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(54) **Method and system for producing fire fighting foam**

(57) It is hereby described a fire-fighting system of the type adapted to produce fire-fighting foam, comprising

- a feed line (1) for feeding pressurized water;
- at least one tank (3) suitable for operation under pressure, and adapted to contain foaming liquid (4), said tank (3) comprising a water outflow line (31), which is fed with pressurized water by said feed line (1), and an outflow line (32), adapted to deliver the foaming liquid (4) contained in said tank (3);
- at least one mixing device (5) for mixing foaming liquid and water, said mixing device (5) being fed by said feed line (1) and said outflow line (32) from which the foaming liquid may be delivered from said tank (3), to create a water-foaming liquid flow;
- at least one foam generating device (6) receiving said foaming liquid-water flow from said at least one mixing device (5);

wherein said water inflow line (31) for said pressurized tank (3) is adapted to feed water into the top end of said tank (3); and

wherein said foaming liquid outflow line (32) for said pressurized tank (3) is adapted to draw the foaming liquid from the bottom end of said tank (3); and

wherein said inflow line (31) and said outflow line (32) of said pressurized tank (3) are in hydraulic communication within said tank (3).

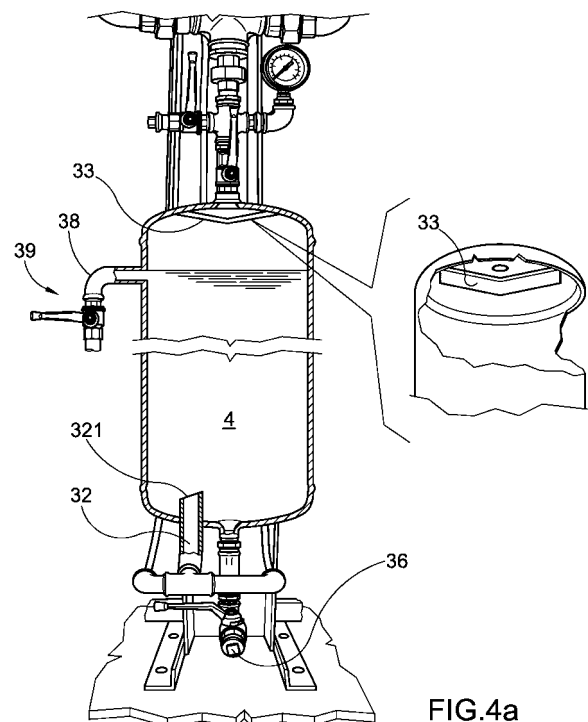


FIG.4a

Description

[0001] There is disclosed herein a method and system for producing fire-fighting foam.

[0002] One of the extinguishing agents most commonly used for suppressing fires is fire-fighting foam. Fire-fighting foam finds use in fire-fighting systems designed for suppressing fires generated by combustion of hydrocarbons and solid materials. The extinguishing effect of foam is caused by a combination of chemical and physical effects, comprising a suffocating action (foam is lighter than water and fuels, and forms a continuous sheet separating fuel from air) and a cooling action (reduction of fuel temperature below the flash point, due to the high percentage of water contained therein).

[0003] Various types of foam are currently available, according to the type of fire to be extinguished. Particularly, synthetic foaming liquids are known, which are formed of mixtures of surfactants, fluoroprotein foaming liquids, fluoro-synthetic foaming liquids and foaming liquids for alcohols. Based on the ratio of the volume of the foam being produced to the original water-foaming agent solution, the fire-fighting foams may be classified into high expansion foams (1:500 - 1:1000), medium expansion foams (1:30 - 1:200) and low expansion foams (1:6 - 1:12).

[0004] In short, the fire-fighting foam generating process includes two successive steps: first a foaming agent-water mixture or solution is formed and then the mixture so obtained is foamed with air to obtain agglomerated bubbles.

[0005] The foaming liquid is typically stored in a refillable tank, with water being fed to the system from a water supply. The foaming liquid and water may be mixed together in the following manner:

- a) by sucking the foaming agent from a tank, and using ejector devices driven by the water flow that is fed to the foam producing system;
- b) by injecting the foaming agent into the water flow that is fed to the system;
- c) by liquid displacement.

[0006] Liquid displacement mixers are a variant of suction mixers. These devices include a pressure tank with a bladder (or membrane) of rubberized fabric therein containing the foaming agent, and an external premixer. The membrane prevents the foaming agent in the tank from contacting water and the container wall, thereby avoiding dilution, as well as any contamination of the foaming agent and tank corrosion.

[0007] The premixer is a Venturi tube fitted into the fire extinguishing water pipe that supplies the system. A pipe extends upstream from the nozzle of the Venturi tube, and connects the stub pipe to the water part of the tanks, i.e. the space between the tank walls and the bladder. A pipe also extends from the stub pipe, downstream from the nozzle, before the choke, for connection to the plung-

er tube at the tip of the tank in the foaming agent part.

[0008] Therefore, the space between the tank walls and the bladder is occupied by pressurized water. When the system is idle, the water and the foaming agent are at the same pressure, whereas when the system is operating, the foaming agent is at a lower pressure. Therefore, water enters the tank, presses onto the bladder wall and displaces the foaming agent, which is ejected from the top and sucked in by the Venturi tube, where it is mixed with water. The percentage of foaming liquid to be mixed with water is controlled by a diaphragm with a calibrated hole which is fitted into the pipe upstream from the mixer.

[0009] The foaming liquid-water mixture is foamed with air using devices that utilize the Venturi effect (the latter solution being particularly used for foaming liquids having a low or medium expansion ratio) or by forced injection of air (for high expansion foams). In practice, a common solution for generating foam consists in causing the water - foaming agent mixture to be fed by pipes that end with a Venturi meter that creates the negative pressure required for taking in the air that is used to form the foam. These devices find application in both stationary and movable systems.

[0010] For satisfactory operation of the system, the water to foaming liquid mixing ratio should fall within a given range. An insufficient amount of water causes increased viscosity of the foam being produced. Conversely, an excess of water causes a deterioration of the extinguishing features of the foam.

[0011] Prior art foam production systems that use liquid displacement mixers suffer from certain drawbacks. For instance, foaming liquid tanks cannot be placed in direct proximity to fire risk areas, because any developed heat may cause damages to the membrane, and hence abnormal operation of the foam generating system. Remote placement of foaming liquid tanks involves increased costs.

[0012] The object of this invention is to obviate at least some of prior art problems and particularly those set out hereinbefore.

[0013] These objects are fulfilled by a foam production system as defined in claim 1 and a foam production method as defined in claim 10.

[0014] Further advantages are achieved by the additional features of the dependent claims.

[0015] A possible foam production method and system will be now described with reference to the accompanying drawings in which:

- Figure 1 is a general view of a foam production system;
- Figure 2 is an enlarged view of the upper portion of the view of Figure 1;
- Figure 3 is an enlarged view of the lower portion of the view of Figure 1;
- Figure 4 is a partially sectional view of a detail of the system of Figure 1;

- Figure 4a is a variant of the embodiment of Figure 4;
- Figure 5 is a diagrammatic view of the system of Figure 1;
- Figure 6 is an enlarged view of a detail of Figure 5.

[0016] Referring now to the accompanying drawings, there is disclosed herein a fire-fighting system of the type adapted to produce fire-fighting foam.

[0017] It includes a pressurized water feeding line 1, which typically feeds water at a pressure from 3 to 8 bar, and at least one system operating valve 2 for controlling a water flow from the pressurized water feeding line. The valve 2 may be a heat-sensitive valve. A manually openable valve (not shown) may be mounted parallel to the heat sensitive valve 2. In a further embodiment (not shown), the valve 2 only includes a manual valve. A water motor alarm 9 may be provided in series with the valve 2 for triggering an audible alarm.

[0018] A preferably vertically extending tank 3 is provided, which is adapted to operate at a pressure corresponding to the pressure of water from the water feeding line 1. Foaming liquid 4 is contained in the tank 3. The tank 3 has an upper water inflow line 31, which receives pressurized water from the feed line 1, and a lower outflow line 32, from which the foaming liquid 4 contained in the tank 3 is delivered.

[0019] Two devices 5 are provided for mixing the water that comes directly from the feed line 1 and the foaming liquid that comes from the pressurized tank 3 through the outflow line 32, to create a flow of water - foaming liquid mixture. In a possible embodiment, the mixing devices 5 are simple T-joints and the foaming liquid, that has a higher pressure than water, is fed thereto through lateral line 51 receiving the liquid from the outflow line 32 (see Figure 6).

[0020] A normally open manual valve (not shown) may be provided on each lateral foaming liquid feeding line 51, and may be closed for maintenance purposes.

[0021] A foam generating device 6 which receives the foaming liquid-water flow is provided downstream from each mixing device 5.

[0022] In an alternative embodiment, not shown, a manually or automatically operating valve (e.g. a heat-sensitive valve) may be provided between each mixing device (5) and the foam generating device (6).

[0023] Two mixing devices 5 are provided in the illustrated embodiment. Thus, a cross 100 is provided, which distributes the water that comes from the feed line 1 into two main flows, directed to the two mixing devices 5, 5 and a secondary flow, directed to the inflow line 31 of the tank 3.

[0024] The foaming liquid that comes out of the tank 3 through the outflow line 32 branches into two flows directed to the two mixing devices 5, 5. The outflow line 32 may be connected with the mixing devices 5, 5, using flexible metal hoses 51, e.g. made of copper. The use of copper hoses facilitates hydraulic connections.

[0025] The tank 3 may be made of metal, such as stain-

less steel. This characteristic imparts corrosion resistance and allows the system to be directly placed in the area potentially exposed to fires, which eventually allows the hoses connecting the mixing devices 5 and the foam generating devices 6 to have a smaller length. By placing the tank 3 in the potential fire-fighting area, fire-fighting times are also reduced, and lower pressure losses occur between the water distribution system and the foam generators.

[0026] In the embodiment of the figures, that show a stationary system, the system is composed of fixed pipes and the foam generating devices 6 may be conventional high expansion foam generators of the suction type, which include a number of nozzles 61 for spraying the foaming liquid-water mixture into a generally frustoconical element formed of a metal mesh, such as a perforated mesh or an expanded mesh. Foam generators may also be of the high, medium or low expansion type, as needed. In one alternative embodiment (not shown), at least one of the foam generating devices may be a conventional low or medium expansion spray nozzle connected to the system by hoses.

[0027] The tank 3 is fed at its top with water from the inflow line 31.

[0028] The outflow line 31, at the bottom end of the tank 3, delivers the foaming liquid contained in the tank 3.

[0029] The inflow line 31 and outflow line 32 of the tank 3 are in hydraulic communication within the tank. In other words, the tank 3 has an internal chamber in which water that comes from the inflow line 31 is in direct contact with the top level of the column of foaming liquid 4 and directly presses onto the column of foaming liquid, like a piston, thereby causing the foaming liquid to come out of the bottom end of the tank 3 through the outflow line 32. Those skilled in the art will promptly understand that the tank 3 involves lower costs and has a smaller size than traditional membrane tanks. Unlike the prior art, the lack of a membrane in the tank 3 allows proper operation of the tank 3 also at high temperatures, and hence even during fire extinction.

[0030] Preferably, the tank 3 has a vertical extension. This feature reduces the risk that the water coming from the inflow line 31 and the foaming agent 4 in the tank 3 may mix together. In one possible embodiment, the tank 3 has a substantially and/or generally cylindrical shape, and the ratio of the height h to the diameter Φ of the tank 3 is 5 or above.

[0031] In one possible embodiment, a jet breaker 33 may be provided in the upper part within the tank 3, under the inlet of the inflow line 31, for deflecting water from the inflow line 31. This feature further reduces the risk that the water coming into the tank 3 and the foaming agent 4 in the tank 3 may undesirably mix together. In one possible variant, the outflow line 32 draws the foaming liquid through a tube 321 projecting out of the bottom of the tank 3. This feature may prevent the risk that any deposits on the bottom of the tank 3 may obstruct the outlet 32 of the tank.

[0032] In the illustrated embodiment, the mixing device 5 is placed at a height above the tank 3, i.e. at a height above the maximum height of the foaming liquid contained in the pressurized tank 3. This feature allows the mixing device 5 to be free of foaming liquid when the fire-fighting system is not operating.

[0033] A flow reducing member, such as a calibrated hole (not shown) is provided upstream from each mixing device 5, and is designed to keep the flow rate of the foaming liquid substantially constant in spite of any water pressure change, and hence to ensure a consistent ratio of the foaming liquid introduced into the mixing device 5 to water (typically the water/foaming liquid mixture contains 3-6% v/v foaming liquid). These calibrated orifices also assist in creating a pressure difference between the water that flows into the mixing device 5 and the foaming liquid introduced from the sides, thereby facilitating the inflow of foaming liquid. Preferably, the calibrated orifices are located in the proximity of the outflow line 32.

[0034] A second cross 110 is provided between the cross 10 and the inflow line 31.

[0035] A relief valve 35 for the tank 3 and a pressure gage are connected to the second cross 110. The relief valve 35 is normally closed and is only opened during maintenance of the system (such as when loading the foaming liquid). A normally open feeding valve 37 may be provided between the second cross 110 and the inflow line 31, and is closed during maintenance (removal of the tank 3). Otherwise, the feeding valve 37 may be situated between the first cross 10 and the second cross 110.

[0036] A non-return valve may be placed between the cross 10 and each mixing device 5, for independent operation of each foam generator 6.

[0037] A filling/discharging valve 36 is provided under the tank 3, for filling or discharging the tank 3. In the embodiment of Figure 4, the discharge valve 36 is hydraulically connected to the outflow line 32. In the embodiment of Figure 4A, the discharge valve 36 is in communication with the tank 3 independently of the outflow line 32.

[0038] In the illustrated embodiment, a cooling nozzle 7 is provided, which is supplied with water by the feed line 1, and is in such position as to direct a water jet onto the top of the tank 3. The system disclosed hereinabove has the advantage that it has no mechanical moving parts or electrical devices, and it requires no pressurized gas tank.

[0039] In one alternative embodiment, the fire-fighting system further comprises means 38, 39 for controlling the level of the foaming liquid 4 in the tank 3. In the embodiment of Figure 4a, the means for controlling the level of the foaming liquid 4 in the tank 3 include a lateral discharge pipe 38 and a manual valve 38. The lateral pipe 38 is situated at a height that is about $\frac{3}{4}$ of the maximum height of the tank 3. As the valve 39 is opened, it is possible to check whether the amount of foaming liquid 4 in the tank 3 is below or above $\frac{3}{4}$ of the maximum capacity

of the tank 3. The valve 39 may be also used for periodic checks (such as chemical analyses) of the foaming liquid 4 contained in the tank 3.

[0040] This system lies on a structure that includes a pair of metal sections 70 (such as L-sections) integral with the tank 3. The L-sections have holes 71 for receiving fastener means, such as screw fasteners. The system is also secured to a vertical section 80, e.g. a U-section, with holes for wall-mounting.

[0041] The above disclosed system may be used for implementing a method for producing fire-fighting foam, comprising the steps of

- creating a pressurized water flow;
- conveying a fraction of the pressurized water flow into the top end of a tank 3 containing a foaming liquid 4 to exert a downward thrust by direct hydraulic communication upon the foaming liquid contained in the tank 3;
- causing an outflow of foaming liquid from the bottom of the pressurized tank 3;
- mixing the outflow of foaming liquid with pressurized water;
- foaming the foaming liquid/water mixture with air to obtain a fire-fighting foam.

Claims

1. A fire-fighting system of the type adapted to produce fire-fighting foam, comprising
 - a feed line (1) for feeding pressurized water;
 - at least one tank (3) suitable for operation under pressure, and adapted to contain foaming liquid (4), said tank (3) comprising a water outflow line (31), which is fed with pressurized water by said feed line (1), and an outflow line (32), adapted to deliver the foaming liquid (4) contained in said tank (3);
 - at least one mixing device (5) for mixing foaming liquid and water, said mixing device (5) being fed by said feed line (1) and said outflow line (32) from which the foaming liquid may be delivered from said tank (3), to create a water-foaming liquid flow;
 - at least one foam generating device (6) receiving said foaming liquid-water flow from said at least one mixing device (5);

wherein said water inflow line (31) for said pressurized tank (3) is adapted to feed water into the top end of said tank (3); and

wherein said foaming liquid outflow line (32) for said pressurized tank (3) is adapted to draw the foaming liquid from the bottom end of said tank (3); and wherein said inflow line (31) and said outflow line (32) of said pressurized tank (3) are in hydraulic com-

munication within said tank (3).

2. A fire-fighting system as claimed in claim 1, further comprising at least one valve (2) for controlling a water flow in said pressurized water feeding line (1). 5
3. A fire-fighting system as claimed in claim 1 or 2, wherein said tank extends vertically and wherein the ratio of the height of the tank (3) to the transverse dimension of the tank (3) is 5 or above. 10
4. A fire-fighting system as claimed in claim 1 or 2 or 3, wherein said at least one mixing device (5) is located at a height above said tank (3). 15
5. A fire-fighting system as claimed in claim 1 or 2 or 3 or 4, wherein a screen (33) is provided in said tank (3) for deflecting the water that comes from said inflow line (31). 20
6. A fire-fighting system as claimed in any preceding claim, wherein a calibrated hole is provided upstream from said at least one mixing device (5).
7. A fire-fighting system as claimed in any preceding claim, further comprising a relief valve (35) and a discharge valve (36) for said tank (3). 25
8. A fire-fighting system as claimed in any preceding claim, wherein a nozzle (7) is provided, which is fed with water by said feed line (1), and is in such position as to direct a water jet onto the top of said tank (3). 30
9. A fire-fighting system as claimed in any preceding claim, wherein said mixing device (5) is a T-joint. 35
10. A fire-fighting system as claimed in any preceding claim, further comprising means for controlling the level of the foaming liquid (4) in said tank (3). 40
11. A system as claimed in any preceding claim, wherein at least one valve, particularly a heat-sensitive valve is located downstream from said at least one mixing device (5) and upstream from said at least one foam generating device (6). 45
12. A method for producing fire-fighting foam, comprising the steps of
 - creating a pressurized water flow; 50
 - conveying a fraction of said pressurized water flow into the top end of a tank (3) containing a foaming liquid (4) to exert a downward thrust by direct hydraulic communication upon the foaming liquid contained in said tank (3); 55
 - causing an outflow of foaming liquid from the bottom of said pressurized tank (3);
 - mixing said outflow of foaming liquid with pres-

surized water;

- foaming the foaming liquid/water mixture with air to obtain a foam.

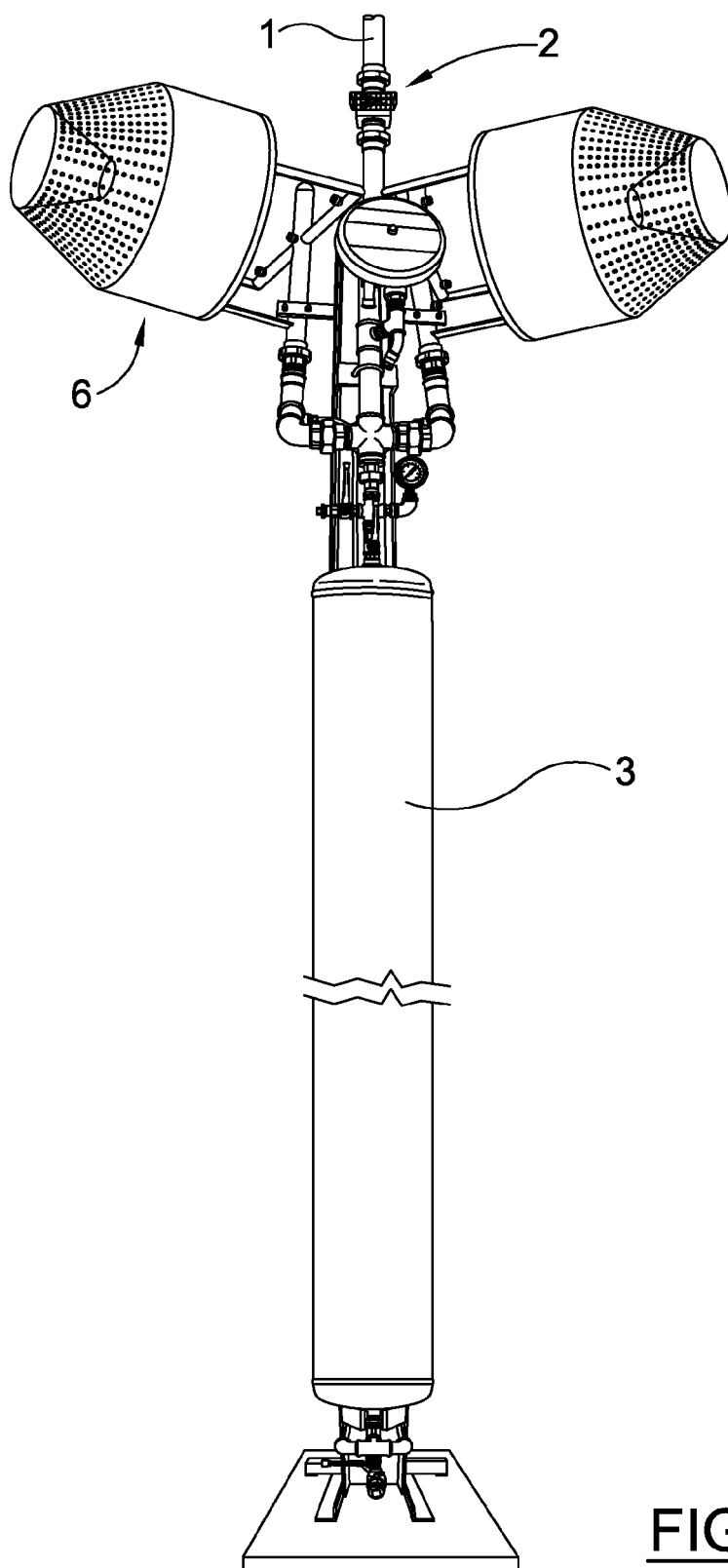
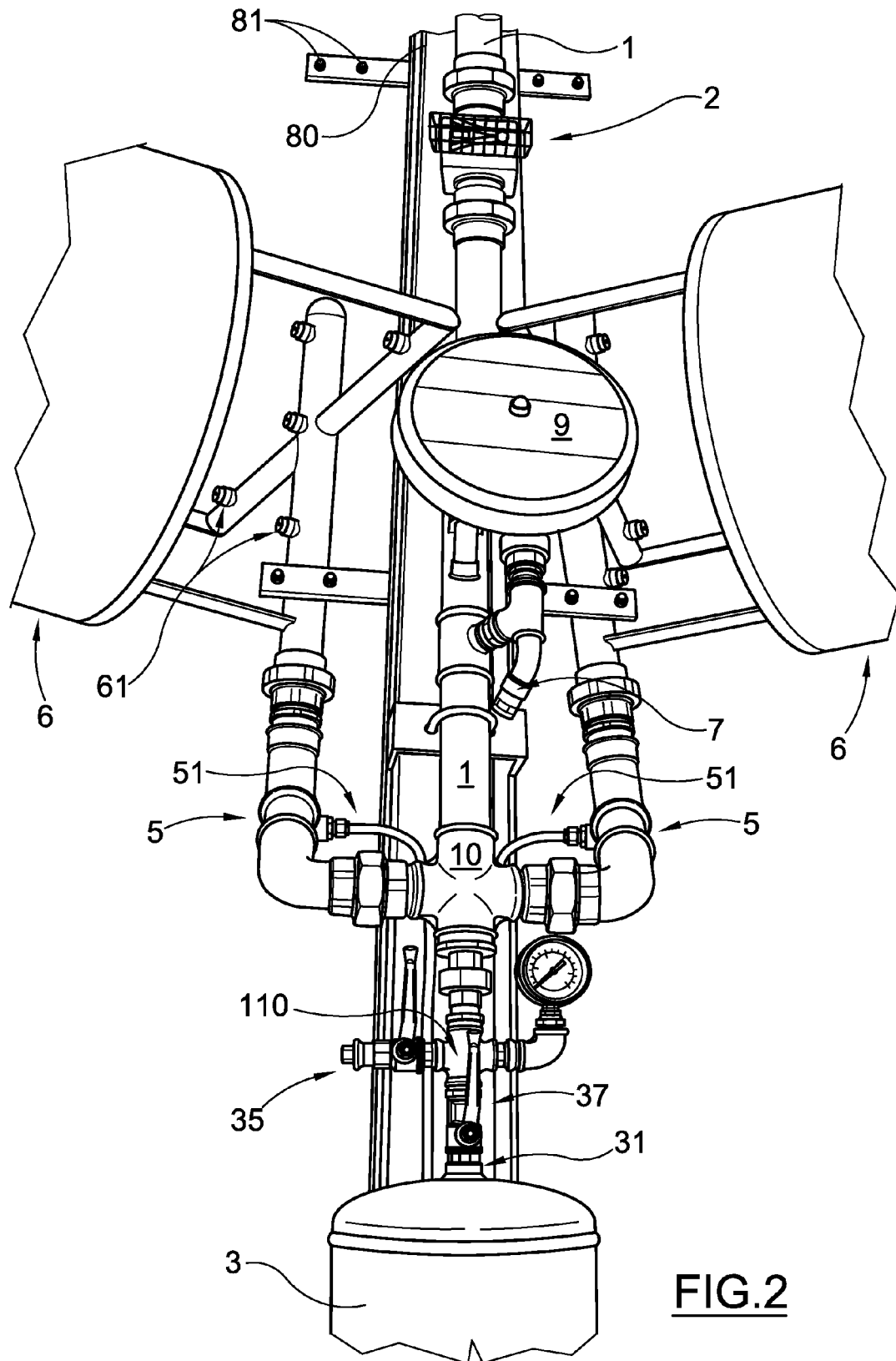


FIG.1



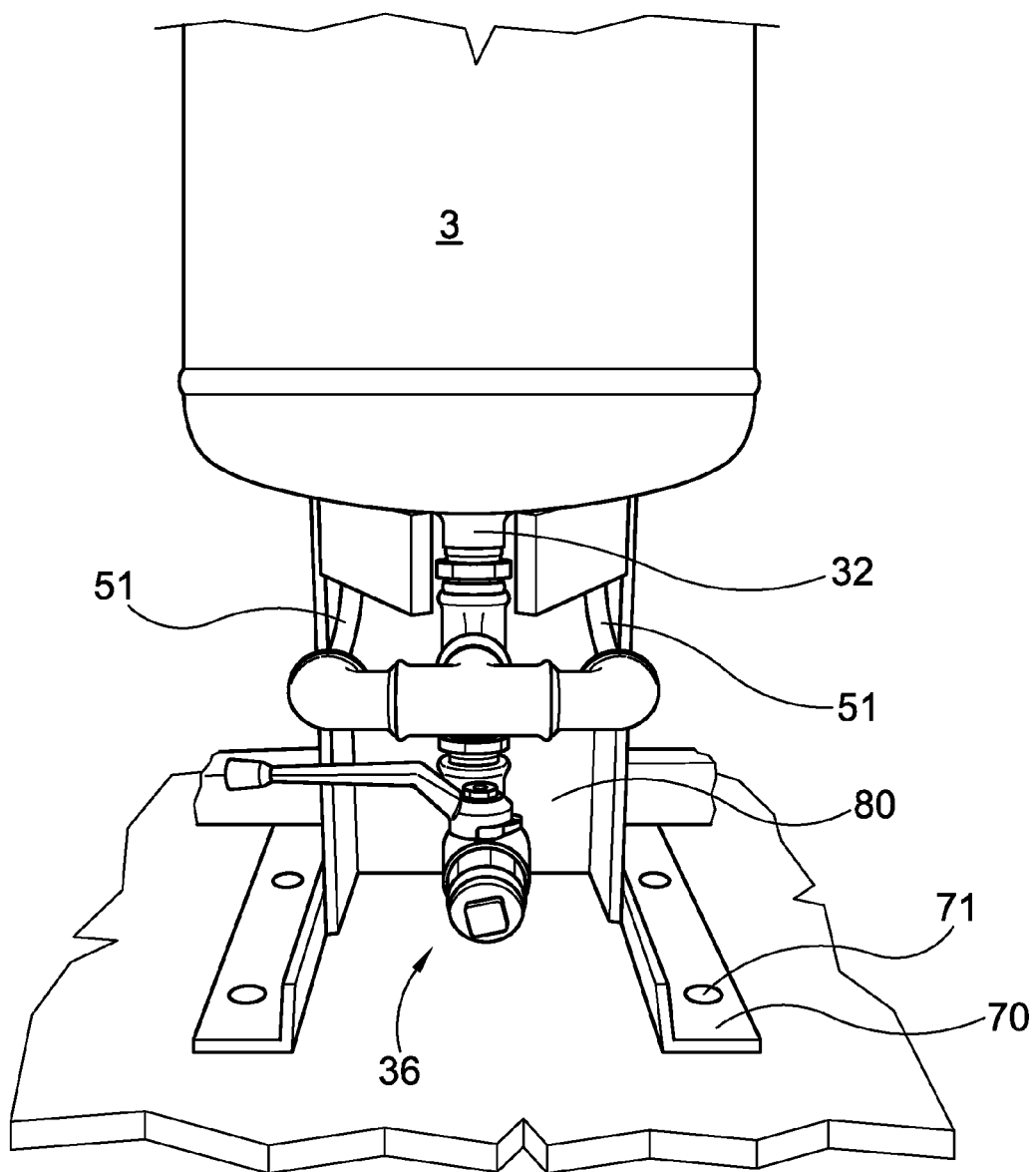
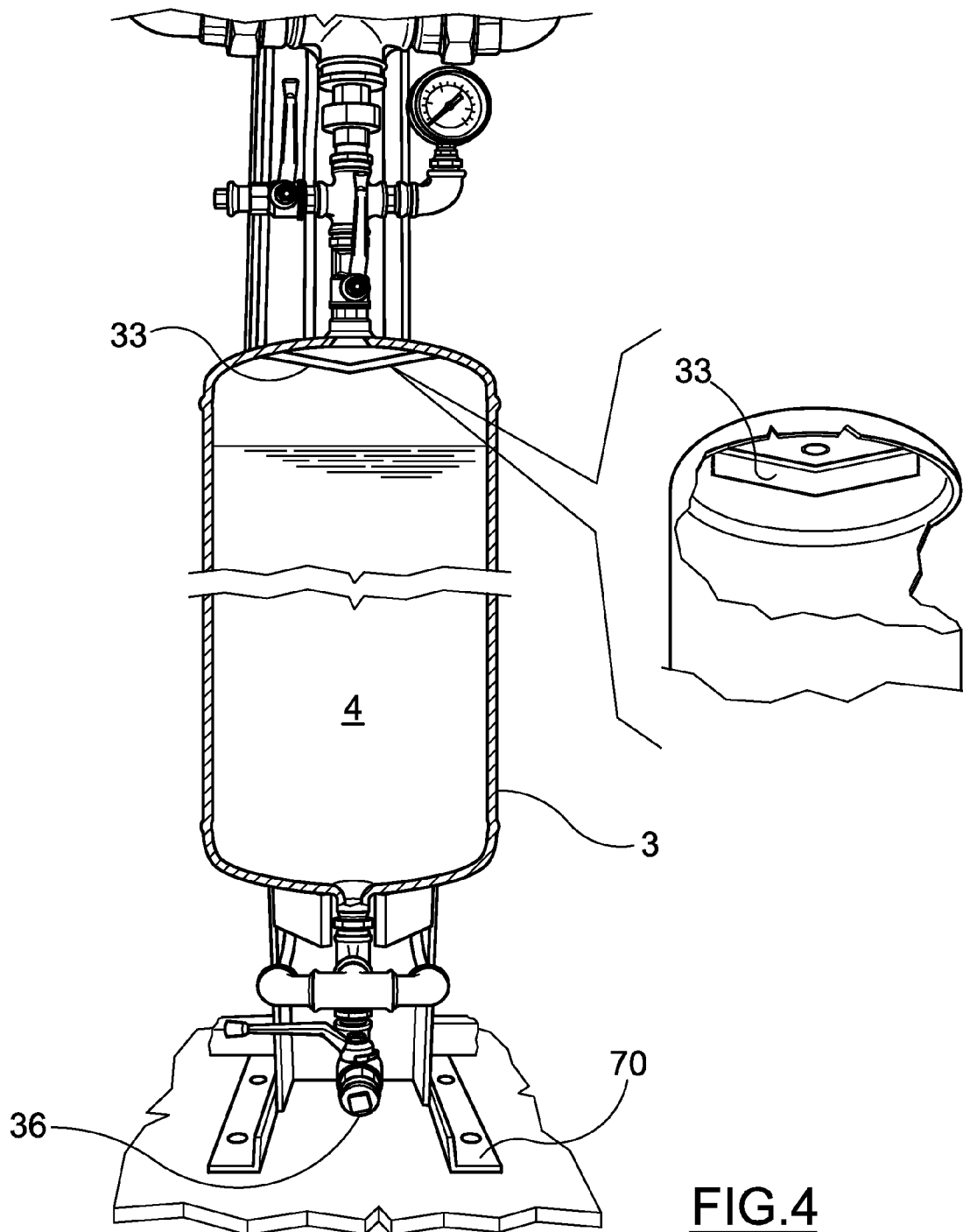


FIG.3



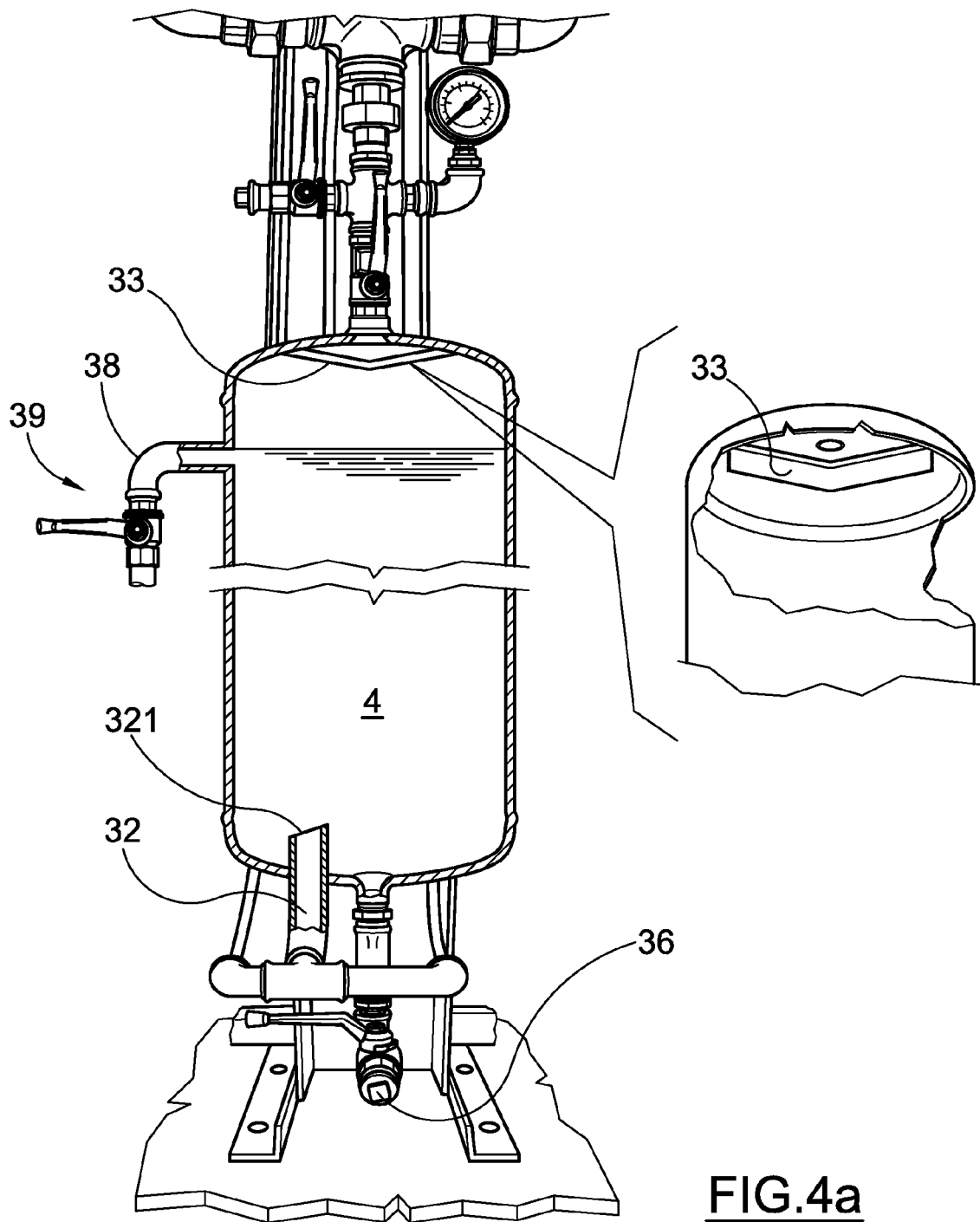


FIG.4a

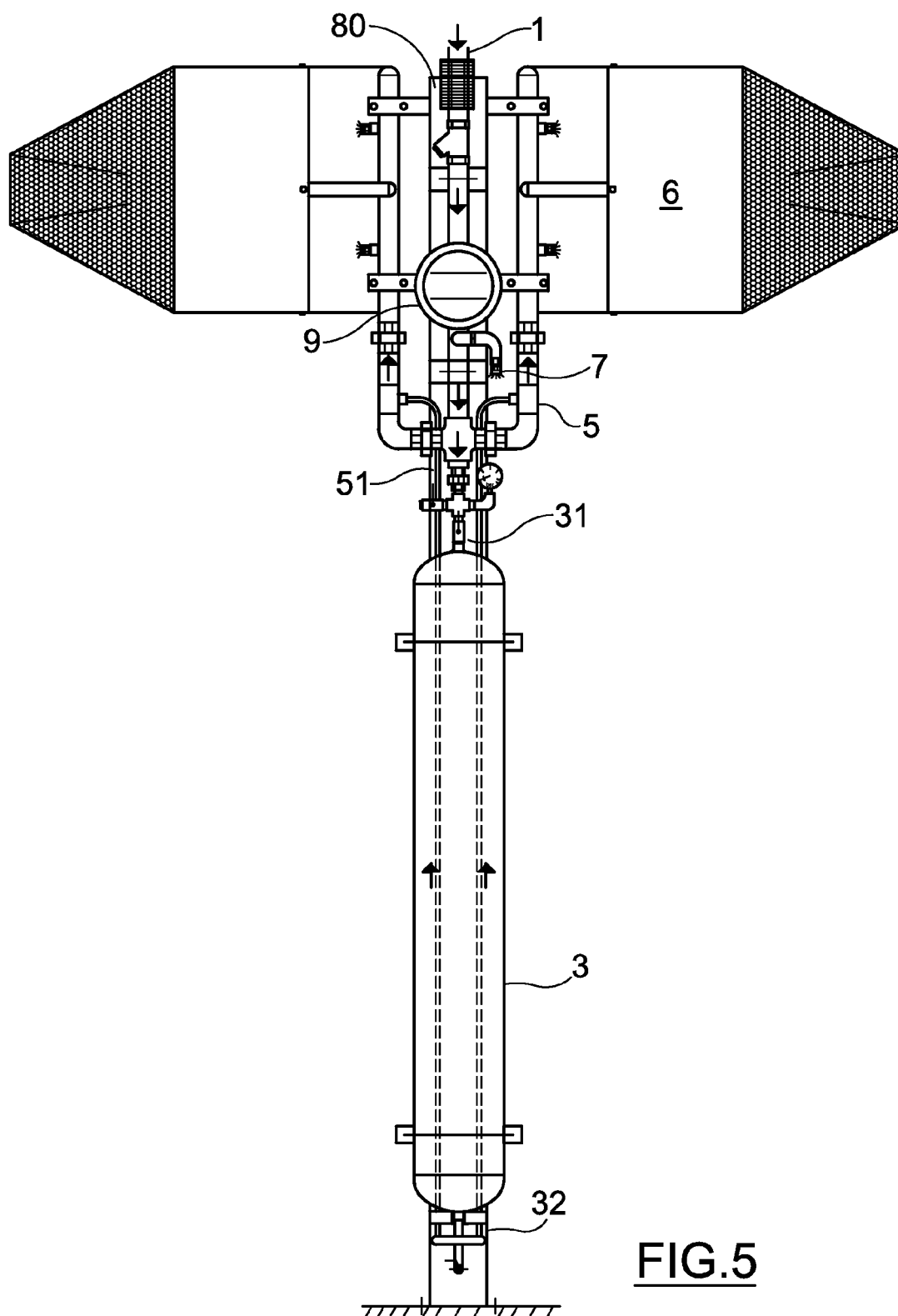


FIG.5

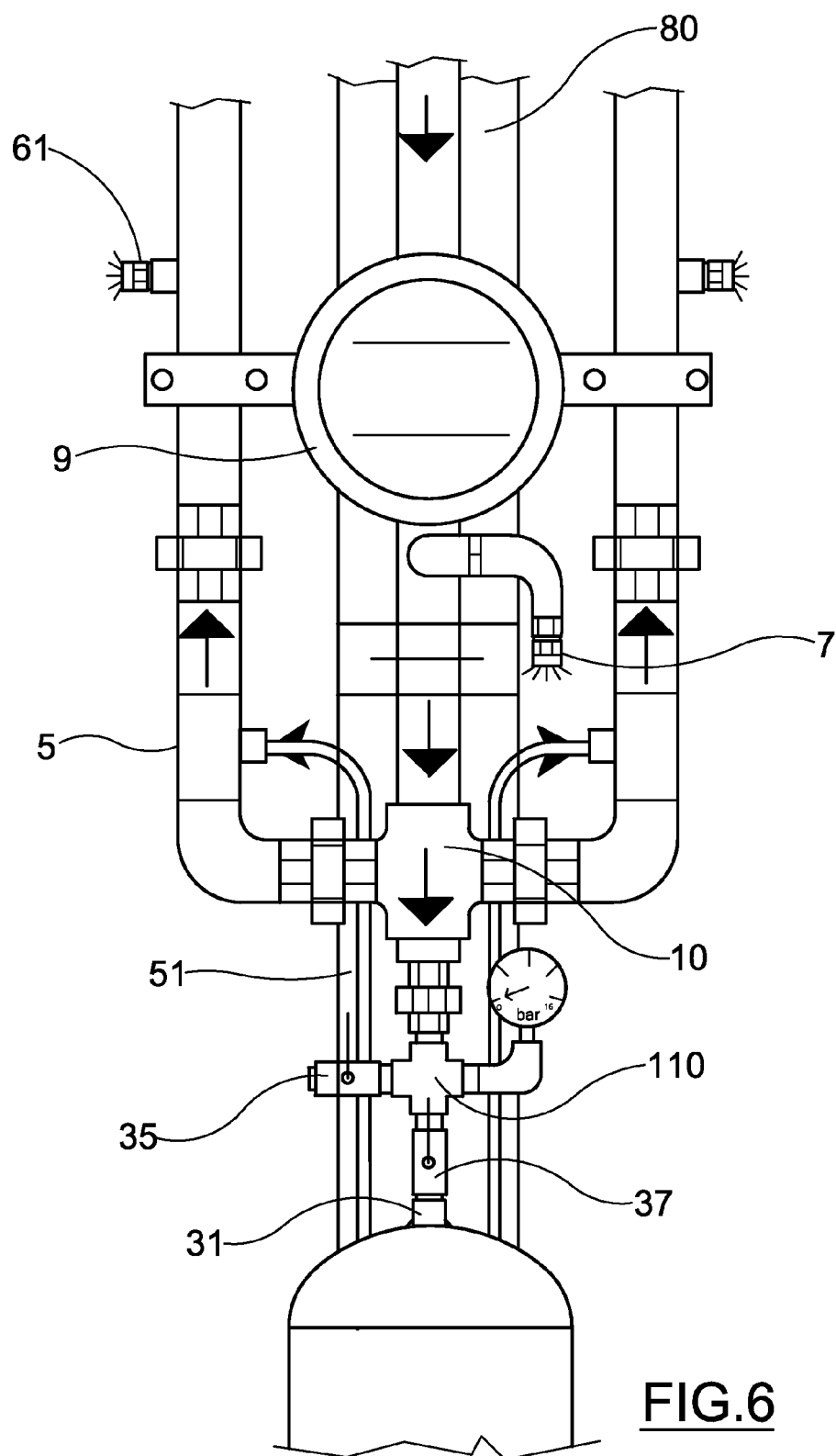


FIG.6



EUROPEAN SEARCH REPORT

Application Number
EP 09 15 9446

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 085 278 A (KELTNER LOREN L [US]) 4 February 1992 (1992-02-04)	1-7,9-12	INV. A62C5/02
A	* column 4, line 18 - column 5, line 17 * * abstract; figures 1,2 * -----	8	A62C5/00 B01F5/04
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			TECHNICAL FIELDS SEARCHED (IPC)
			A62C B01F
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 17 August 2009	Examiner Nehrdich, Martin
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	
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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17-08-2009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5085278	A	04-02-1992	NONE

US 2811211	A	29-10-1957	NONE

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82