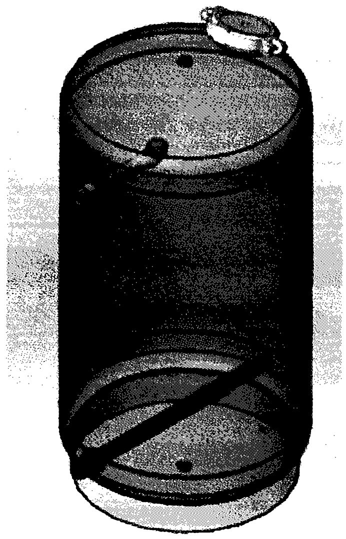


Fig. 1D
PRIOR ART

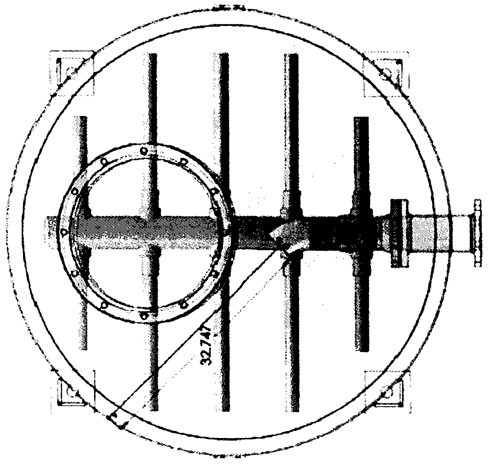


Fig. 1E
PRIOR ART

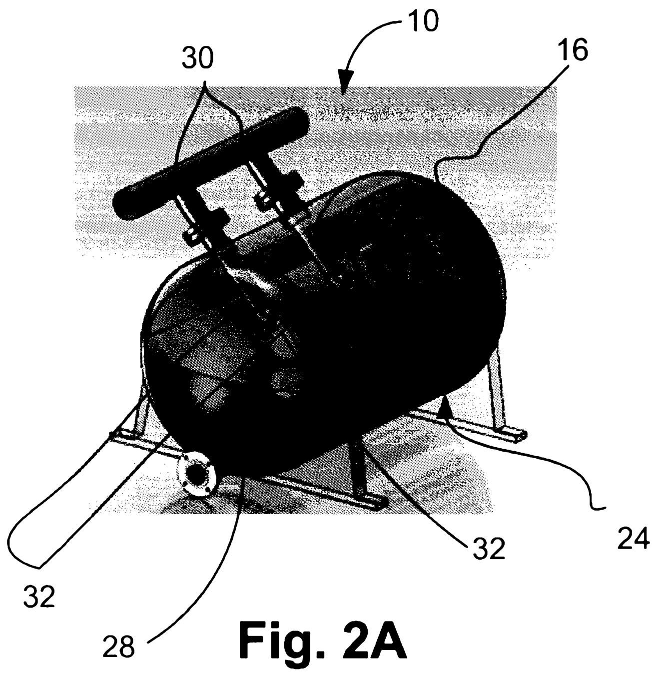


Fig. 2A

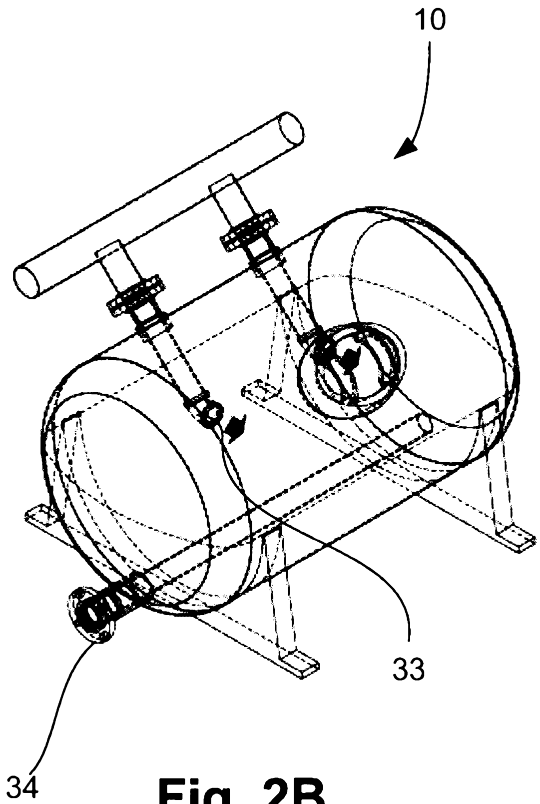


Fig. 2B

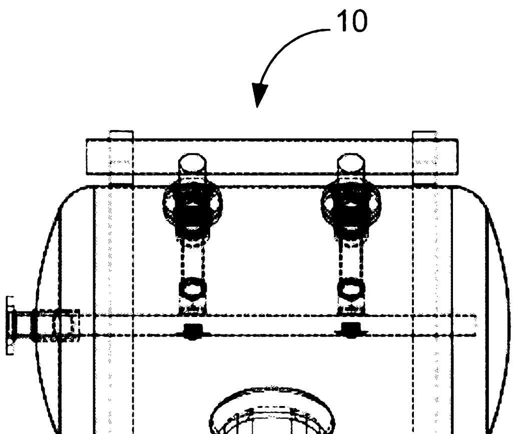


Fig. 2C

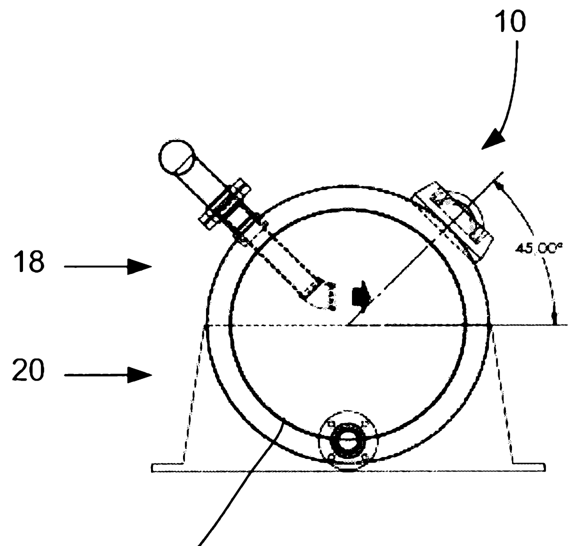


Fig. 2D

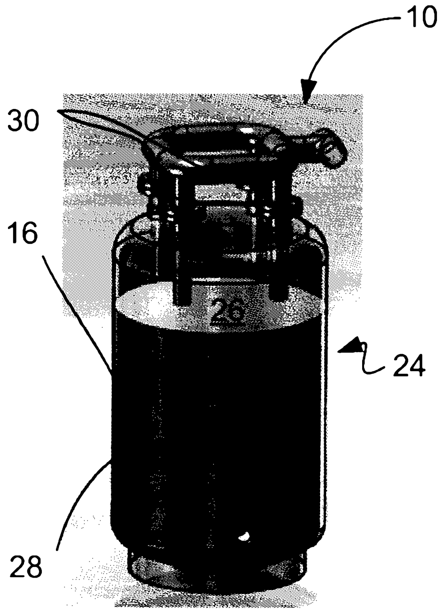


Fig. 3A

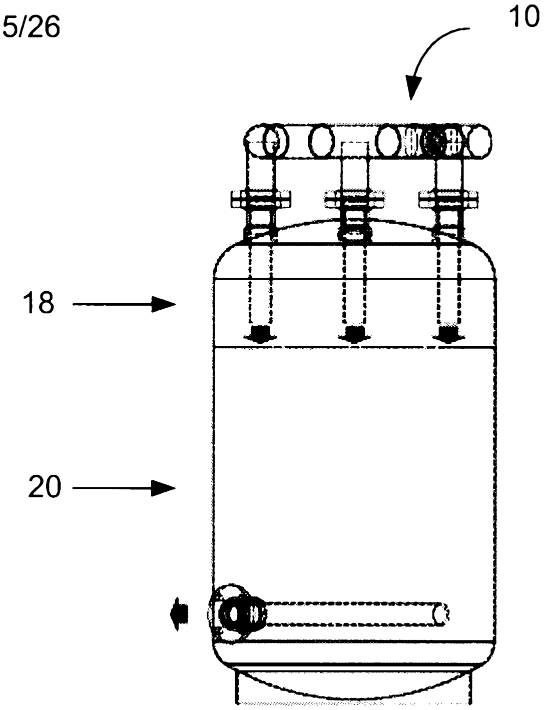


Fig. 3C

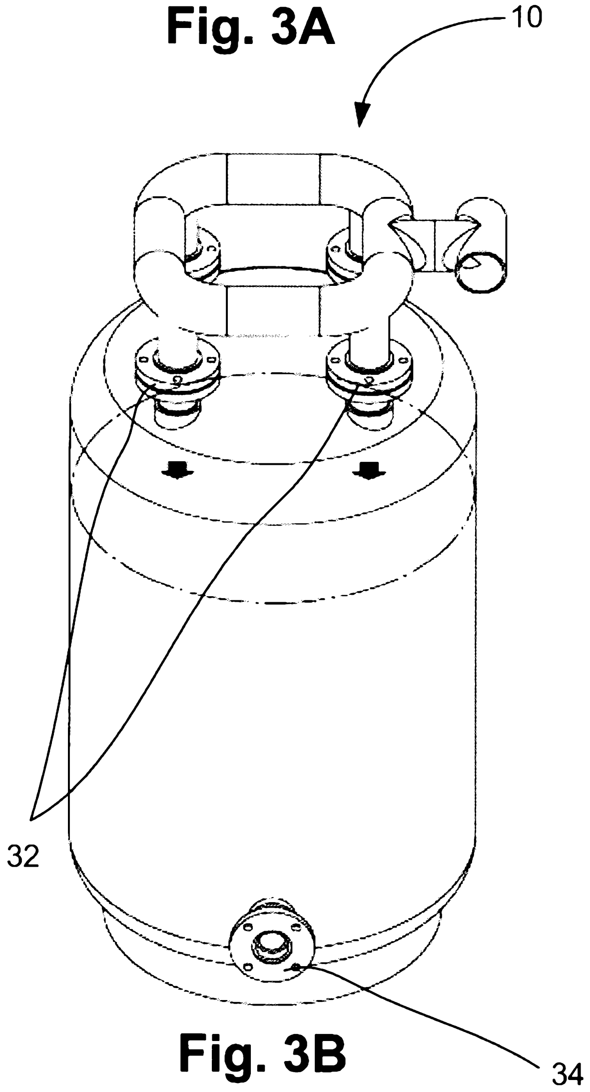


Fig. 3B

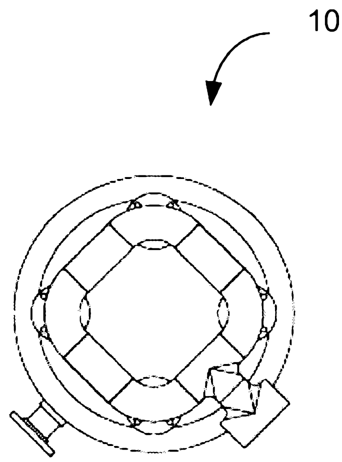


Fig. 3D

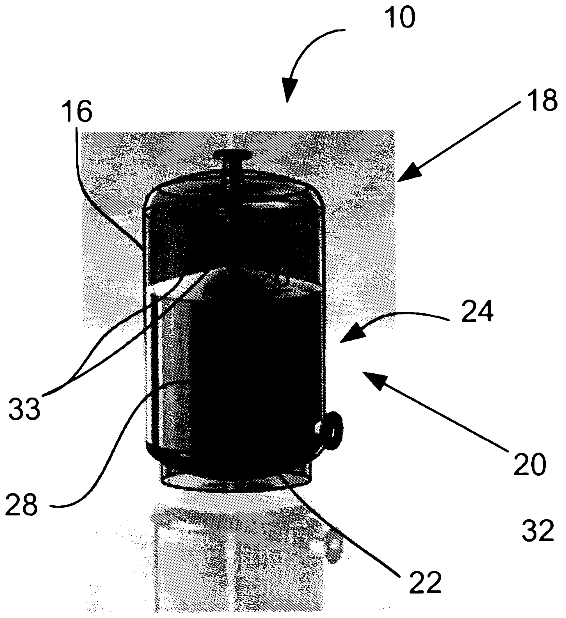


Fig. 4A

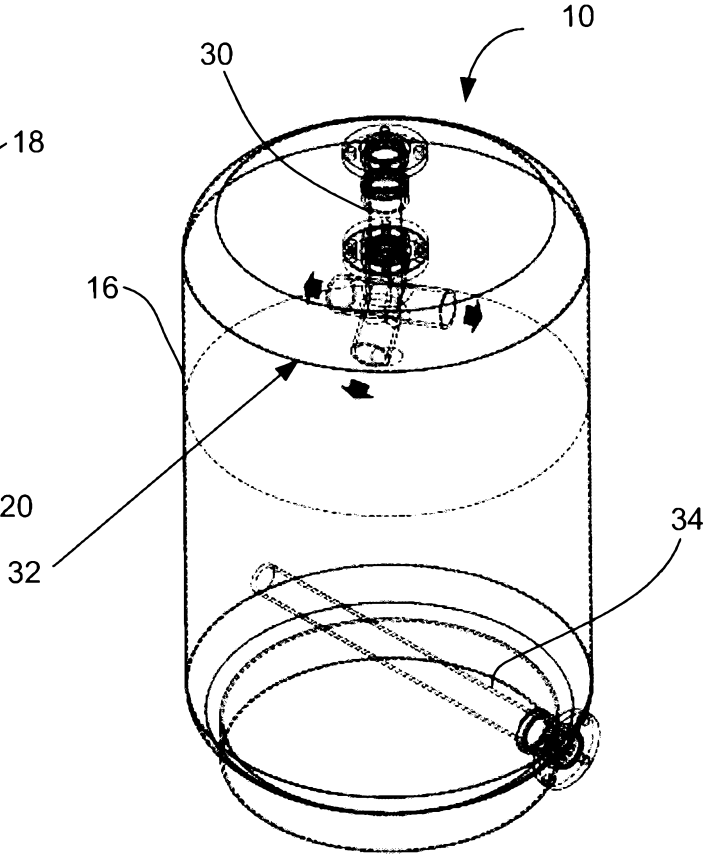


Fig. 4B

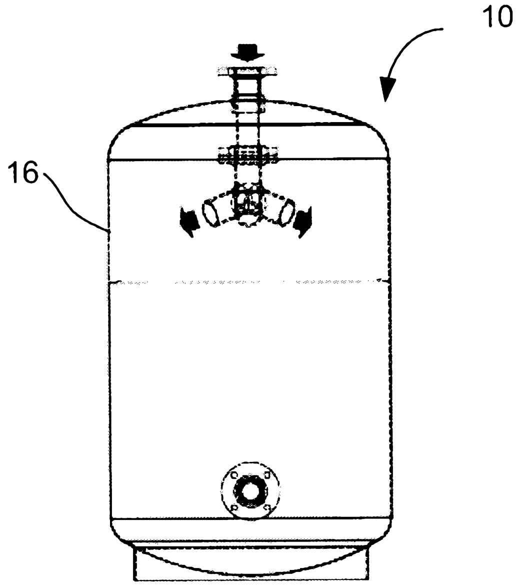


Fig. 4C

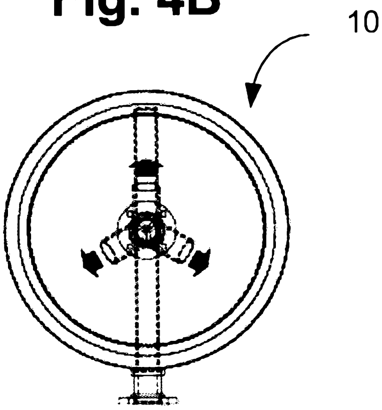


Fig. 4D

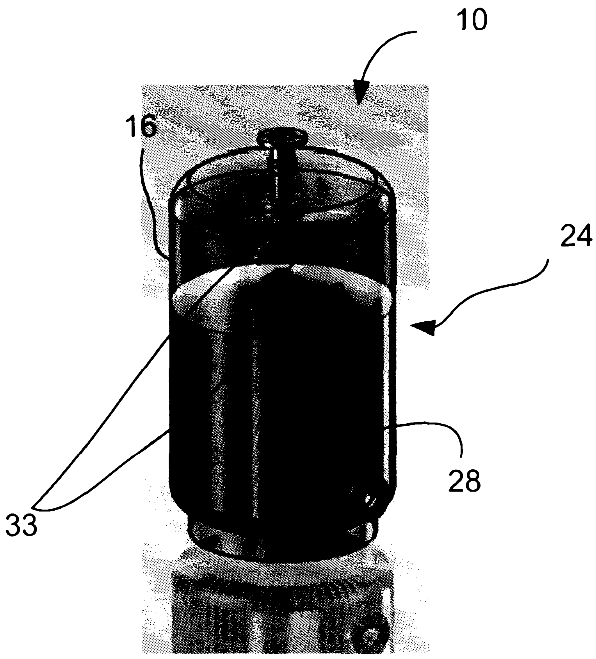


Fig. 5A

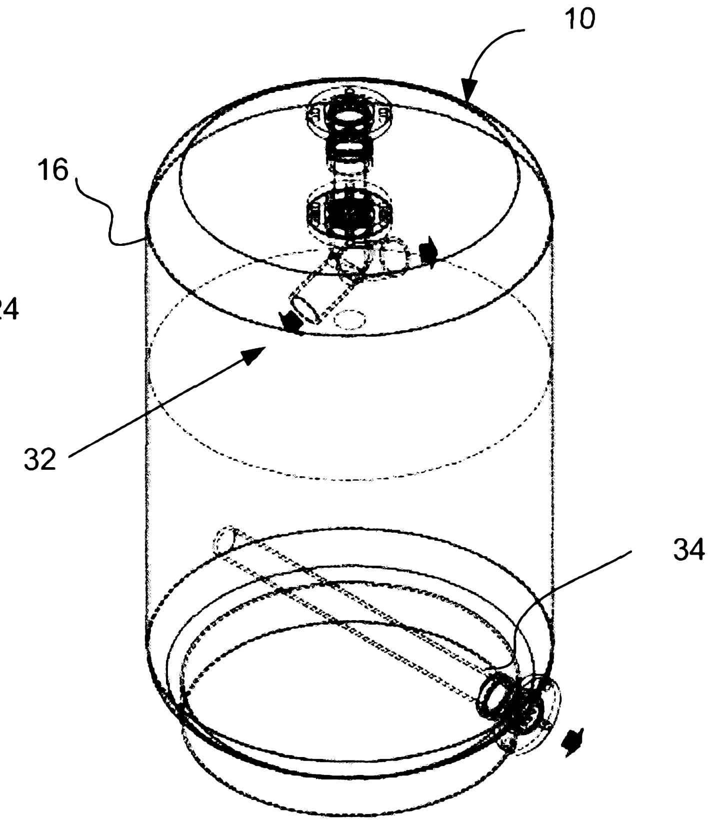


Fig. 5B

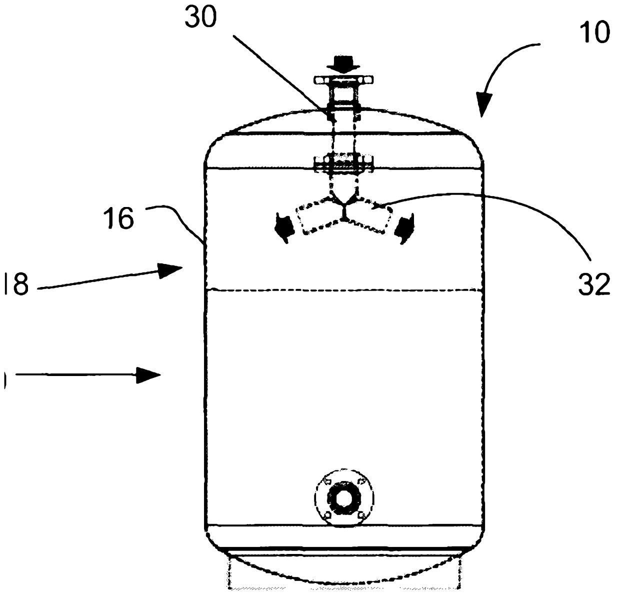


Fig. 5C

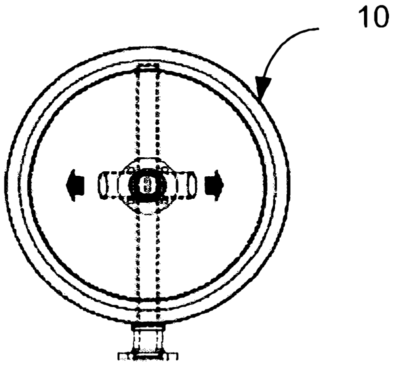


Fig. 5D

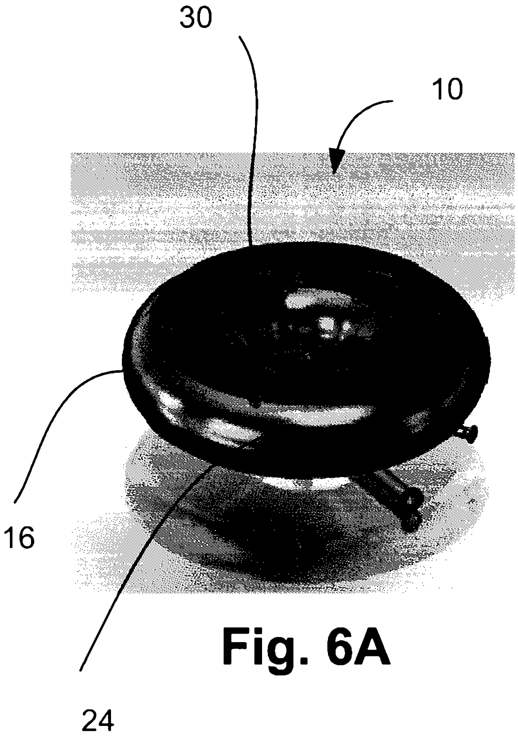


Fig. 6A

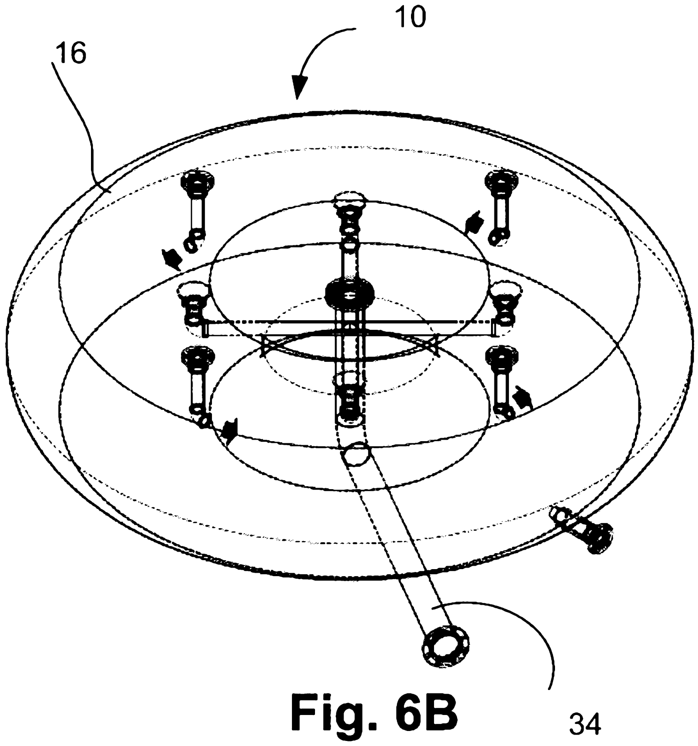


Fig. 6B

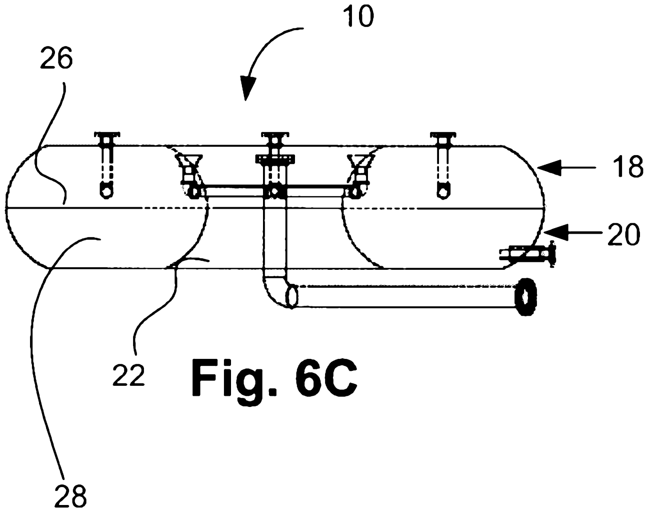


Fig. 6C

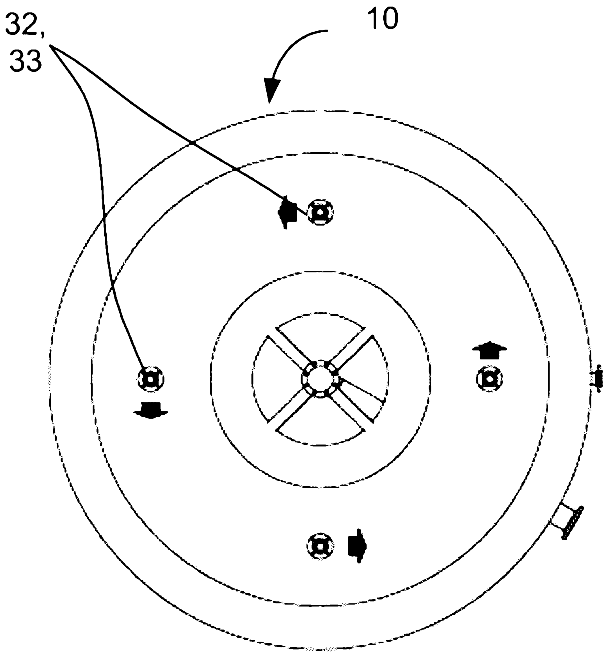


Fig. 6D

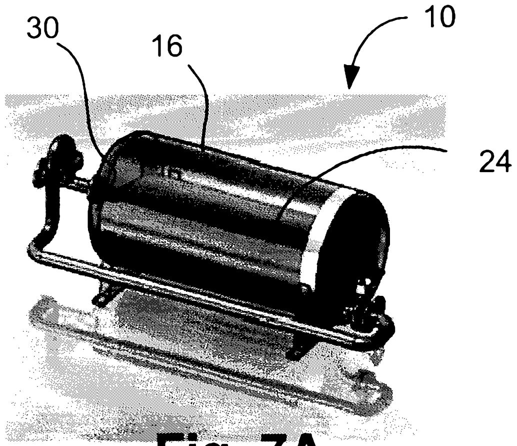


Fig. 7A

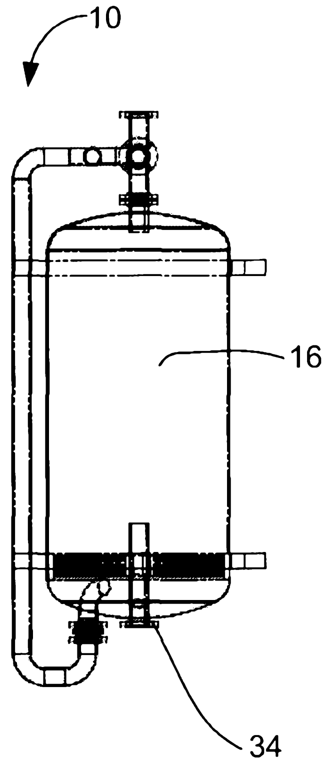


Fig. 7D

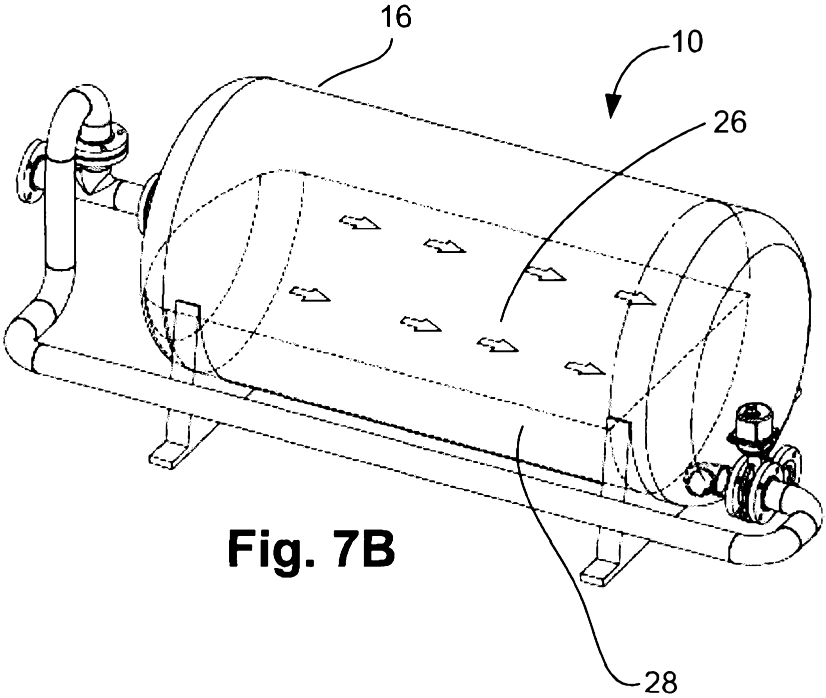


Fig. 7B

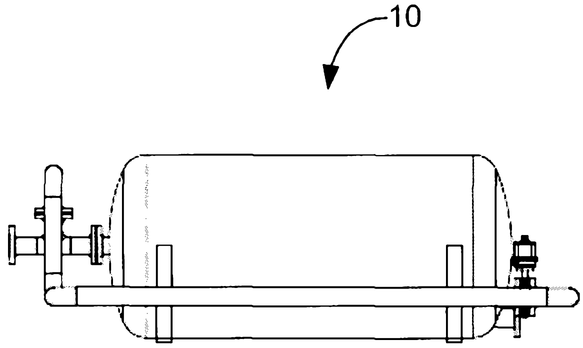


Fig. 7C

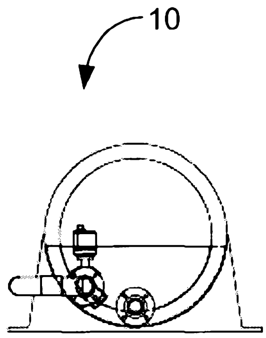


Fig. 7E

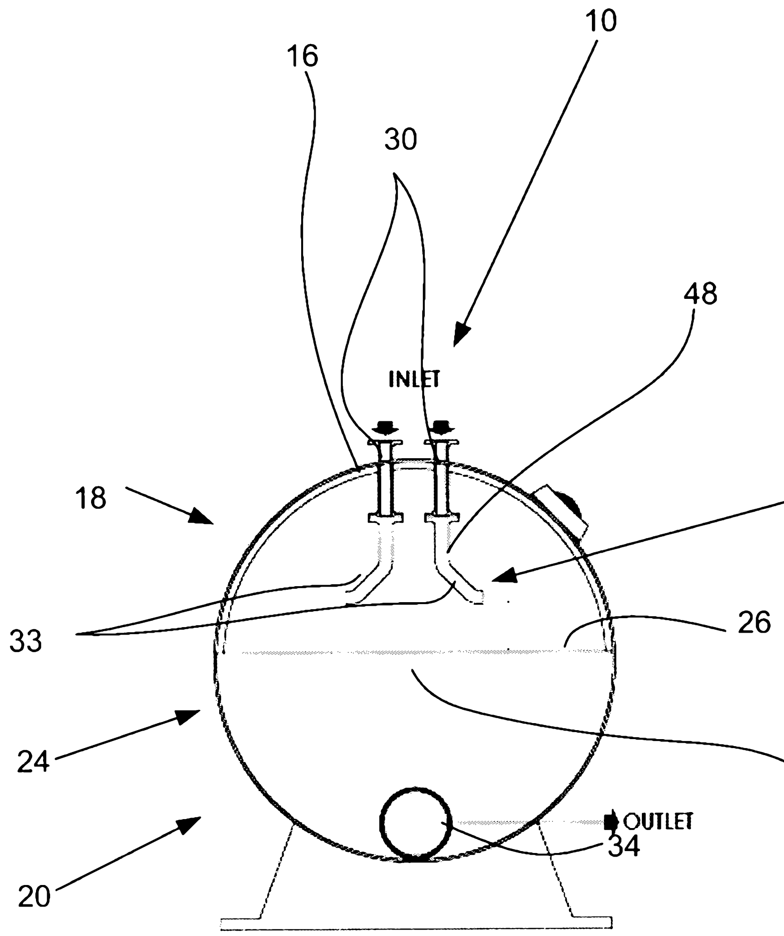


Fig. 8

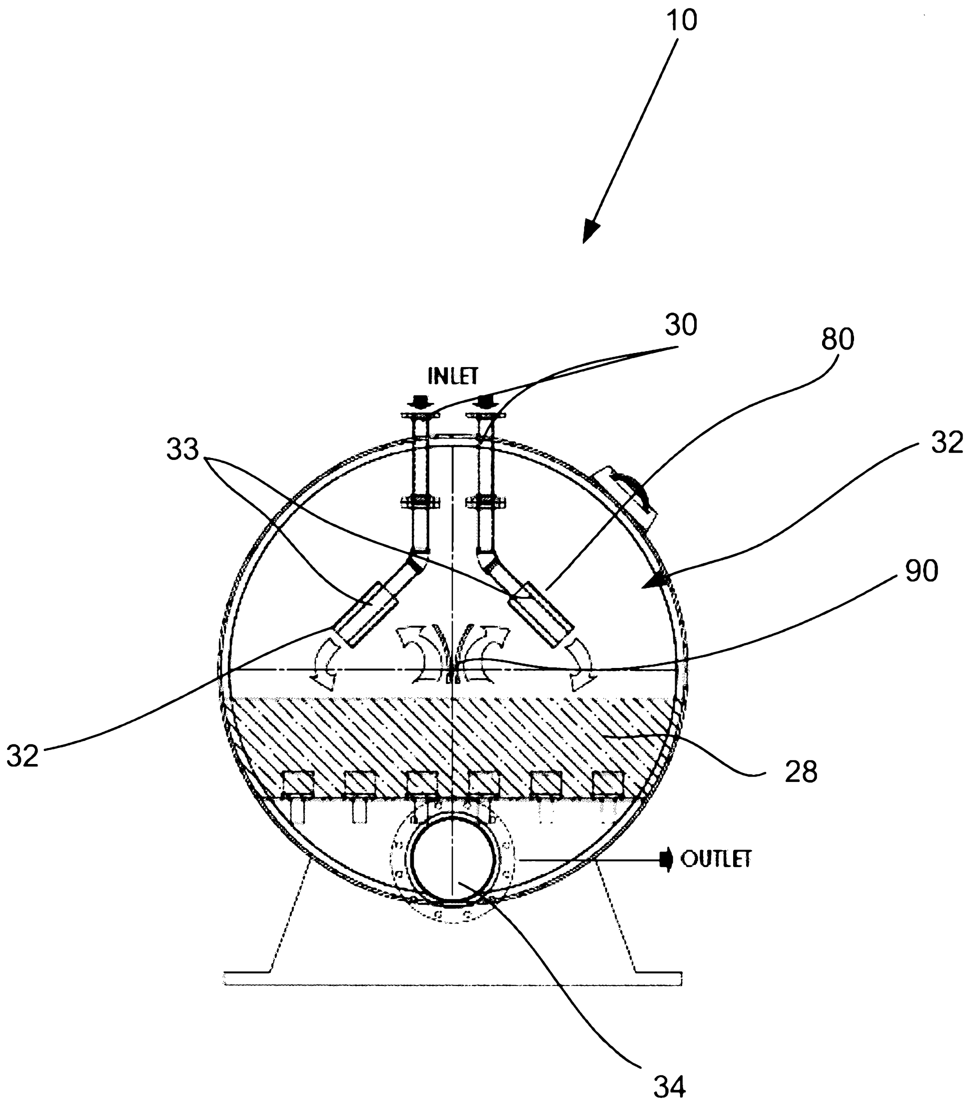


Fig. 9

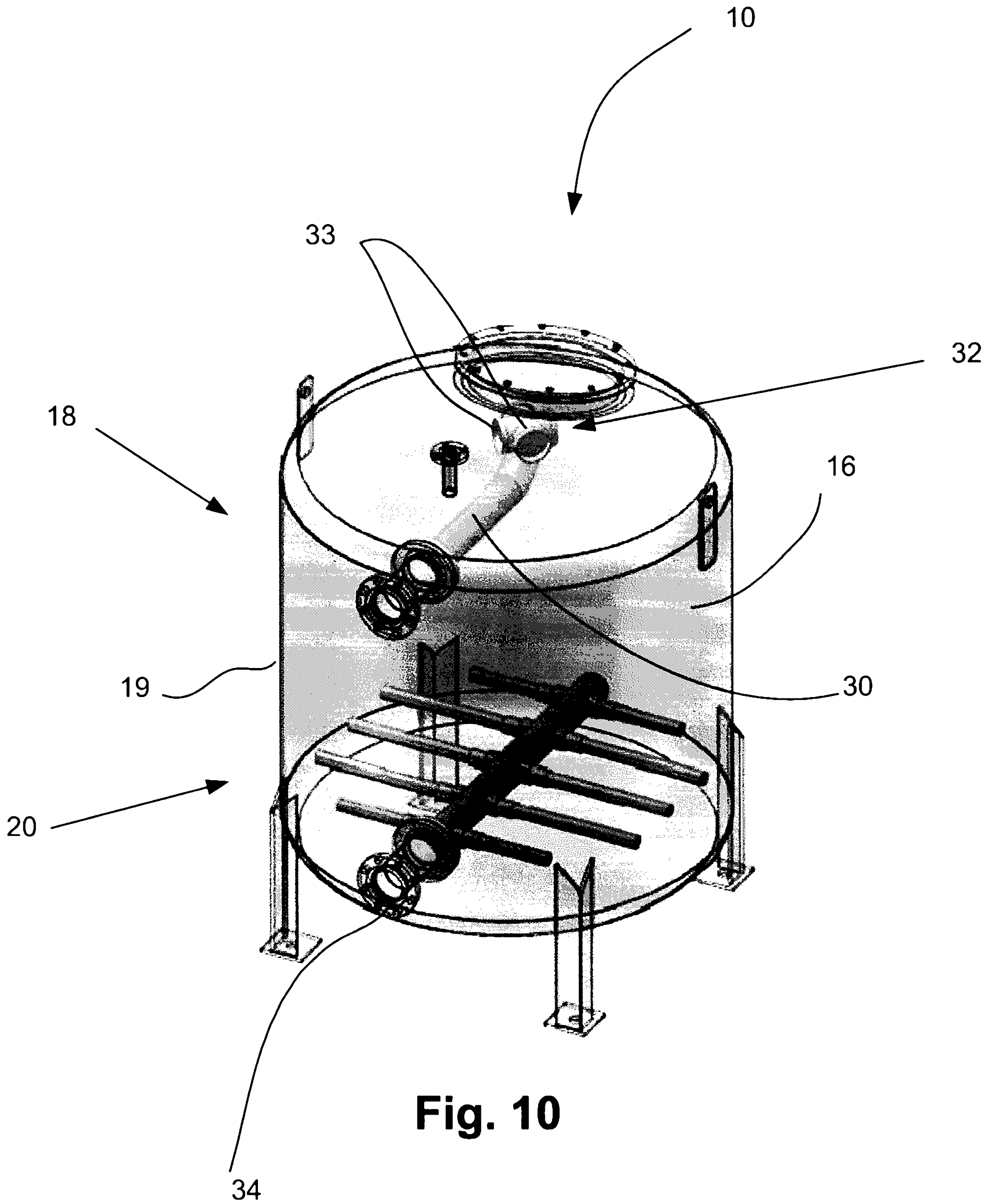
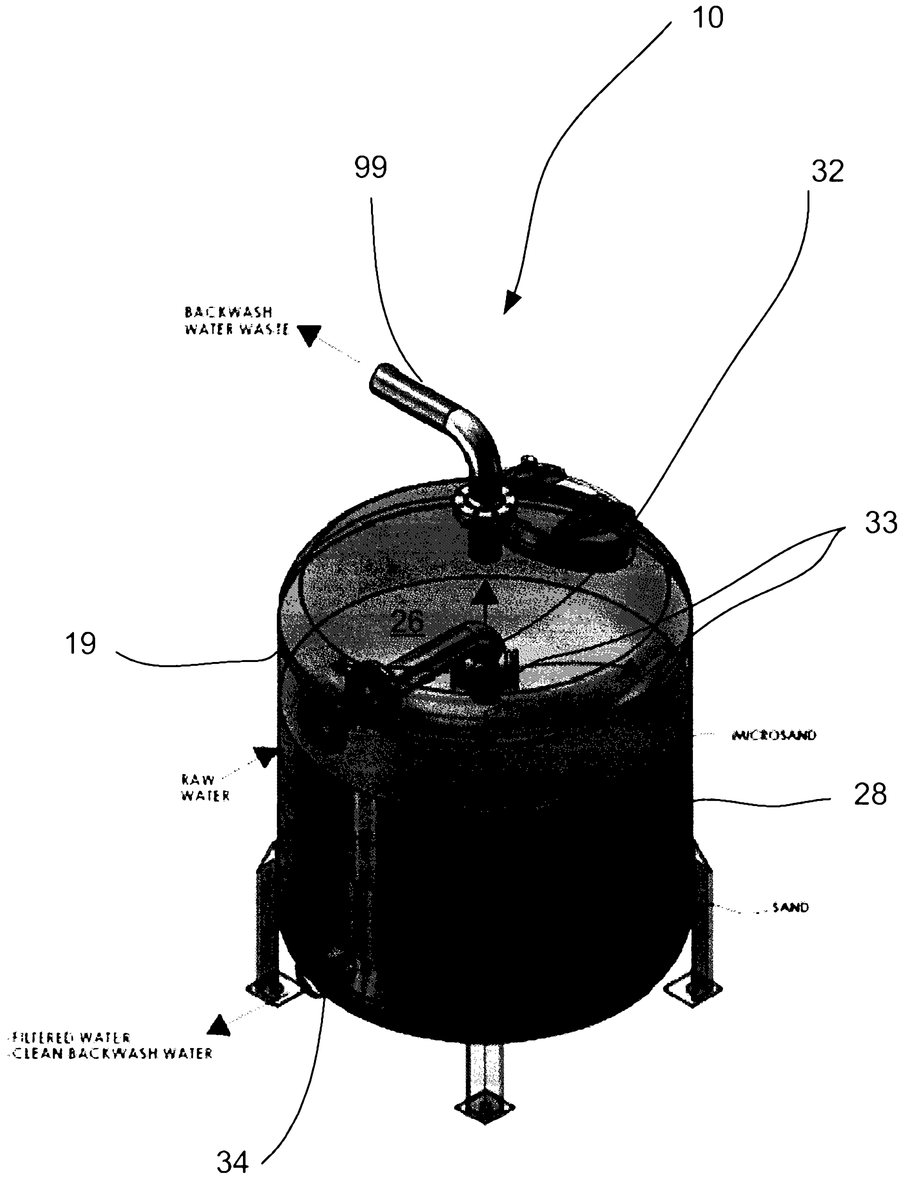


Fig. 10


10
99
32
BACKWASH
WATER WASTE
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26
19
MICROSAND
RAW
WATER
28
SAND
FILTERED WATER
CLEAN BACKWASH WATER
34

Fig. 11

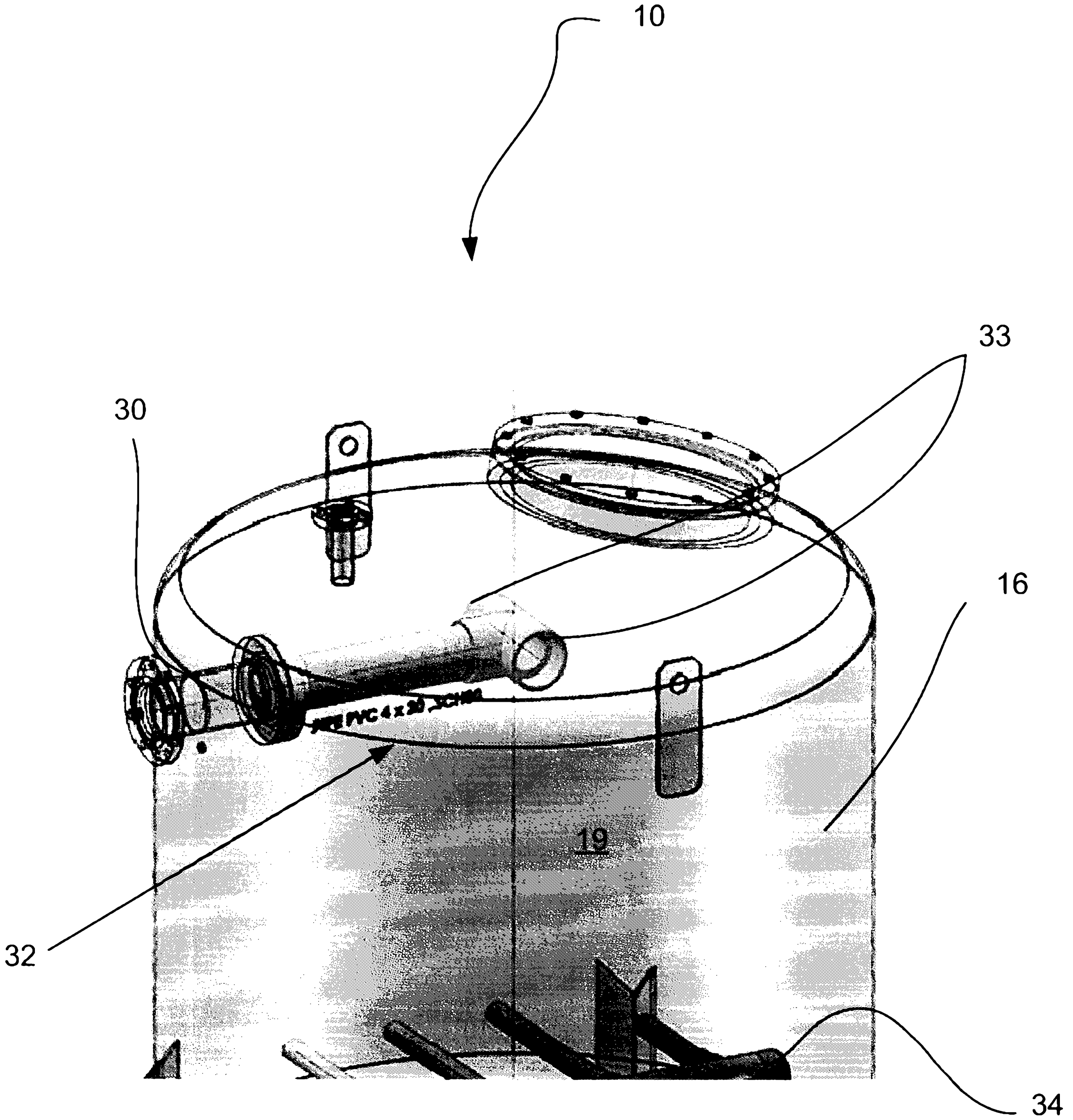


Fig. 12A

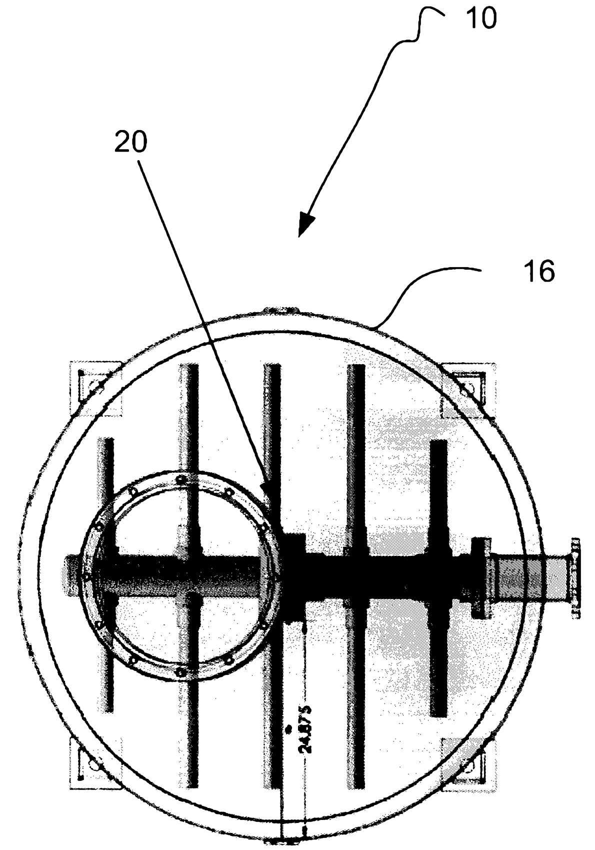


Fig. 12B

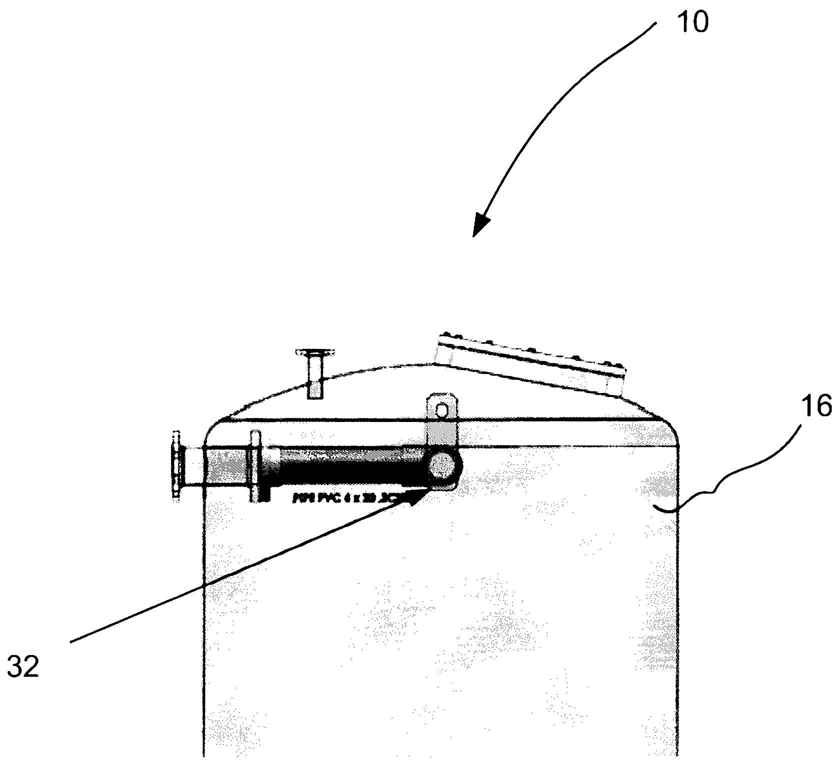


Fig. 12C

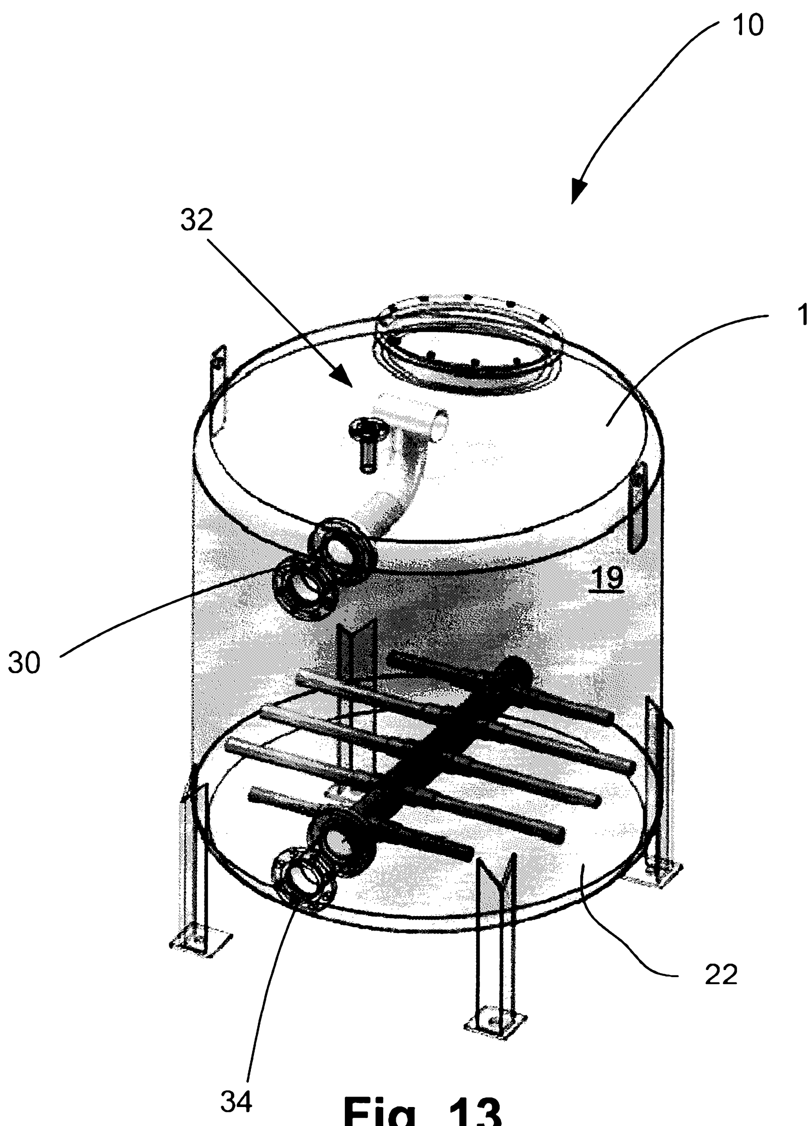


Fig. 13

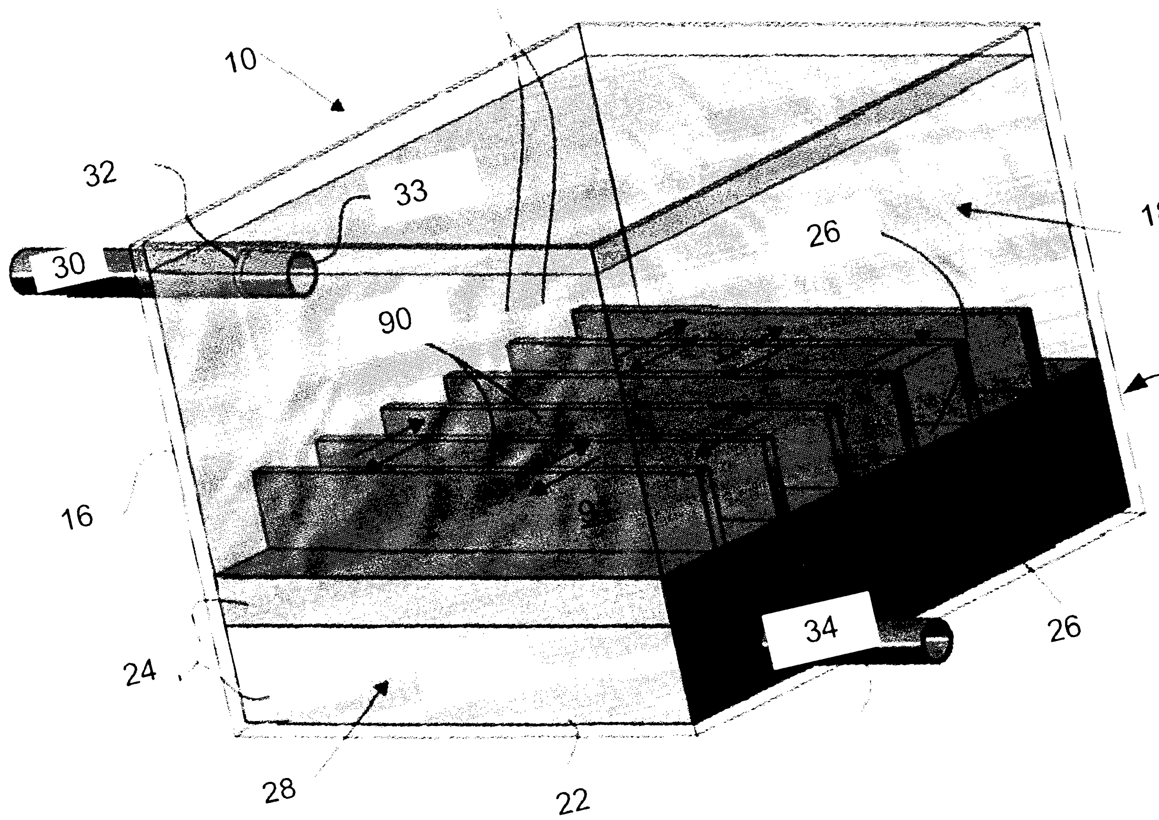
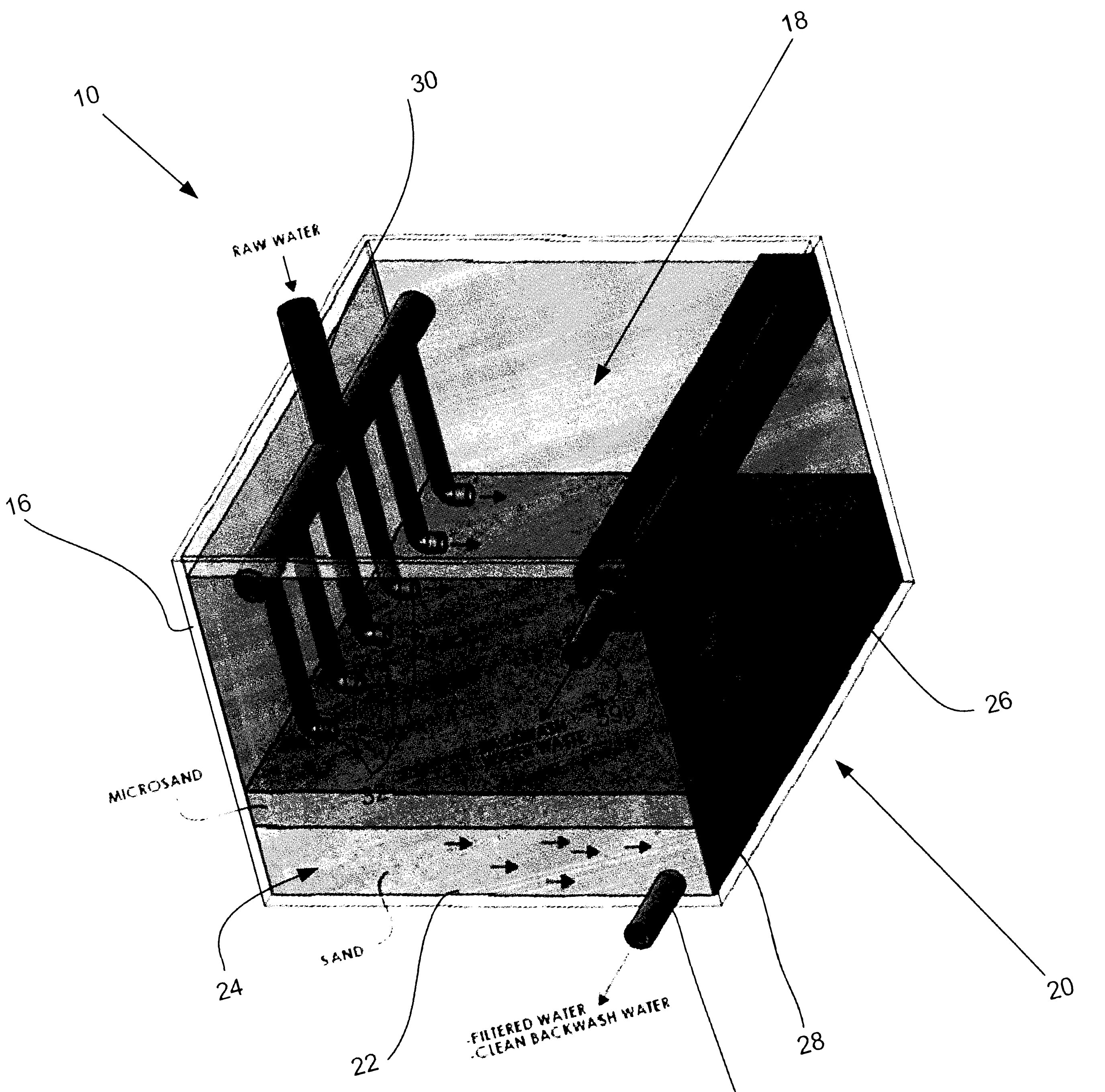


Fig. 14


10
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RAW WATER
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MICROSAND
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22
-FILTERED WATER
-CLEAN BACKWASH WATER
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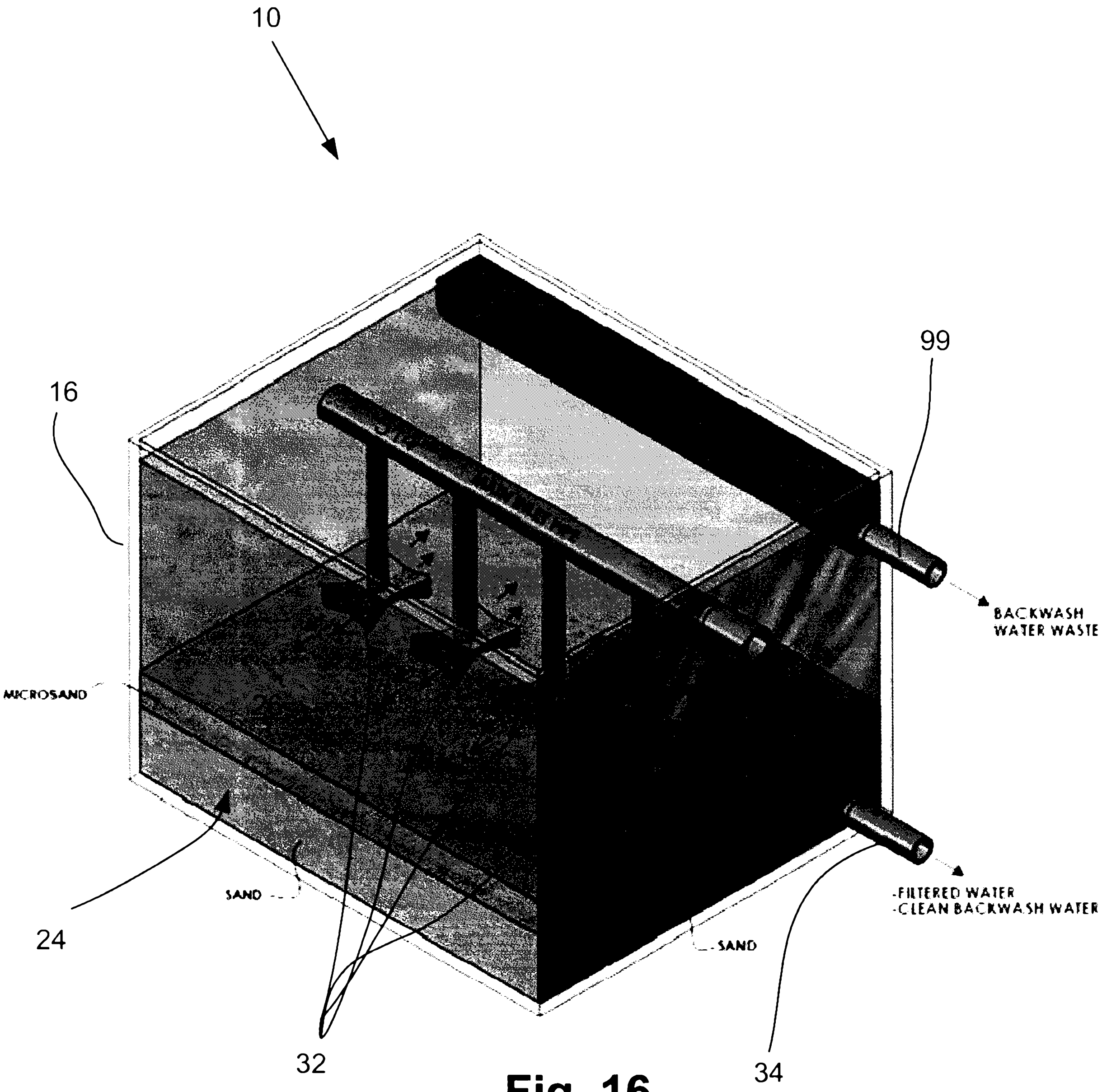
Fig. 15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-FILTERED WATER
-CLEAN BACKWASH WATER
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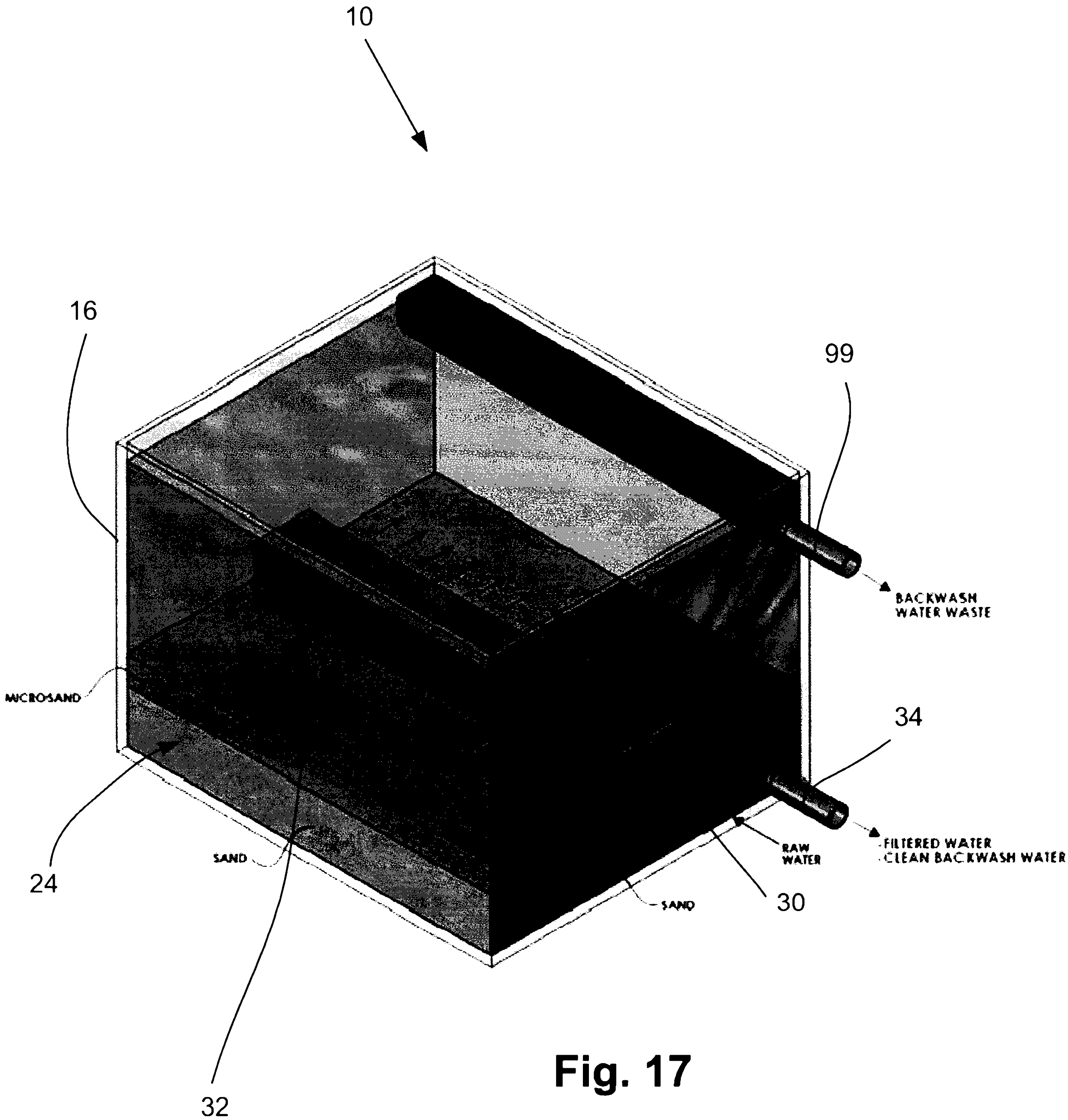
Fig. 16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BACKWASH
WATER WASTE
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FILTERED WATER
CLEAN BACKWASH WATER
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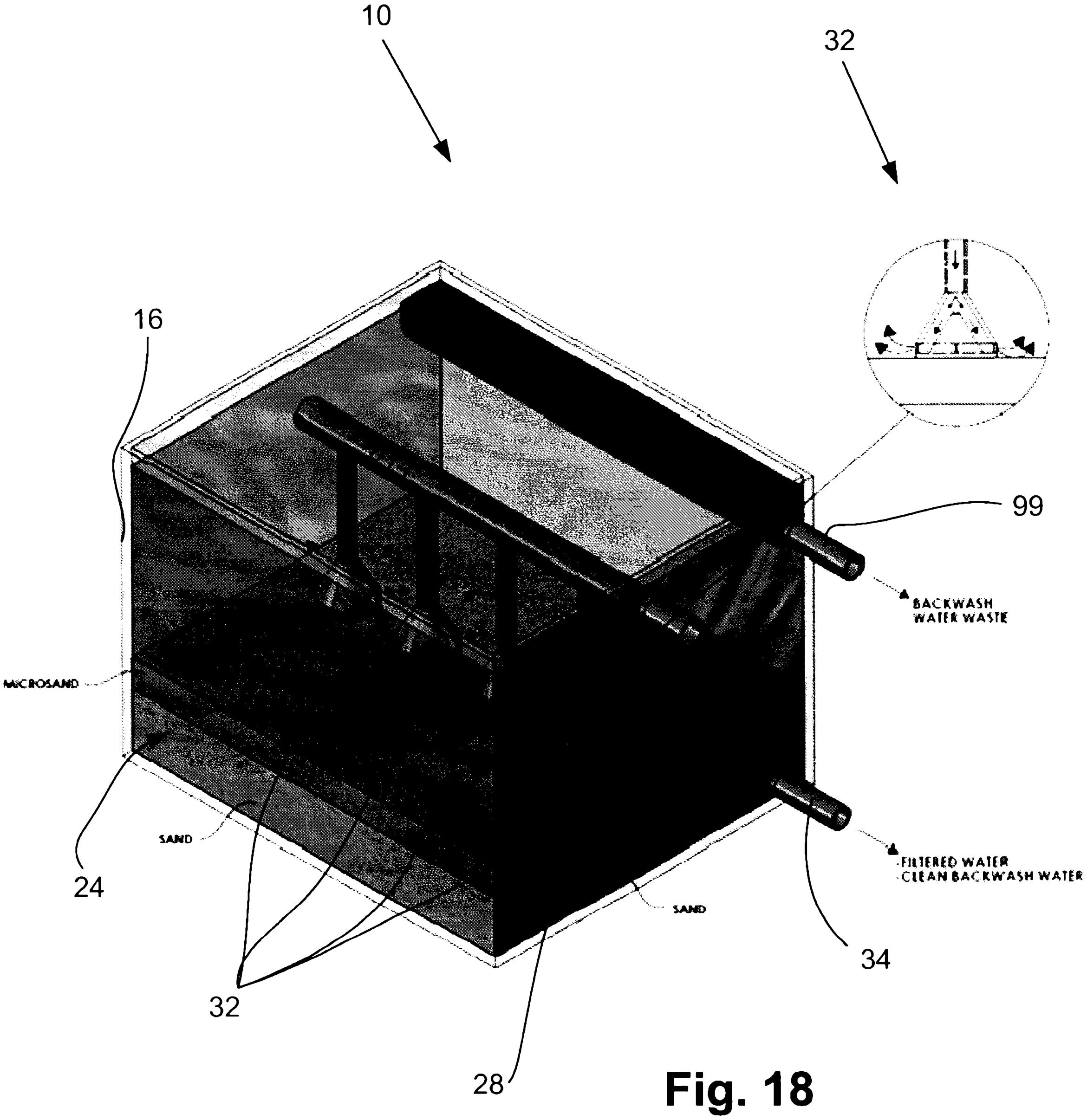
WATER
SAND
SAND
24
30
32

Fig. 17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BACKWASH WATER WASTE
MICROSAND
SAND
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FILTERED WATER
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SAND
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32
28

Fig. 18

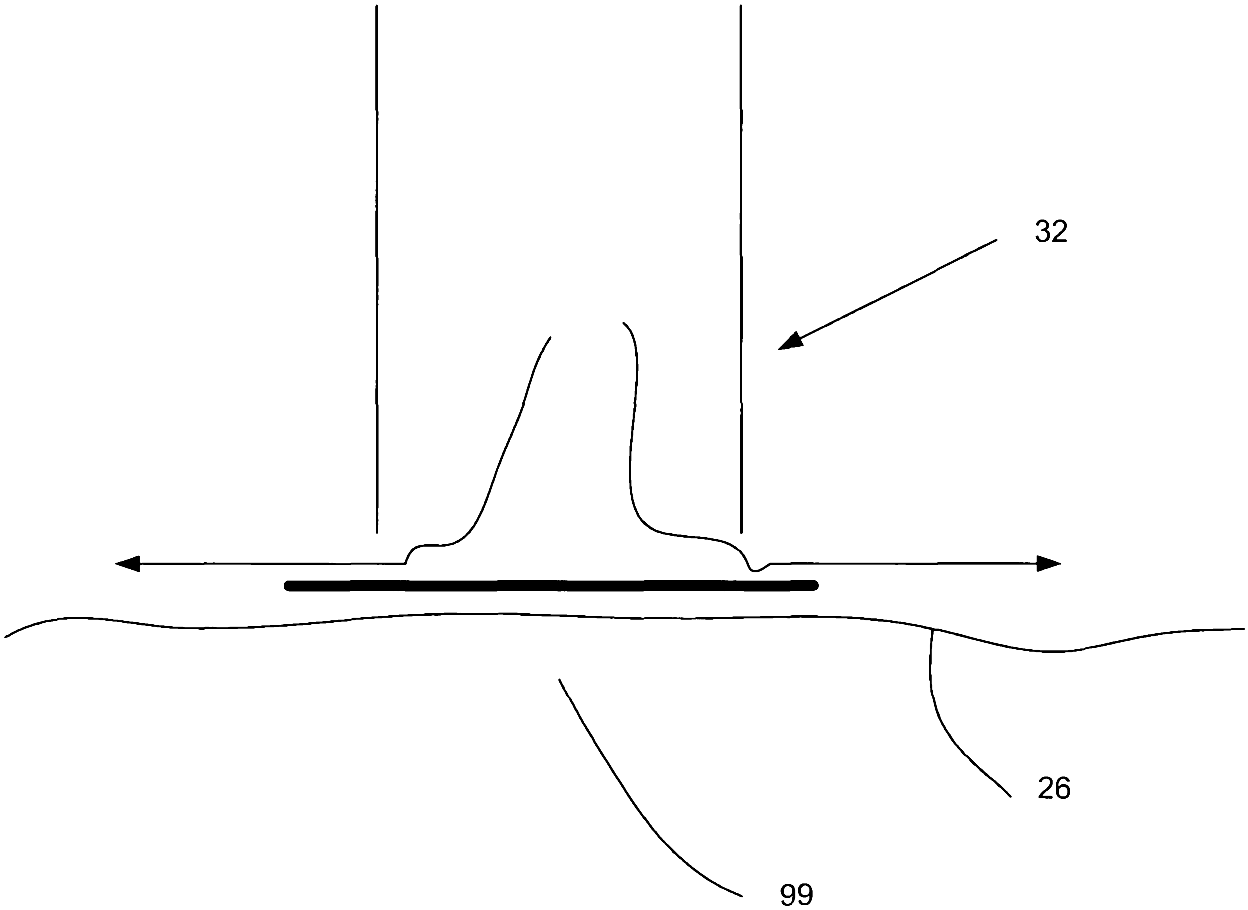

Fig. 19

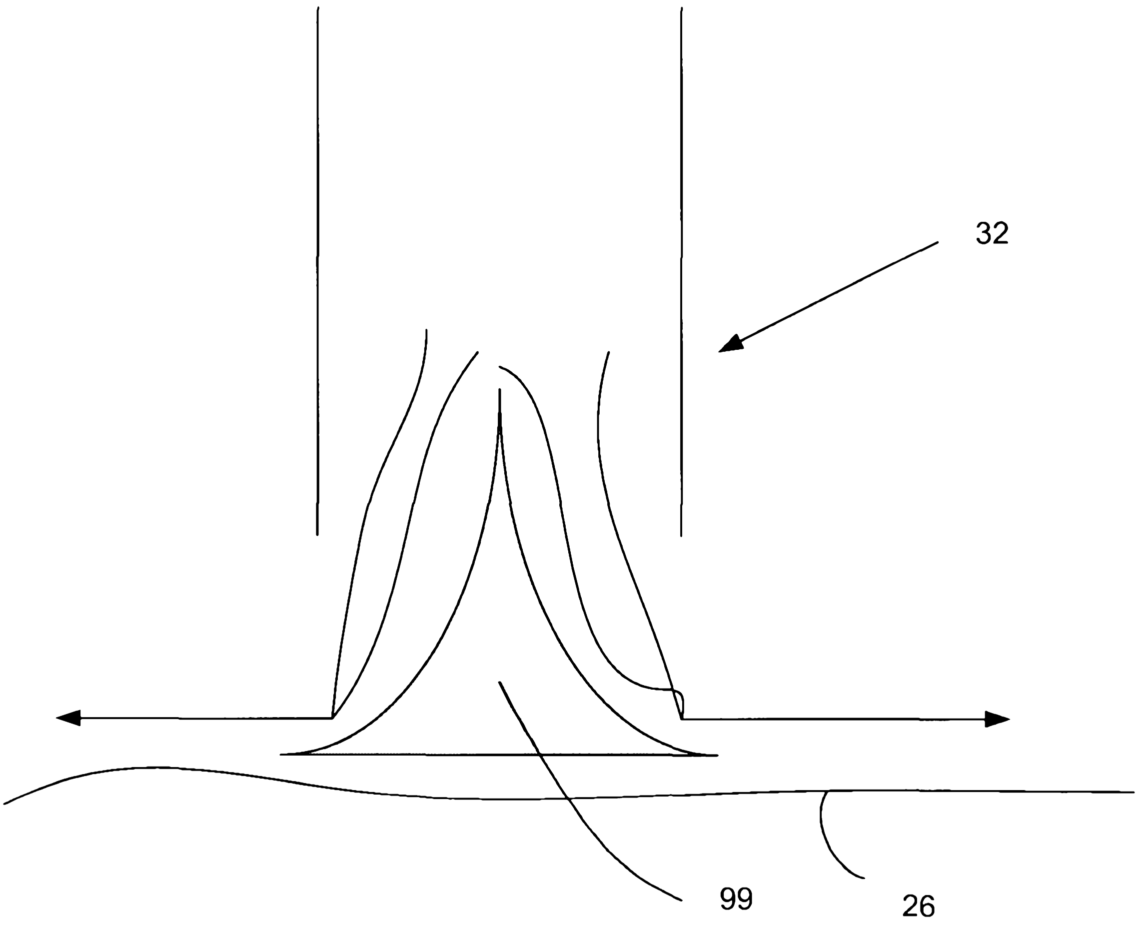

Fig. 20

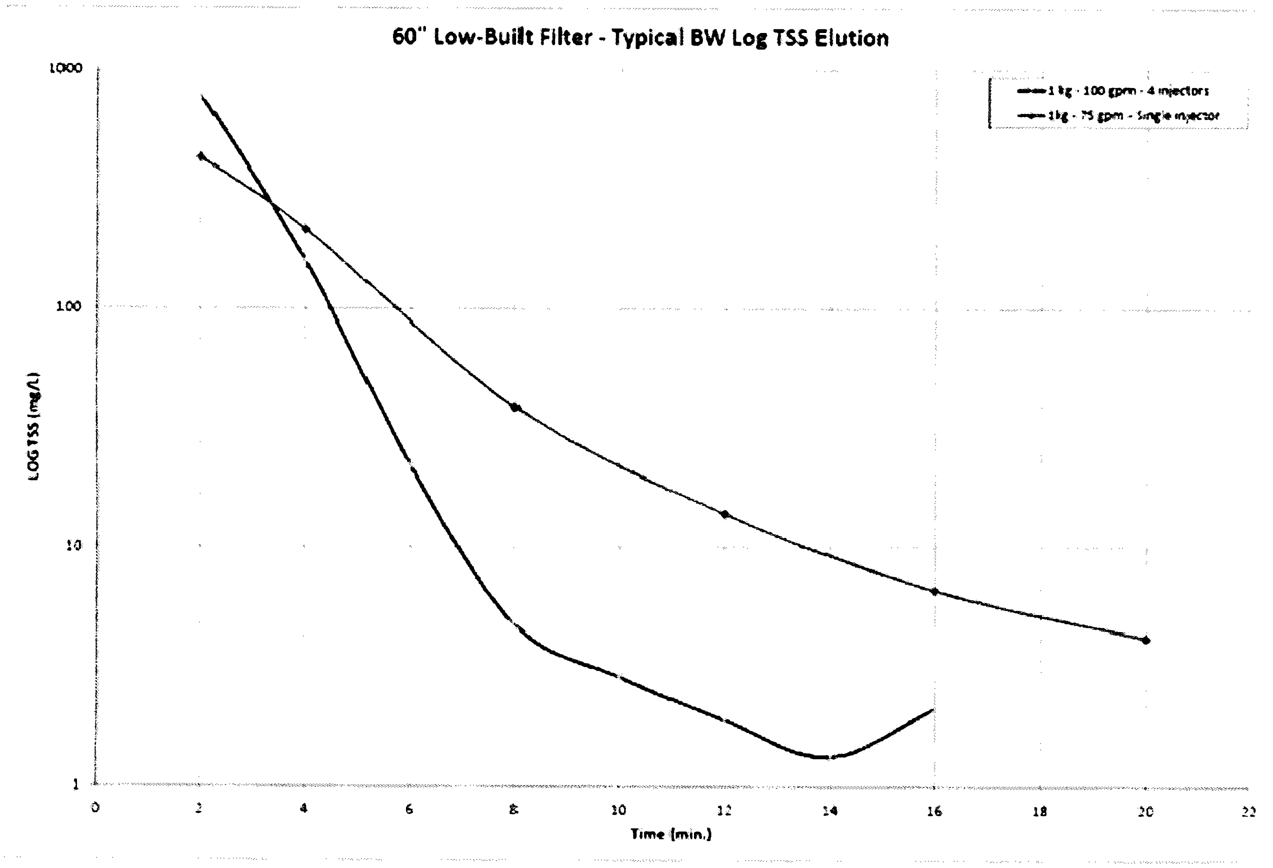
60" Low-Built Filter - Typical BW Log TSS Elution
1000
100
10
1
LOG TSS (mg/L)
0
2
4
6
8
10
12
14
16
18
20
22
Time (min.)
1 kg - 100 gpm - 4 injectors
1kg - 75 gpm - Single injector

Fig. 21

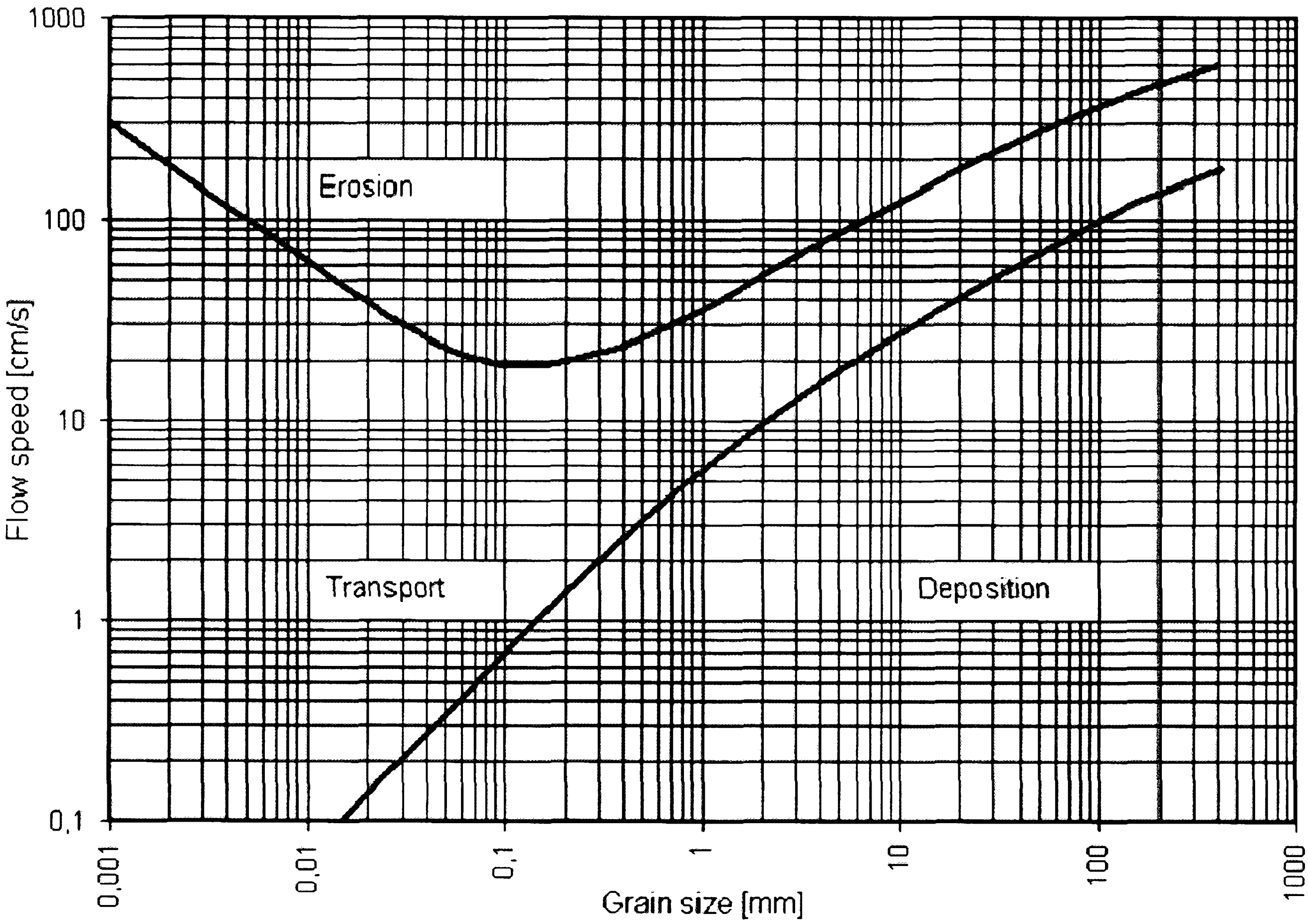
1000
100
10
1
0,1
Flow speed [cm/s]
Erosion
Transport
Deposition
0,001
0,01
0,1
1
10
100
1000
Grain size [mm]

Fig. 22