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(72) Inventor: **Haley, Martin**
King's Lynn, Norfolk PE33 9AS (GB)

(74) Representative: **Hartwell, Ian Peter et al**
Maguire Boss
24 East Street
St Ives
Cambridge PE27 5PD (GB)

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(71) Applicant: **Forbes Technologies Ltd**
Crimpleham
King's Lynn
Norfolk PE33 9AS (GB)

(54) Dip pipe assembly and method of operation

(57) A dip pipe assembly (10) for a tank (1) containing a fluid (6) comprises a conduit (12) having an inlet (14) and an outlet (16). The assembly comprises a body (17) defining a chamber (18) for fluid communication with the

conduit inlet (14), the chamber (18) being configured to extend vertically above the conduit inlet (14) when in use. The body (17) has a one-way valve (20) for admission of fluid from the tank (1) into the chamber (18) and a port (22) for the inlet of pressurised gas into the chamber (18).

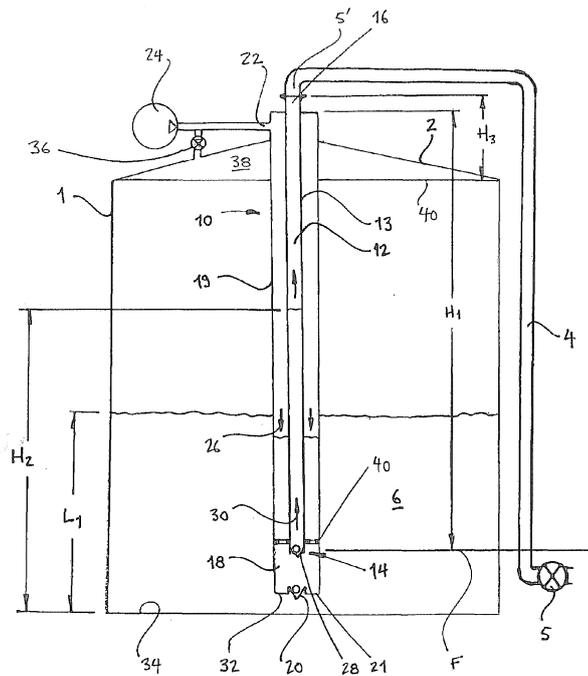


FIG. 3

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DescriptionTECHNICAL FIELD

[0001] The present invention relates to large tanks holding hazardous liquids.

BACKGROUND ART

[0002] Under health & safety requirements, large tanks holding hazardous liquids such as hydrochloric acid are not permitted to have any fittings or outlets below liquid level. Accordingly, tanks may be constructed as shown schematically in figure 1, with all fittings and outlets in the roof 2 of the tank 1 and a dip pipe 3 having a lower end immersed ("dipped") in the fluid 6 and feeding over the roof into an external down pipe 4 to form an outlet point 5 at ground level.

[0003] It may not be appropriate to pressurise such large tanks and their contents. Accordingly, to prime the down pipe (i.e. initially induce a siphon) it is possible to use a pump 6 which will generate a vacuum. Since tanks can be up to 10 metres high and store liquids with a specific gravity of 1.6, the vacuum required can be considerable. Such vacuum systems may also suffer from corrosion from fumes and can potentially release such fumes into the atmosphere. Diaphragm or peristaltic pumps can produce high vacuums even when running dry but are expensive.

DISCLOSURE OF INVENTION

[0004] According to the present invention, there is provided a dip pipe assembly for a tank containing a fluid, the assembly comprising:

a conduit having an inlet and an outlet;
 a body defining a chamber for fluid communication with the conduit inlet, the chamber being configured to extend vertically above the conduit inlet when in use, the body having a one-way valve for admission of fluid from the tank into the chamber and a port for the inlet of pressurised gas into the chamber.

[0005] The one-way valve allows fluid from the tank to enter the chamber. Pressurised gas may then be introduced into the chamber via the port. The gas accumulates in that part of the chamber extending above the conduit inlet when in use, thereby displacing the fluid in the chamber through the conduit inlet and into the conduit (the one-way valve prevents the fluid from leaving the chamber the same way as it came in). In this way, fluid can be pumped up the conduit to the conduit outlet and thence into a down pipe of the kind previously described, thereby inducing a siphon flow. The conduit inlet may be located so as lie adjacent the vertically lowermost point in the chamber when the assembly is in use. This will ensure that almost all of the fluid in the chamber can be

displaced into the conduit by the pressure of the gas.

[0006] The one-way valve may be located so as to lie at the vertically lowermost point in the chamber when the assembly is in use. This will ensure that fluid can enter the chamber even when the fluid level in the tank is near the bottom of the assembly.

[0007] The conduit may be defined by a first tube. The assembly may further comprise a second tube, arranged co-axially with and radially outwardly of the first tube, the chamber being defined between the first and second tubes. The first and second tubes may be substantially the same length, such that the chamber extends along substantially the entirety of the conduit.

[0008] The first conduit inlet may have a one-way valve such that, once fluid has been displaced from the chamber into the conduit, it may not then return to the chamber even if the pressure in the chamber is reduced.

[0009] According to the invention, there is also provided a tank assembly comprising a tank having a dip pipe assembly as set out above, the conduit outlet being located vertically above the maximum fluid level of the tank when in operation.

[0010] The tank assembly may further have a down pipe having a down pipe inlet for fluid communication with the conduit outlet and a down pipe outlet located at a level below that of the down pipe inlet when in operation.

[0011] The tank assembly may further comprise a source of pressurised gas connected to the port and a pressure release valve operable to reduce the pressure of gas in the chamber once siphon flow through the conduit and down pipe is established. In this way, more fluid is allowed to flow into the chamber through the one-way valve and thence up the conduit by siphon flow.

[0012] The one-way valve of the chamber may be located adjacent the vertically lowermost interior surface of the tank when in operation.

[0013] The chamber may be connectable to the ullage space of the tank.

[0014] According to the invention there is also provided a method of pumping fluid from a tank containing a fluid comprising the steps of:

providing a dip pipe assembly as set out above;
 inserting the dip pipe assembly into a tank containing fluid,
 supplying pressurised gas into the chamber, thereby displacing fluid out of the chamber and into the conduit.

[0015] The method may comprise the step of supplying pressurised gas into the chamber so as to displace fluid into the conduit and out of the conduit outlet.

[0016] Where the dip pipe assembly has a conduit connected to a down pipe as set out above, the method may comprise the steps of:

supplying pressurised gas into the chamber, thereby displacing fluid through the conduit and down pipe

so as to establish siphon flow; and thereafter relieving the gas pressure in the chamber once siphon flow through the conduit and down pipe is established.

[0017] Where the first conduit inlet has a one-way valve for admission of fluid, the method may comprise the steps of:

supplying pressurised gas into the chamber; thereafter relieving the gas pressure in the chamber; and thereafter supplying pressurised gas into the chamber.

[0018] The step of relieving the gas pressure in the chamber may comprise connecting the chamber to the ullage space of the tank.

[0019] The method aspects of the invention can be particularised using features of the apparatus described above.

BRIEF DESCRIPTION OF DRAWINGS

[0020] An embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 2 is highly schematic view illustrating the operation of the invention;
Figure 3 is a schematic view of a particular embodiment of the invention.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

[0021] The operation of the invention will now be described with reference to figure 2, which is a highly schematic view of a dip pipe assembly 10 supported by the roof 2 of a tank 1 containing a fluid 6. The assembly has a conduit 12 having an inlet 14 immersed in the fluid and an outlet 16 above the top of the tank. Conduit outlet 16 is in fluid communication with the inlet 5' of a down pipe 4 having an outlet 5 located below the inlet (typically at ground level and at or below the minimum fluid level F in the tank, as determined by the height of the conduit inlet 14). Conduit inlet 14 is surrounded by a body 17 defining a chamber 18 and having a one-way valve 20 for admission of fluid from the tank and a port 22 for the admission of pressurised gas from a source 24 such as an on-site compressed air supply (suitably restricted/regulated), a mini compressor or a foot pump.

[0022] The one-way valve 20 allows fluid 6 from the tank to enter and fill the chamber 18 such that the chamber is in fluid communication with the conduit inlet. As indicated at H1, the chamber extends vertically above the conduit inlet 14 such that, when pressurised gas is fed into the chamber 18 via the port 22, it accumulates

at the top of the chamber, thereby displacing the fluid in the chamber downwards as indicated by arrows 26. The one-way valve 20 prevents the fluid from leaving the chamber the same way as it came in; instead the fluid is forced through the conduit inlet 14 and up the conduit as indicated by arrow 30. When the fluid reaches the outlet 16, it flows into the down pipe 4, thereby inducing a siphon flow as known per se.

[0023] To maintain the siphon flow, the pressurised gas source 24 can be operated, e.g. manually, to reduce the pressure of gas in the chamber. This in turn allows more fluid to flow from the tank into the chamber through the one-way valve 20 and thence up the conduit by siphon flow.

[0024] Figure 3 illustrates a particular embodiment of the invention. A dip pipe assembly 10 is suspended from the roof 2 of a tank 1 containing a fluid 6 at a level L1. Although shown suspended in the middle of the tank, the assembly could also be bracketed to the side wall of the tank.

[0025] The assembly comprises a first conduit 12 defined by a first tube 13 and having an inlet 14 and an outlet 16. Inlet 14 is immersed in the fluid 6 and has a one-way valve (indicated at 28 by the standard symbol for a one-way or non-return valve). Outlet 16 is connected to an external down pipe 4 having an outlet point 5 at ground level. In accordance with the regulations mentioned above, the conduit outlet 16 is located vertically above (by a distance H3) the maximum fluid level 40 of the tank when in operation, i.e. above the roof 2 of the tank.

[0026] A second tube 19 is arranged co-axially with and radially outward of the first tube 13. Tube 19 is sealed against the first tube 13 at its upper end and is blanked at its lower end 21, thereby defining a gas-tight chamber 18 that surrounds the first conduit inlet 14. A perforated spacer holds tube 13 centred within tube 19. The blanked end 21 of tube 19 is fitted with a spigot to which is mounted a one-way valve (indicated at 20 by the standard symbol for a one-way or non-return valve) for admission of fluid from the tank. The upper end of tube 19 has a port 22 for the inlet of pressurised gas from a source 24 such as an on-site compressed air supply (suitably restricted/regulated), a mini compressor or a foot pump.

[0027] The one-way valve 20 allows fluid 6 from the tank to enter the chamber 18 until levels within the tank 1, chamber 18 and conduit 12 are equal. Pressurised gas is then introduced into the chamber 18 via the port 22, thereby pushing the fluid in the chamber down (as indicated by arrows 26) and through the conduit inlet 14 and its one-way valve 28 (the one-way valve 20 prevents the fluid from leaving the chamber the same way as it came in). The fluid is then pushed up the conduit (as indicated by arrow 30), out of the conduit outlet 16 and into the down pipe 4, thereby priming the down pipe and inducing a siphon.

[0028] To maintain the siphon flow, the pressurised gas source 24 can be operated, e.g. manually, to reduce

the pressure of gas in the chamber. Specifically, the gas in the chamber can be vented into the ullage space of the tank 38 via valve 36. This in turn allows more fluid to flow from the into the chamber through the one-way valve 20 and thence up the conduit by siphon flow.

[0029] To reduce the overall diameter of the assembly, the first and second tubes 13,19 are of substantially the same length, such that the chamber 18 extends along substantially the entirety of the conduit 12.

[0030] As illustrated in figure 3, the inlet 14 is located adjacent the vertically lowermost point 32 in the chamber when the assembly is in use (the actual separation will be determined inter alia by the actual size of the valves 20 and 28) so as to ensure that almost all of the fluid in the chamber can be displaced into the first conduit by the pressure of the gas.

[0031] To ensure operation of the assembly over a wide range of fluid levels, the one-way valve 20 is located at the vertically lowermost point 32 in the chamber when the assembly is in use. As shown, the length of the assembly is substantially equal to the height of the tank so that the one-way valve 20 is located adjacent the vertically lowermost interior surface 34 of the tank when in operation, allowing fluid to be extracted from the tank even at low fluid levels.

[0032] It will be appreciated that, when the fluid level in the tank is low, the amount of fluid displaced into the conduit 12 may be insufficient to reach the conduit outlet 16 (e.g. as indicated by height H2 in figure 3). In such circumstances, the gas pressure in the chamber is relieved by operating valve 36 to allow the gas and any fumes to vent into the tank ullage space 38. The one-way valve 28 in the inlet 14 to the first conduit 12 prevents the fluid in the conduit 12 from flowing back into the chamber 18; instead, more fluid 6 flows into the chamber 18 via valve 20. Gas pressure can then be supplied to the chamber once again, pushing the fluid in the conduit higher still. Such pressurising / depressurising of the chamber can be repeated until the fluid reaches the outlet of the conduit and a siphon is established.

[0033] The present invention is for use with large tanks holding hazardous liquids. Typical dimensions for the first tube 13 are 50mm bore and 63mm outside diameter and for the second tube 19 150mm bore and 160mm outside diameter, giving an approximate 11:2 ratio of cross-sectional areas. Suitable one-way valves are Praher type S4 foot valves having a polypropylene body.

[0034] It should be understood that this invention has been described by way of examples only and that a wide variety of modifications can be made without departing from the scope of the invention.

Claims

1. A dip pipe assembly for a tank containing a fluid, the assembly comprising:

a conduit having an inlet and an outlet; and a body defining a chamber for fluid communication with the conduit inlet, the chamber being configured to extend vertically above the conduit inlet when in use, the body having a one-way valve for admission of fluid from the tank into the chamber and a port for the inlet of pressurised gas into the chamber.

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2. A dip pipe assembly according to claim 1, wherein the conduit inlet is located so as lie adjacent the vertically lowermost point in the chamber when the assembly is in use.

3. A dip pipe assembly according to claim 1 or claim 2, wherein the one-way valve is located so as to lie at the vertically lowermost point in the chamber when the assembly is in use.

4. A dip pipe assembly according to any preceding claim, wherein the conduit is defined by a first tube and the body is configured as a second tube, with the chamber being defined between the first and second tubes.

5. A dip pipe assembly according to claim 4, wherein the second tube is arranged co-axially with and radially outwardly of the first tube.

6. A dip pipe assembly according to claim 5, wherein the first and second tubes are substantially the same length, such that the chamber extends along substantially the entirety of the conduit.

7. A dip pipe assembly according to any preceding claim, wherein the conduit inlet has a one-way valve configured to prevent fluid in the conduit from returning to the chamber through the inlet even if the pressure in the chamber is reduced.

8. A tank assembly comprising a tank having a dip pipe assembly according to any one of claims 1 to 7, wherein the conduit outlet is located vertically above the maximum fluid level of the tank when in operation.

9. A tank assembly according to claim 8 and comprising a down pipe having a down pipe inlet for fluid communication with the conduit outlet and a down pipe outlet located at a level below that of the down pipe inlet when in operation.

10. A tank assembly according to claim 8 or claim 9 and comprising a source of pressurised gas connected to the port and a pressure release valve operable to reduce the pressure of gas in the chamber once siphon flow through the conduit and down pipe is established.

11. A tank assembly according to any one of claims 8 to 10, wherein the one-way valve of the chamber is located adjacent the vertically lowermost interior surface of the tank when in operation. 5
12. A tank assembly according to any one of claims 8 to 11, wherein the chamber is connectable to the ullage space of the tank.
13. A method of pumping fluid from a tank containing a fluid comprising the steps of: 10
- providing a dip pipe assembly according to any one of claims 1 to 7;
- inserting at least part of the body of the dip pipe assembly into a tank containing fluid, 15
- supplying pressurised gas into the chamber, thereby displacing fluid out of the chamber and into the conduit. 20
14. A method according to claim 13 and wherein the dip pipe assembly has a conduit connected to a down pipe, the method comprising the steps of:
- supplying pressurised gas into the chamber, 25
- thereby displacing fluid through the conduit and the down pipe so as to establish siphon flow; and thereafter
- relieving the gas pressure in the chamber once siphon flow through the conduit and down pipe is established. 30
15. A method according to claim 13 or claim 14 and wherein the first conduit inlet has a one-way valve for admission of fluid, the method comprising the steps of: 35
- supplying pressurised gas into the chamber; thereafter
- relieving the gas pressure in the chamber; and 40
- thereafter
- supplying pressurised gas into the chamber. 45

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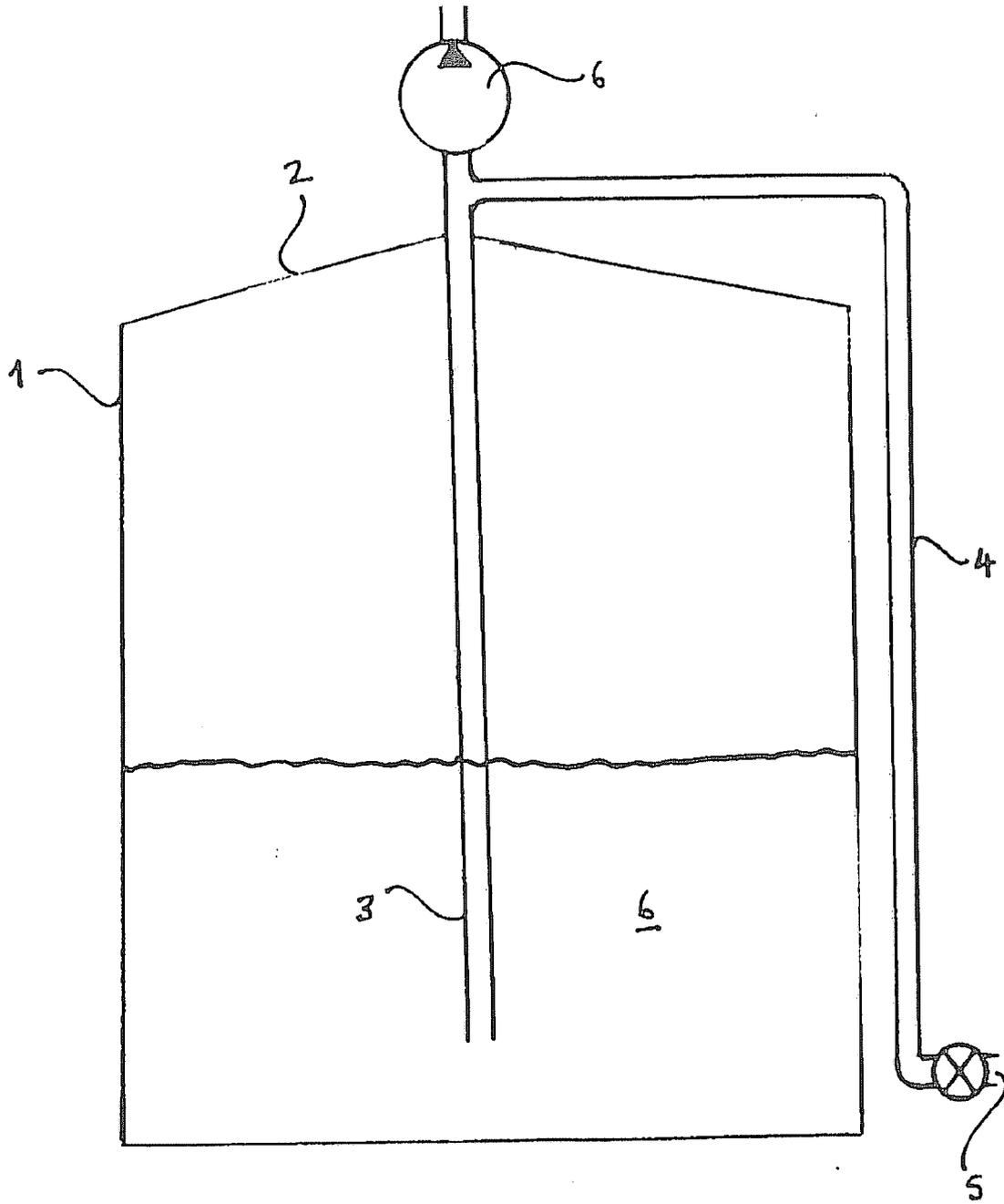


FIG. 1

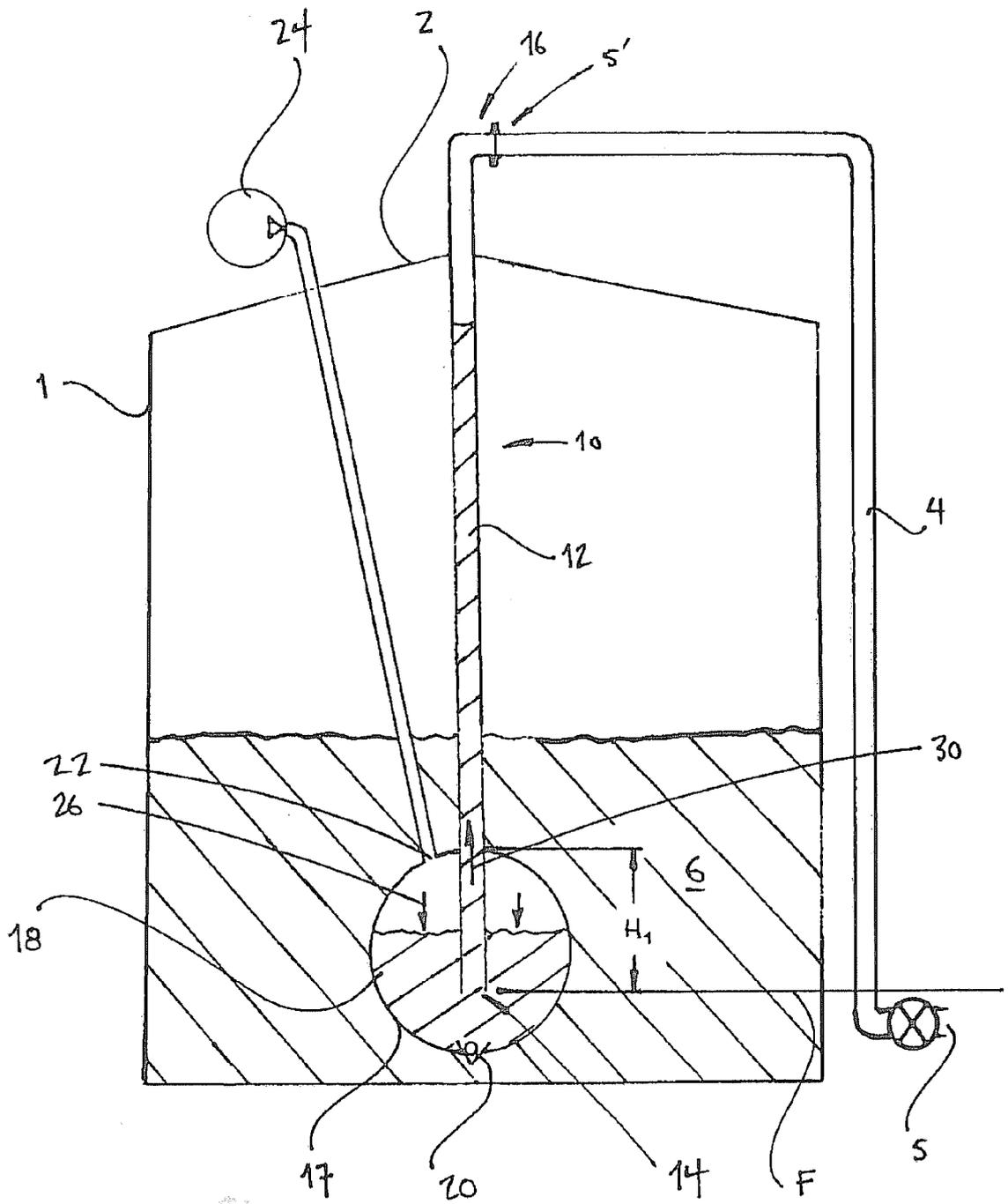


FIG. 2

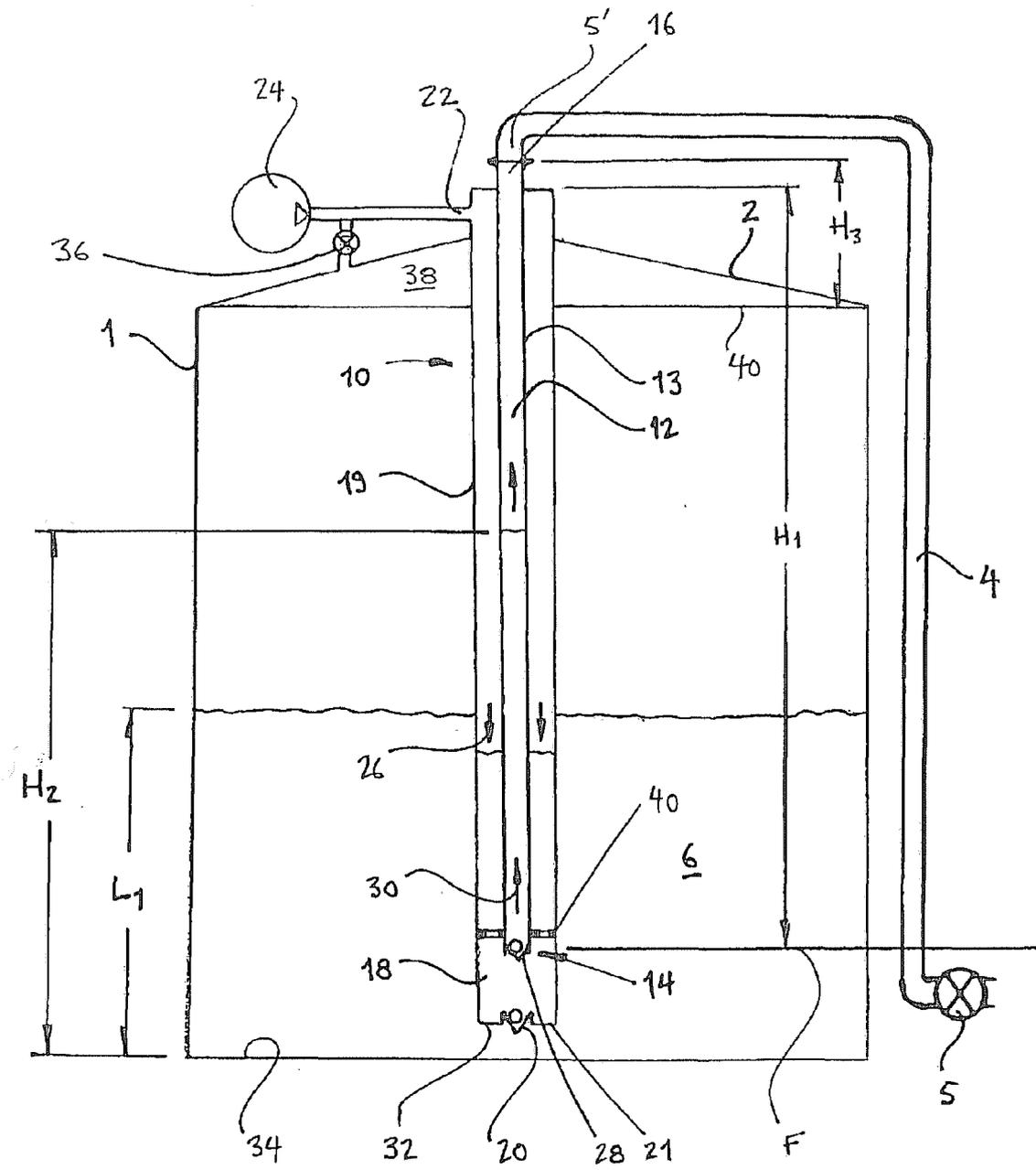


FIG. 3



EUROPEAN SEARCH REPORT

Application Number
EP 12 19 6553

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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		22 April 2013	Stängl, Gerhard
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

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EPO FORM 1503 03.82 (P04G01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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