



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
15.04.2009 Bulletin 2009/16

(51) Int Cl.:
E03F 7/10 (2006.01)

(21) Application number: **08166069.8**

(22) Date of filing: **08.10.2008**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

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(30) Priority: **08.10.2007 FI 20075713**

(54) **Apparatus for servicing a drain and a corresponding method**

(57) The invention relates to an apparatus (10) for servicing a drain system (13), which apparatus includes a first tank (12) for liquid (42) to be fed to the drain system (13, 30.2) and a second tank (14) for the liquid (41) with a solids content, removed from the drain system (13, 30.2), means (15, 61) for pressurizing the liquid and feeding it to the drain system, means (44 - 48) for removing

the liquid with a solids content from the drain system into the second tank, a filtration process (16) arranged to clean the liquid removed from the drain system to the second tank, in order to recycle it in the apparatus. The filtration process is based on dynamic filtration (20) and is fitted between the first and second tanks. In addition, the invention also relates to a corresponding method.

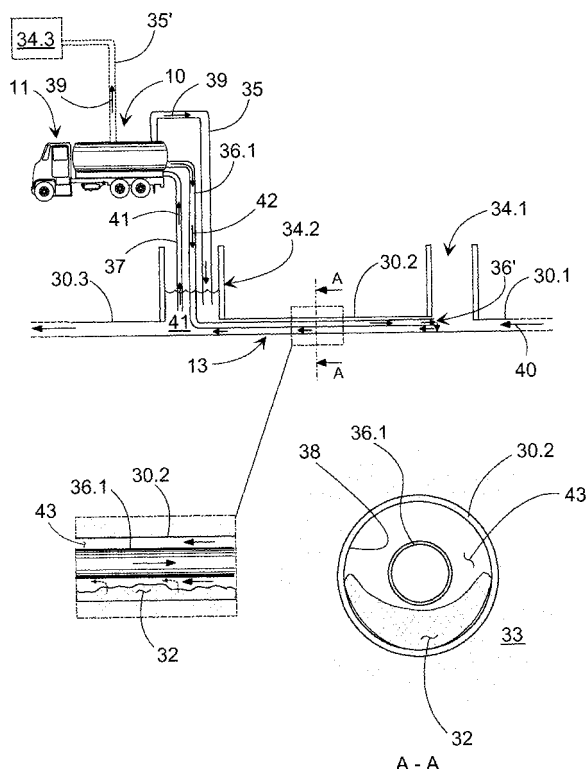


Fig. 1

Description

[0001] The present invention relates to an apparatus for servicing a drain system, which apparatus includes

- a first tank for liquid to be fed to the drain system and a second tank for the liquid with a solids content, removed from the drain system,
- means for pressurizing the liquid and feeding it to the drain system,
- means for removing the liquid with a solids content from the drain system into the second tank,
- a filtration process arranged to clean the liquid removed from the drain system to the second tank, in order to recycle it in the apparatus.

[0002] In addition, the invention also relates to a corresponding system.

[0003] Various kinds of drain-servicing apparatuses, for example fitted to vehicles, are known from the prior art. They are used to wash drainpipes with high-pressure water. In addition, solids that have accumulated in drains and manholes and detached during the washing are flushed and removed as sludge by sucking them into a vacuum tank fitted to the vehicle.

[0004] However, there are unresolved problems associated with the apparatuses according to the prior art. One of the most important is that the washing must be interrupted now and then in the middle of the workday, in order to empty the liquid, sucked from the drain system, from the vacuum tank and/or to fetch clean wash water. In drain servicing, the wash water is used up quite rapidly, so that new water must be fetched frequently to allow work to continue. A significant part of the workday can be taken up by fetching wash water, during which time the apparatus is not really in effective use.

[0005] Some apparatuses are also known, in which flocculation of the solids is performed using polymers, for example. Problems with working with them are caused, however, by the cold conditions in northern countries, and by the properties of the sludge being sucked into the vacuum tank, for which reasons their functioning is uncertain.

[0006] Further, solutions are also known from the prior art, in which filtered liquid sucked from the drain system and recycled filtered water are utilized. Such systems are disclosed in international patent application WO - 03/095754 A1 and US patent 4,134,174. The US patent is based on mesh-screen filtering, which takes place in essentially the same vacuum tank, into which the liquid containing solids is removed from the drain. In the solution according to the WO publication, the filtration process takes place outside the tank and the filtered water is fed directly to be pressurized and thus reused. The operating reliability of neither of these solutions is that it would permit the continuous operation of the apparatus, and thus also of the drain-servicing process.

[0007] In the solution according to the US patent, the

mesh-screen filters must necessarily be cleaned from time to time, during which time the device cannot be used for drain servicing. In the solution according to the WO publication, even a small disturbance in the filtration process will affect the operation of the apparatus and may thus, in the worst case, interrupt servicing work, due to a lack of liquid suitable for pressurization.

[0008] One way to try to improve the continuity of the operation of the apparatus is to make it comprise with the precision of the filtering and use chemical flocculation alongside it. While this will certainly lengthen the uninterrupted operating time, the use of chemicals will, in turn, cause their own problems, for example cleaning process becoming complicated, an increase in the competency required in the operator of the apparatus and a reduction in cleaning capacity. In any event, the liquid circulated in the apparatus must be of a certain level of cleanliness, so that the liquid being circulated will not damage, for example, the high-pressure pump, nor interfere with the operation of the drain-flushing hose.

[0009] The present invention is intended to create a simpler and more effective apparatus than previously for servicing a drain system. The characteristic features of the apparatus according to the invention are stated in the accompanying Claim 1 and the features of the corresponding method in Claim 10.

[0010] In the invention, the filtration process is based on dynamic filtering and is fitted between a first and a second tank. Thus the apparatus need not interrupt work, for example, due to the washing of the filter or its blockage, but instead the apparatus can operate effectively for the whole workday.

[0011] According to one embodiment, the dynamic filtering can include a rotating drum, the direction of flow of the liquid travelling through the filter baffle of which and removed from the drain system, can be from outside to inside the drum. This will improve the functioning of the embodiment based on a drum of limited capacity, because the amount of liquid can be varied more freely outside the drum than inside the drum of limited capacity. In addition, according to one embodiment, the filter baffle can be washed while the apparatus is operating and thus further improve the maintenance of the functioning of the filtration process. According to one embodiment, the filter baffle can be washed by means of water jets fitted inside the drum. According to one embodiment, washing can take place at a point on the filter baffle of the drum that is above the surface of the water.

[0012] According to one embodiment, the drum can be fitted to a room, in which there are water-distribution elements for distributing the water principally over the entire length of the drum. This was further promote the functioning of the filter.

[0013] As well as reliability and continuity of operation, the construction according to the invention substantially simplifies the apparatus. Because the filtration process is isolated outside the tank, there will be space in the tank for more liquid removed from the drain. Cleaning and

servicing the filtering means is easier, because they form their own independent structure, access to which is simple. In addition, the separation of the filtration process from the tank ensures an undisturbed filtration process, which is not disturbed by, for example, the amount of water or solids in the tank, or unstable behaviour in the tank. The sludge accumulated in the filtering chamber can be removed, for example, from time to time while the apparatus is operating. An important advantage is also the continuity of the operation of the wash liquid, which is achieved by means of the continuously operating filtering outside the tank. Through this, for example, the drain washing operation need not be interrupted at intervals on account of a separate round of wash-liquid cleaning.

[0014] According to one embodiment, the apparatus can include at least one tank, in which a vacuum can be created, and to which the liquid with a solids content is sucked from the drain. The tank can be compartmentalized into a settling chamber, in which the liquid with a solids content is cleaned, for example, by gravity, and pump chamber, from which the pre-cleaned liquid is transferred to the filtration process outside the tank. Thus the very coarsest substances are removed simply from the liquid with a solids content even before the pumping stage, so that the liquid with a solids content going to the filtration process is already reasonably pre-cleaned. This saves the pump and also lightens the cleaning load on the filtering-process system, thus achieving more effective filtering. In addition, thanks to the gravity settling and compartmentalization, the inside of the tank is free of functional structures, providing more space for liquid with a solids content from the drain system.

[0015] The apparatus according to the invention is constructed in such a way that it will also operate in freezing conditions, which is quite essential when considering northern conditions, for example. This is achieved by the dynamic nature of the filtering. In addition, the compact dynamic filtering system can be kept unfrozen in freezing conditions by means of a heating apparatus, which will permit safe fully effective working even in a cold environment. Other advantages and additional forms of application of the invention will be described hereinafter, in connection with the embodiments.

[0016] The invention, which is in no way restricted by the embodiments disclosed in the following, is described in greater detail with reference to the accompanying drawings, in which

- Figure 1 shows a schematic drawing of one example of a way to perform drain cleaning using the apparatus according to the invention,
 Figure 2 shows a rough schematic diagram of the basic principle of the apparatus according to the invention,
 Figure 3 shows an operating diagram of one embodiment of the apparatus according to the invention, and

Figure 4 shows one example of dynamic filtering, as longitudinal and transverse sections, seen from different directions.

[0017] Figure 1 shows a schematic drawing of one example of a way to perform, for example, the cleaning of a rainwater drain system 13, using the apparatus 10. It should be noted that the actual form of cleaning method, which is practised outside the apparatus 10, in no way restricts the actual invention, or its applications, but instead other ways too of cleaning the drain network 13, or corresponding systems of flow channels are possible when applying the apparatus 10 and method. In addition, it should further be noted that the applicability of the apparatus 10 according to the invention is not restricted to only the rainwater drains presented as an example of an application, but instead other types of flow channel requiring cleaning from time to time are possible subjects for servicing using the apparatus 10. Numerous kinds of these can be found, for example, in the industrial and municipal services sectors.

[0018] In the case of the rainwater drain used as an example of an application, the drain line system 13 is generally formed of a set of pipelines, which is formed of one or several pipes 30.1 - 30.3 joined to each other, or of a corresponding structure forming a flow channel. The diameter of the pipe 30.1 - 30.3 can normally be, for example, 200 - 1000 mm. The pipeline 30.1 - 30.3 can be cut by manholes 34.1, 34.2, which are at a distance from each other. Conventionally, it is possible at one time to service a drain line 30.2 between two consecutive manholes, 34.1, 34.2, by flushing it with a wash liquid 42, the main component of which is conventionally water. During the flushing, the drain line 30.2 is washed, i.e. cleaned, for example, of material 32 (cross-section A-A of Figure 1) that has adhered to its internal surface 38, and thus accumulated. In the case of stormwater drains, the material 32 can be, for example, mineral in composition, such as sand and/or clay.

[0019] One example of a way to perform the washing of the drain line 30.2 is to feed a flushing hose 36.1 into the pipeline 30.2. The flushing hose 36.1 in the pipe 30.2 sunk into the ground 33 is shown in the inset in the lower part of Figure 1 and next to the inset of the corresponding cross-section A-A of Figure 1. The feeding of the flushing hose 36.1 into the drainpipe 30.2 can take place from a latter manhole 34.2 in the flow direction of the line 13. When the flushing hose 36.1 emerges from the pipe 30.2 in the preceding manhole 34.1 in the flow direction of the line 13, high-pressure wash liquid 42 can be fed into the drain system 13, in order to detach the solids 32 and flush it away from the pipeline 30.2 as a liquid 41 containing solids. The drain 13 is washed conventionally in this manner by flushing it against its direction of flow, so that both the flow water 40 of the drain 13 and the wash water 42 flow towards the service manhole 34.2, taking the solids 32 with them.

[0020] When washing the pipeline 30.2, the wash liquid

42 loaded in connection with the apparatus 10 is pressurized and led into the flushing hose 36.1. At the end 36' of the flushing hose 36.1 led into the preceding manhole 34.1 upstream in the drain line 13 to the service manhole 34.2, can be a special, as such known, nozzle (not shown), which guides the wash liquid 42 back into the drainpipe 30.2. This permits the wash liquid 42 to return from the upstream manhole 34.1 to the service manhole 34.2. Of course, this can happen already in the flushing-hose 36.1 feeding stage, in which case the end of the flushing hose 36.1 will move in the drainpipe 30.2 towards the upstream service manhole 34.1.

[0021] The return of the wash liquid 42 to the service manhole 34.2, from which the feeding of the hose 36.1 is thus commenced, takes place from the space 43 remaining between the flushing hose 36.1 and the drainpipe 30.2. In this space 43, there is also the solids 32 accumulated inside the drainpipe 30.2. The material 32 detaches from the internal surface 38 of the pipe 30.2, due to the high-pressure wash water 42, and becomes sludge in the water 42 and is thus flushed back to the service manhole 34.2 along with the wash water 42. The wash liquid 42 that has travelled through the pipeline 30.2, together with the solids 32 mixed with it, which together form the liquid 41 with a solids content, is removed from the service manhole 34.2, for example, by suction using the apparatus 10 in the vehicle 11.

[0022] Figure 2 shows a rough schematic diagram of the basic principle of the apparatus 10 and method according to the invention. The drain-servicing apparatus 10 according to the invention can be built, for example, on a truck 11. The apparatus 10 can be used to wash a drainpipe 30.1 - 30.3 with high-pressure water 42 and correspondingly to remove solids 32 detached by flushing water 42 and turned into sludge, i.e. liquid 41 with a solids content, that has accumulated in the drain 13 and/or manholes 34.1, 34.2. The removal can be performed, for example, by vacuum, in which the liquid 41 is sucked from the drain system into a vacuum tank 14 arranged in connection with the apparatus 10. Pumping can be another way to move the liquid 41 from the drain system 13 to the vicinity of the apparatus 10.

[0023] One embodiment of the apparatus 10 can include, as basic functionalities, means 44 - 48 for creating a vacuum in the vacuum tank 14, the vacuum tank 14 itself, in which the pre-cleaning, for example gravity settling, of the liquid 41 with a solids content, sucked from the drain system 13 can be performed, a fine-cleaning process, following the pre-cleaning and external to the tank 14, being, for example, a mesh-screen-filtering functionality 16, for cleaning the liquid that has settled in the vacuum tank 14 and is thus pre-cleaned and for circulating it in the apparatus, a clean-water tank 12 for storing seed water and the water 42 that has gone through the mesh-screen filtration process 16, and wash liquid 42 pressurization and feed 15, 61 to the drain system 13.

[0024] Figure 3 shows one example embodiment of the apparatus 10 for servicing, more specifically cleaning,

a drain system 13. It should be noted that all the functionalities, which the apparatus 10 according to the invention may require in order to operate, may not necessarily be shown in Figure 3. All kinds of functionalities, obvious to one skilled in the art, such as part of the apparatus's 10 temperature, pressure, and surface-level measurements, and also some of the valves, have been omitted from the schematic figure, in order to clarify the basic principle of the invention.

[0025] The apparatus 10 includes a possible first tank 12 for the wash liquid 42, such as water, to be fed to the drain system 13, 30.2, and, in addition, a second tank, which is in this case a vacuum tank 14, for the liquid 41 containing solids 32, to be sucked out of the drain system 13, 30.2. The vacuum tank 14 can have a capacity of, for example, 10 m³. Means 15 on the pipelines 58, 37 are connected to the tanks 12, 14 for pressurizing the wash liquid 42 and feeding it into the drain system 13, 30.2, and also means 44 - 48 for removing the liquid 41 from the drain system 13, 30.2, 34.1 to the vacuum tank 14. The liquid 41 containing solids sucked from the drain system 13, 30.2 to the vacuum tank 14 is cleaned continuously of the solids 32 forming a sludge in it, in order to re-circulate the wash liquid 42 several times in the apparatus 10.

[0026] According to one embodiment, the vacuum i.e. suction tank 14 can have been compartmentalized into at least two chambers, i.e. a settling chamber 17 and a pump chamber 18 connected to it. The settling chamber 17, which is open and free of internal structures, can have a capacity of, for example, 8 m³, while the pump chamber 18 connected to it can have a capacity of, for example, 2 m³. In the settling chamber 17, the liquid 41 containing solids, which has been sucked from the drain system 13, of which the wash liquid 42 forms at least a part, can be preliminarily cleaned, for example, by gravity. Gravity cleaning in the settling chamber 17, which is open and free of internal structures, provides surprisingly simple pre-cleaning, for which plenty of space is available in the settling chamber 17 of the vacuum tank 14. When the solids from the sucked water-solids mixture 41 settles onto the bottom of the settling chamber 17, the water remaining on the surface moves to the pump chamber 18 of the tank 14.

[0027] By means of the implementation in question, the internal implementation of the vacuum tank 14 is simple in the extreme. Most of the internal space of the vacuum tank 14 is reserved for the liquid 41, containing solids, sucked into it and there are few moving objects, or those requiring servicing, inside the vacuum tank 14. In addition, the mesh-screen filtration process 16 arranged outside the vacuum tank 14 and the circulation of the liquid through it permits, for its part, the continuous cleaning of the wash water, and thus also the continuous flushing/washing of the drain system 13. Thus, the washing of the drain system 13 need not be interrupted at times, for example, for cleaning runs of the wash water.

[0028] For example one or more submersible pumps

19, suitable for sludge operation, can be used as a transfer pump in the pump chamber 18 of the vacuum tank 14. One example of such a pump 19 is the Mamec LL-2003H, running at a minimum of 2500 r/min. By means of the pump 19, the preliminarily cleaned wash liquid in the settling chamber 17 is moved from the pump chamber 18 to the mesh-screen filtration process 16 after and outside the vacuum tank 14, by means of which the liquid 41 removed from the drain system 13, 30.2, 34.2 to the second tank 14 is cleaned, in order to circulate it in the apparatus 10. In the pump line, there is also a bypass flow line 50, 56, by means of which the preliminarily cleaned liquid with a solids content can be returned to the settling chamber 17 of the vacuum tank 14 bypassing the mesh-screen filtration process 16.

[0029] The mesh-screen filter process 16 is based on dynamic mesh-screen filtering 20 in a surprising way and is implemented between the first tank 12 and the second tank 14. In this case, the term dynamic filtering refers to a state of motion, which is actively created in the filtering means 20. In the case according to the embodiment, the external mesh-screen filtering arrangement 16 of the vacuum tank 14 includes at least one mesh-screen filter 20. In terms of operation, the mesh-screen filter 20 based on through-flow can rotate, thus making it dynamic. It will then remain better and longer in good condition.

[0030] Figure 4 shows in slightly greater detail one embodiment of mesh-screen filtering 16, seen as longitudinal and transverse sections in different directions. Now the dynamic mesh-screen filtering 16 includes a horizontal cylindrical drum 20 rotating around its central axis, the liquid 41 removed from the drain system 13, 30.2, 34.2 being arranged to travel through a filter jacket 20' fitted to the circumference of the drum, the direction of its flow being thus from the outside of the drum 20 to the inside. One example of the dimensions of the drum 20 is a diameter of 200 - 500 mm, for example 300 mm, and a length of 1000 - 3000 mm, for example 1500 mm. The drum 20 can be rotated through its central shaft, for example, by an electric motor or similar (not shown). The speed of rotation of the drum can be, for example, 5 - 20 r/min, for example 10 r/min. The frame structure of the drum 20 can be galvanized while on its circumference there is a sieve screen 20' of, for example, stainless steel, which filters the liquid flowing through the jacket 20' into the drum 20.

[0031] The drum 20 is fitted in a chamber separate from the vacuum tank 14, which in this case is a trough 80. The chamber can also be covered. Water-distribution elements 82 connected to the tank 14 over a pipeline 87 are fitted to the trough 80. By means of these, the liquid 41 led from the tank 14 to the filtration process 16 can be distributed evenly primarily over the entire axial length of the drum 20. According to one embodiment, the water distribution element can be a manifold 82 equipped with nozzles, which is fitted to the lower part 81 of the trough 80, and which distributes the liquid 41 to be filtered to the trough 80.

[0032] The flow of the liquid 41 to be filtered to the trough 80 can be regulated from the filtering trough 80 by means of surface-level upper-limit sensors (not shown) for the liquid 41 and the wash-water tank 12. If the surface L of the water rises to a set surface level in the trough 80, or in the tank 12, most of the flow of the submersible pump 18 can be led from the branch 21 to an exit pipe 35 and thus back to the drain system 13 (Figure 3).

[0033] According to one embodiment, the filter jacket 20' can be washed in connection with the operation of the apparatus 10, in order to maintain the functioning of the mesh-screen filtration process 16 and to improve the continuity of operation of the filtration process 16. One way to wash the filtering jacket 20' is to arrange wash jets 84 inside the drum 20. In that case, a wash-water line 86 can be brought, for example, to the end of the drum 20, and the line continued inside the drum 20 as an elongated sparge pipe 83, in which there are nozzles for spraying the water against the internal surface of the filtering jacket 20'. The sparge pipe 83 can be, for example, on the central axis of the drum 20, or close to it. According to one embodiment, the filtering jacket 20' of the drum 20 can be washed at a point, which is above the water level L of the trough 80. The point of impact of the wash jets 84 on the jacket 20' of the drum 20 changes, because the drum 20 rotates in the direction of its circumference. The water jets 84 detach the solids from the jacket 20', which then drop to the lower part 81 of the trough 80.

[0034] In sub-zero weather, the mesh-screen filter 20 can be kept from freezing by means of, for example, a heating apparatus based on liquid circulation, which will permit safe, fully effective work, even in a cold environment. The heating energy can be taken, for example, to a heat-exchanger structure 88 fitted to the bottom 81 of the trough 80, by circulating a heated non-freezing heating liquid through it (Figure 4). In that case, a metal trough 80, for example, will remain unfrozen during work and during breaks in work. In addition, the pump cabin 18 too can be heated.

[0035] According to one embodiment, the mesh size of the filtering surface 20' of the mesh-screen filter 20 can be, for example, 100 micron, more generally 50 - 300 micron. When using such a surprisingly small-mesh screen filter 20, which for its part permits, for example, a dynamic mesh-screen filtration process 16, as well as the principally continuous washing of the mesh-screen filter 20, there is no need at all to use chemicals to ensure continuous operation of the filtering in the filtering of the liquid 41 removed from the drain 13. There is no need, during the filtration process 16, to attempt the complete removal of substances dissolved in the liquid 41, because dissolved substances do not cause operating disturbances. The advantages of not using chemicals are, among others, the simplicity of the mesh-screen filtration process 16, a reduced need for skill in the operator of the apparatus 10, and a higher filtering capacity.

[0036] The wash water strained through the mesh-screen filter 20, and thus also mostly cleaned of solids, is removed from the drum 20, for example, through a pipe connection 89 attached to its end, and is pumped by a pump 54 along a pipeline 55 back to the operating water tank 12 of the apparatus 10 for reuse and pressurization for feeding to the drain 13. According to one embodiment (not shown), the cleaned wash liquid 42 can be fed, not only, or instead of to the operating water tank 12, directly to the pressurization process 15, 59 - 62. In terms of ensuring a sufficient reserve of wash liquid for the pressurization process 15, 59 - 62, and thus the continuous and reliable operation of the apparatus 10, the embodiment with an operating water tank according to Figure 3 is, however, more advantageous.

[0037] Through the filtration process 16 based on mesh-screen filtering 20, the cleaning flushing water 42 can be fed without worry to the high-pressure pump 15, without its operation suffering, or the operating components of the pressurization circuit 15, 59 - 62 being damaged. It should be noted that the 'absolute' cleanliness demanded in, for example, virgin water is not necessarily required in the wash water cleaned in the mesh-screen filtration process 16 and fed to the high-pressure pump 15, but instead small impurities can be allowed, the effect of which in the operation of the pressurization circuit 15, 59 - 62 is non-existent. The filtration process 16 according to the invention, which functions without chemicals, can operate as a continuous process simultaneously with normal drain-servicing work, in which high-pressure wash liquid 42 is fed to the drain 13 and liquid 41 with a solids content is sucked mainly simultaneously out of the drain 13 to a sludge tank 14 in connection with the apparatus 10. In addition, the cleaning based on mesh-screen filtering is extremely reliable in operation and ensures a good cleaning result.

[0038] It should be noted that, during servicing work, other water 40 too can flow in the drain 13, and be sucked into the vacuum tank 14 along with the liquid 41 consisting of the wash liquid 42 and solids 32, in connection with service measures. Such water comes, for example, from upstream, 30.1 in the drain system 13, relative to the service point (Figure 1). That part of the water that does not fit into the water tank 12, is returned from the vacuum tank 14 to the drain system 13. According to one embodiment, the reject water 39 in question can be pumped by a transfer pump 19 to bypass the mesh-screen filter 20 back to the drain system 13, for example, to the same service manhole 34.2, from which the servicing work is being carried out (Figure 1). In that case, there can be a connection 21 between the pump chamber 18 of the vacuum tank 14 and the fine-filtering 16. Part of the preliminarily cleaned sludge that may have settled is returned through the connection 21 to the drain system 13 through the pipe 35. This ensures that the water 39 returned to the drain 13 is mainly already clean of all kinds of sludge and sand and thus will not stress the drain system 13 by causing restrictions in the pipelines. At the same time, it

permits the continuous operation of the apparatus 10, because the tank 14 does not become full and work need not be interrupted for a trip to empty the tank 14.

[0039] The discharge of the excess reject water 39 can be led elsewhere than to the work point 34.2. It can be discharged downstream of the drain system 13, for example, into the next service manhole 34.3 about 100 m from the service point. The pipe 35' shown by a broken line in Figure 1 shows this application. This allows the drain line 30.3 following the service point 34.2 too to be shut off for servicing and repair, without interfering with the normal use of the drain 13. In other words, the apparatus 10 then replaces the drain line 30.3 in question.

[0040] The compartmentalization of the settling chamber 17 of the vacuum tank 14 into at least two spaces can have been achieved by means of a single hinged partition 24. The partition 24 can open under its own weight, turning out of the road when the vacuum tank 14 is tipped to empty it of the sludge collected in it. For this purpose, then can be a hinge 49 in the partition 24, for example, at half the height of the tank 14. The continuation of the hinged partition 24 can be a fixed wall, which extends, for example, to 250 mm from the roof of the tank 14. In addition, the partition 24 can lessen the disturbances in the liquid in the tank 14, for example, when using the vehicle 11 to move it from one place to another. In addition, the partition 24, which is easily opened, is sure to move out of the way of the solids collected in the front part of the settling chamber 17, but will nevertheless be sure to hold the solids collected on the bottom of the settling tank 17, in rear part of the settling tank 17.

[0041] The settling chamber 17 and the pump chamber 18 of the vacuum tank 14 may be separated from each other by a partition 26 equipped with an overflow 25. The distance between the upper part of the partition 26 and the upper part of the tank 14 can be, for example, 100 mm. There can be collection means 27 in the partition 26 for moving the preliminarily cleaned sludge in a controlled and sure manner from the settling chamber 17 to the chamber 18 containing the transfer pump 19. According to one embodiment, the connection means can include a set of curved tubes 27, which can be arranged in the maintenance hatch 28 of the pump chamber, 18. They can then be easily changed if necessary while the addition of new tubes is simple. There can be, for example, five tubes 27, which can have a diameter of, for example 150 mm. The ends of the tubes 27 on the settling-chamber 17 side can be arranged relative to the minimum depth of the liquid in the chamber 17 in such a way that the liquid travelling into the pump chamber 18 through the tubes 27 is taken from beneath the surface of the liquid. Thus rubbish floating in the chamber 17, for example, cannot travel to the transfer pump 19 and the transfer pump 19 can thus be in the tank 14.

[0042] The vacuum connection 29 of the vacuum tank 14 can be in connection with the pump chamber 18 of the vacuum tank. Connected to the connection 29 is a vacuum-creation line, the means of which can include a

shut-off ball valve 44, a water separator 45, and a suction pump 46 with threads, a suction filter 47, and a sound attenuator 48. One example of the suction filter 47 is the AFIU-910, 150 micr., of which there can be two. One example of the suction pump 46 can be the Hibon VTB-820, 2400 m³/h.

[0043] The following describes one example of an application of the means for pressurizing the liquid 42 and feeding it to the drain system 13, 30.2. When washing the pipeline 30.2, water is taken from the wash-water tank 12 to the high-pressure pump 15, the water 42 pressurized by which being led into the selected flushing hose 36.1. The flushing-water tank 12 can be integrated on the roof of the vacuum tank 14. In that case, the tank 12 can form a rectangular prism dividing the vacuum tank 14 longitudinally on each side of its divided upper part. A pipeline 58 can be connected to the upper parts of both halves of the tank, in order to lead the wash water for pressurization.

[0044] An example of the sequence in the line 58 is: filling valve / suction pipe shut-off valve 59 of the tank 12, suction filter 60, feed-water pump 61, pressurizing water pump 15, pressure regulator 62, and flushing-hose reels 57.1, 57.2, of which there are two in this case. The suction filter 60 can be formed of two AFIU-910, 80 micron filters, the feed-water pump 61 can be, for example, Grundfoss, the pressurizing water pump 15 can be, for example, Woma 150 ARP (329 1/min, 170 bar), while the pressure regulator 62 can be, for example, 170 bar. There can be a bypass flow 70 back from the pressure regulator 62 to the flushing-water tank 12. To prevent freezing, the apparatus can include a compressed-air feed valve 67, which is connected to the high-pressure water pump 15 and the wash circuit of the mesh-screen filter 20. There can be 120 metres of 1" flushing hose 36.1 on the reel 57.1 and 80 metres of ½" flushing hose on the reel 57.2. The diameter of the hose and the nozzle at the end of it is normally, for example, about 50 mm.

[0045] For the washing of the screen 20' mesh-screen filter 20 and of the vacuum tank 14, there can be a connection in the pipeline after the suction filter 60, from which a pipeline branches off to the water pump 65 (for example, Speck, 68 1/min, 20 bar). Before the mesh-screen filter 20 on the wash line 86 there is also a prefilter 66 for the wash nozzles of the mesh-screen filter 20. In the lower part 81 of the trough 80 of the mesh-screen filter 20, is the emptying valve 52 of the filtering chamber, i.e. the chamber outside the drum 20, and the emptying valve 53 of the clean chamber, i.e. the internal cylindrical chamber of the drum 20. The filtering chamber, i.e. in this case the trough 80, can be emptied even in the middle of the filtration process, i.e. in connection with the operation of the apparatus 10, for example, automatically in a timed manner, aided by vacuum, along the line 56 to the tank 14, if this is required. This feature too will improve the continuity of operation of the apparatus 10.

[0046] There is a dedicated line 72 for the washing of the vacuum tank 14, which terminates in a washing

sparge pipe 64.

[0047] Though the invention is described above solely on the basis of a rotating drum 20, one skilled in the art will understand that the dynamic mesh-screen filtration process can also be implemented using, for example, traditional planar filter structures, in which motion can be induced and thus a cleaning effect achieved for the filter structure.

[0048] The continuous cleaning improves the continuous operational readiness of the apparatus 10. The operation of the apparatus is then not interrupted by, for example, having to fetch clean wash liquid or empty the sludge tank 12, or even separate filtering runs of the wash liquid, during which the drain itself cannot be washed. Continuous operation is an important advantage for a wash-services provider for channel systems, because it is essential for the cost-intensive investment in cleaning vehicles to be in the most productive operation possible, in the most efficient manner.

[0049] It must be understood that the above description and the related figures are only intended to illustrate the present invention. The invention is thus in no way restricted to only the embodiments disclosed or stated in the Claims, but many different variations and adaptations of the invention, which are possible within the scope on the inventive idea defined in the accompanying Claims, will be obvious to one skilled in the art.

Claims

1. Apparatus for servicing a drain system, which apparatus includes

- a first tank (12) for liquid (42) to be fed to the drain system (13, 30.2) and a second tank (14) for the liquid (41) with a solids content, removed from the drain system (13, 30.2),
- means (15, 61) for pressurizing the liquid (42) and feeding it to the drain system (13, 30.2),
- means (44 - 48) for removing the liquid (41) with a solids content from the drain system (13, 30.2, 34.2) into the second tank (14),
- a filtration process (16) arranged to clean the liquid (41) removed from the drain system (13, 30.2, 34.2) to the second tank (14), in order to recycle it in the apparatus (10),

characterized in that the filtration process (16) is based on dynamic filtration (20) and is fitted between the first and second tanks (12, 14).

2. Apparatus according to Claim 1, **characterized in that** the dynamic filtration includes a rotating drum (20), through the filter jacket (20') of which the liquid (41) removed from the drain system (13, 30.2, 34.2) is arranged to filter.

3. Apparatus according to Claim 2, **characterized in that** the filter jacket (20') is arranged to be washed in connection with the operation of the apparatus (10), in order to maintain the operational capability of the filtration process (16).
4. Apparatus according to Claim 3, **characterized in that** the filter jacket (20') is arranged to be washed by means of wash jets (84) fitted inside the drum (20).
5. Apparatus according to any of Claims 2 - 4, **characterized in that** the drum (20) is fitted in a chamber (80), in which distribution elements (82) are fitted, in order to distribute the liquid (41) evenly over principally the entire length of the drum (20).
6. Apparatus according to any of Claims 3 - 5, **characterized in that** the filter jacket (20') of the drum (20) is arranged to be washed at a point that is above the water surface level (L).
7. Apparatus according to any of Claims 1 - 6, **characterized in that** the second tank (14) is compartmentalized into a settling chamber (17) and a pump chamber (18) and a submersible pump (19), by means of which the liquid (41), which has been pre-cleaned by gravity in the settling chamber (17), is arranged to be transferred to the filtration process (16), is fitted in the pump chamber (18).
8. Apparatus according to Claim 7, **characterized in that** the settling chamber (17) and pump chamber (18) of the tank (14) are separated from each other by means of a partition (26), to which connection means (27) are fitted for transferring the liquid (41) from the settling chamber (17) to the pump chamber (18), the ends of which connection means (27) in the settling chamber (17) being arranged below the liquid surface in the settling chamber (17).
9. Apparatus according to any of Claims 1 - 8, **characterized in that** the chamber (80) is arranged to be emptied of material collected on its bottom (81), during the operation of the apparatus (10).
10. Method for servicing a drain system, in which servicing takes place using an apparatus (10) arranged on a vehicle (11), by means of which
 - high-pressure liquid (42) from a first tank (12) is fed into the drain system (13, 30.2), in order to detach solids (32) and flush them out of the drain system (13, 30.2),
 - the liquid (41) with a solids content is removed from the drain system (13, 34.2) into a second tank (14), which is cleaned by filtration (16), in order to recycle the liquid (42) in the apparatus (10),
- characterized in that** the liquid (41) is cleaned by dynamic filtration (16), which is performed between the first and second tanks (12, 14).
11. Method according to Claim 10, **characterized in that**, in the dynamic filtration (16), a drum (20) is rotated, through the filter jacket (20') of which the liquid (41) removed from the drain system (13, 30.2, 34.2) is filtered.
12. Method according to Claim 11, **characterized in that**, in connection with the operation of the apparatus (10), the filter jacket (20') is washed, in order to maintain the operational capability of the filtration (16).
13. Method according to Claim 11 or 12, **characterized in that** the liquid (41) brought to the filtration (16) is distributed evenly over principally the entire length of the drum (20).
14. Method according to any of Claims 10 - 13, **characterized in that** before filtration (16), the liquid (41) is preliminarily cleaned by gravity settling, from which the liquid is transferred to the filtration (16) by a pump (19).
15. Use of the apparatus (10) according to any of Claims 1 - 9 for servicing a flow-channel system (13).

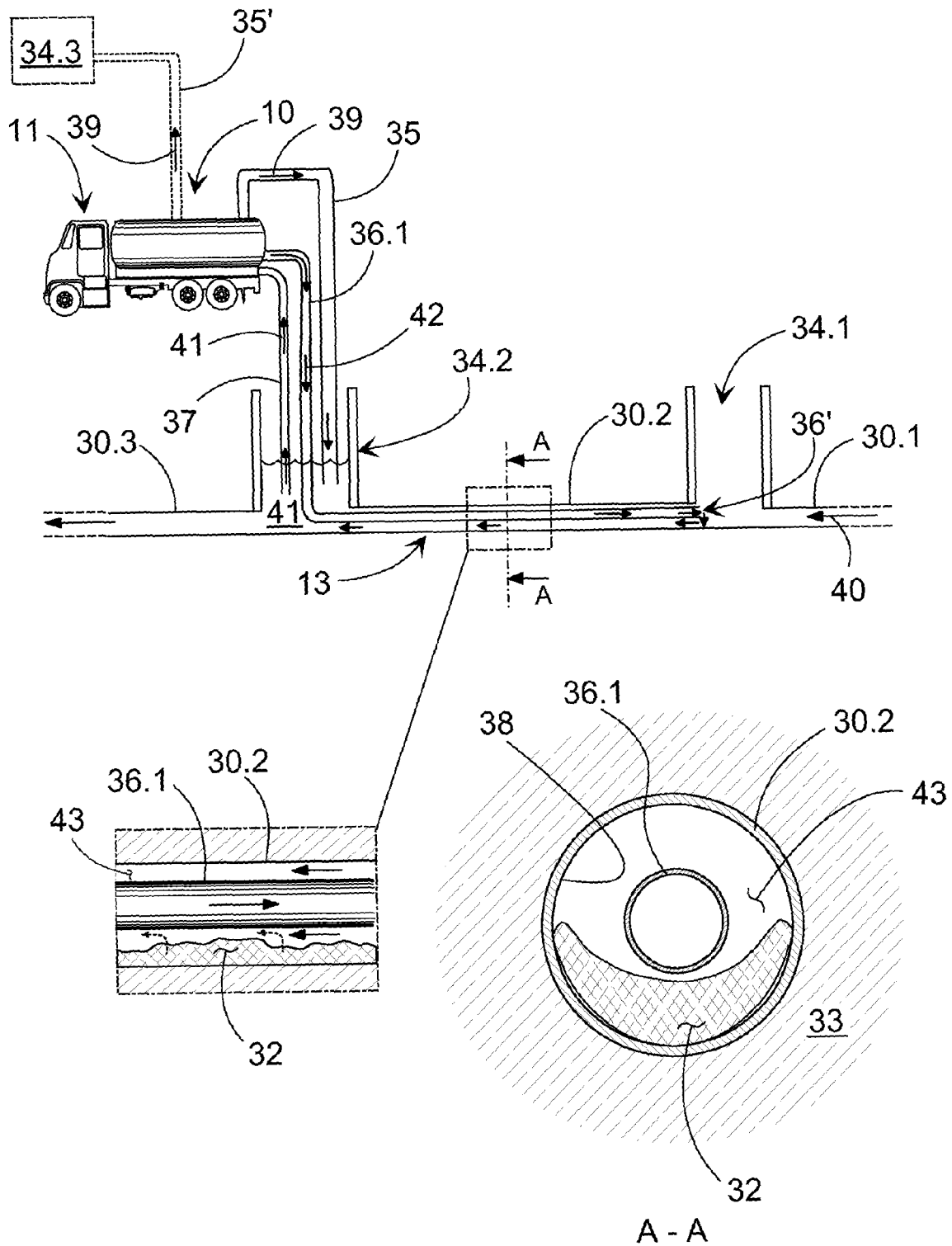


Fig. 1

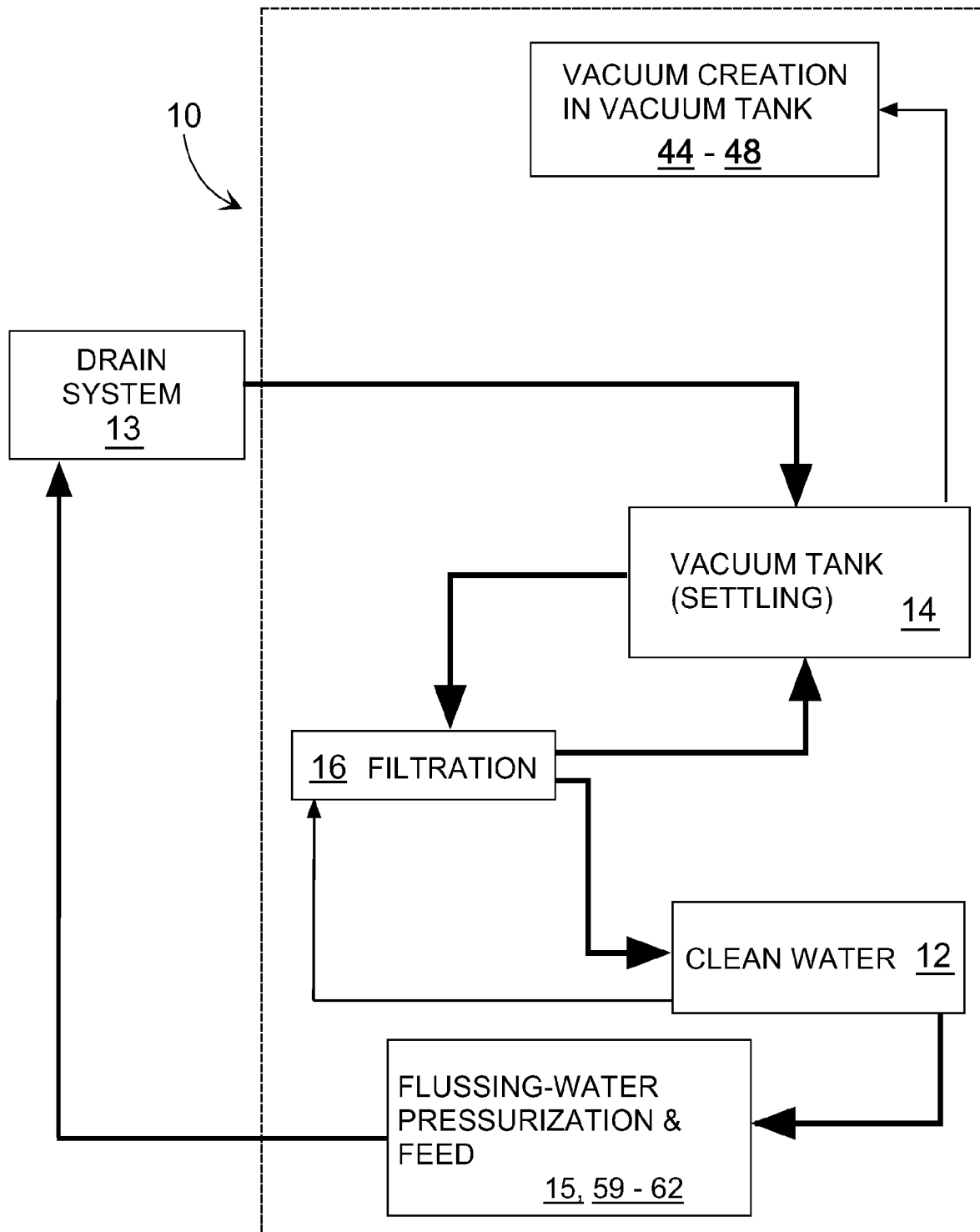


Fig. 2

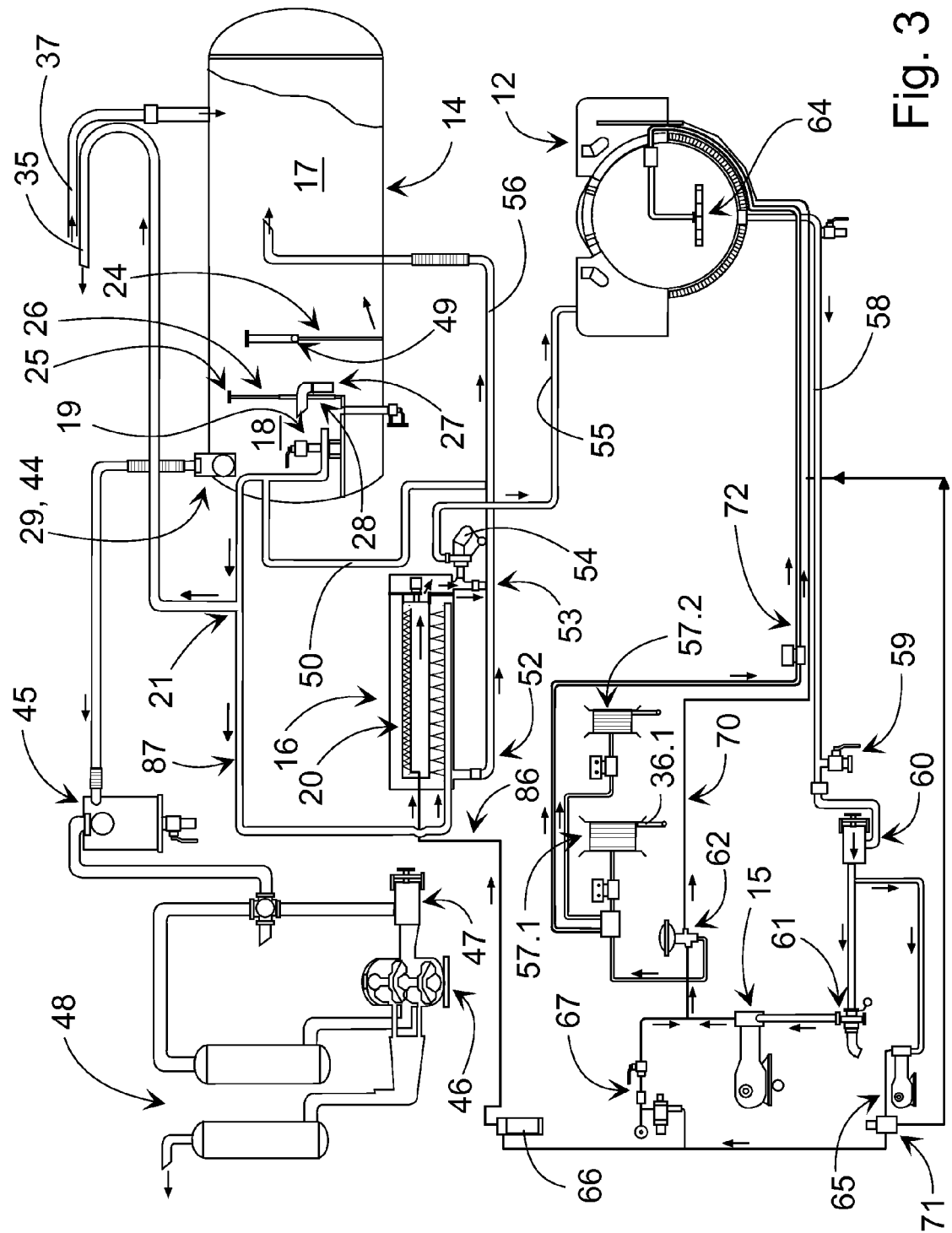


Fig. 3

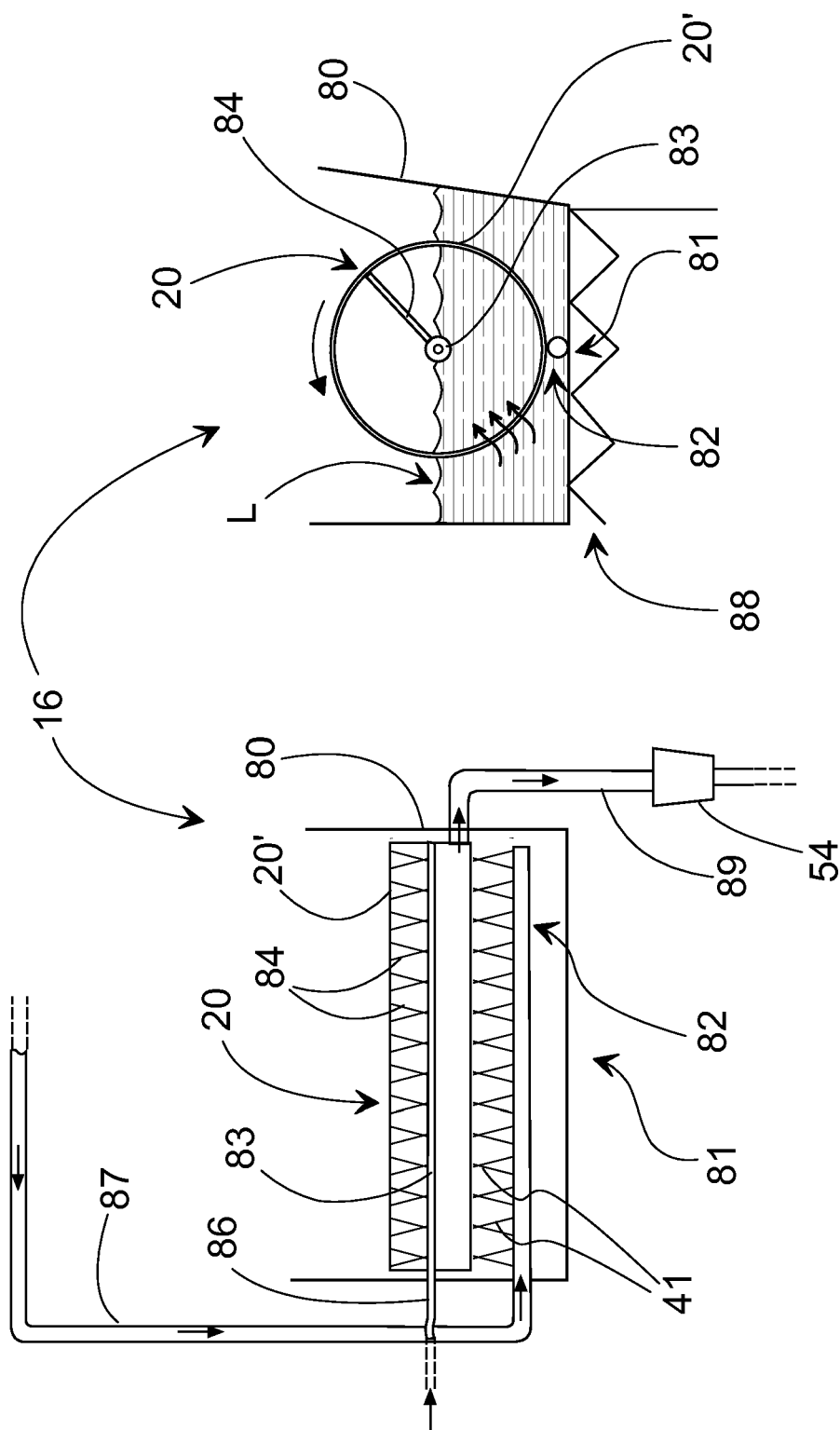


Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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