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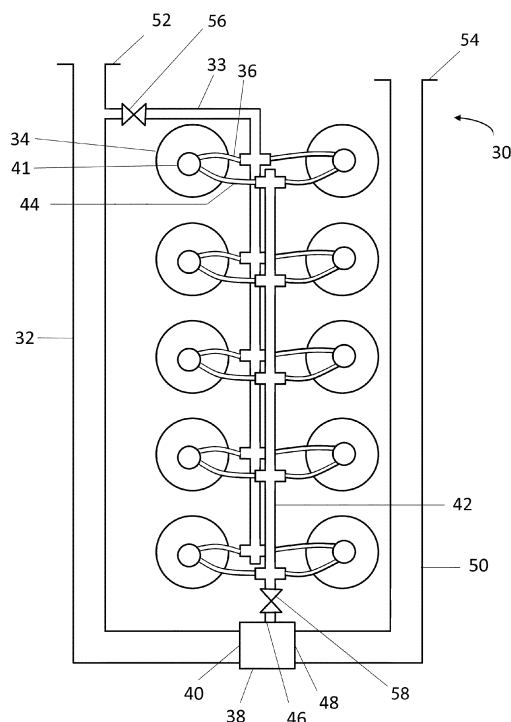
(54) **A system suitable for proportioning foam and methods of use of the system**

(57) A system for proportioning foam comprises a bladder container and a mixing device. The bladder container comprises a vessel having a wall which is at least partly made of a plastic material and, inside the vessel, a flexible bladder for holding a foam concentrate. The bladder container is configured to receive water from a water source into a space defined by the wall of the vessel and the flexible bladder, and to discharge the foam con-

centrate from the flexible bladder. The mixing device is configured to receive water from the water source and the foam concentrate from the flexible bladder, and to discharge a diluted foam concentrate.

Also claimed: an apparatus suitable for use in the system for proportioning foam, a bladder container, and methods of use of the system.

FIG. 2

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Description

[0001] The invention relates to a system for proportioning foam, an apparatus suitable for use in the system, a bladder container suitable for use in the system, and methods of use of the system.

[0002] A system for proportioning foam may be employed under circumstances that foam is used for fighting a fire or preventing a fire. In such a system a foam concentrate is added to water forming a diluted foam concentrate. The diluted foam concentrate is led through a nozzle to produce the foam. The foam concentrate comprises typically an aqueous detergent composition.

[0003] US 2010/0314137 A1 discloses a system for proportioning foam, which system comprises

- a bladder container comprising a vessel and inside the vessel a flexible bladder for holding the foam concentrate, and
- a mixing device for diluting the concentrate with water.

The bladder container is configured to receive water from a water source into a space defined by the wall of the vessel and the flexible bladder, and to discharge the foam concentrate from the flexible bladder. The mixing device is configured to receive water from the water source, to receive the foam concentrate from the flexible bladder, and to discharge the diluted foam concentrate.

[0004] The bladder container disclosed in US 2010/0314137 A1 corresponds to the general design of a conventional vertical tank. The skilled person appreciates that the conventional vertical tank used for this purpose is a steel tank. Such steel equipment is heavy and its installation may be cumbersome when the equipment is to be located in a remote area and/or in an area where work space is costly and insufficient. After the system for proportioning foam has been used for fighting or preventing a fire the foam concentrate needs to be restocked. Restocking the foam concentrate by refilling the flexible bladder may also be a cumbersome operation at the remote locations or where there is insufficient work space. Such locations may be, for example, oily refineries, drilling rigs, oil or gas producing rigs, ships, trucks and other vehicles, and airports and landing platforms for helicopters.

[0005] It is now proposed to employ in a system for proportioning foam a bladder container of which the vessel has a wall which is at least in part made of a plastic. Such a bladder container has significantly less weight than a comparable steel bladder container and is considered to be a light-weight bladder container. It is also proposed to restock the foam concentrate by exchanging the used light-weight bladder container by a light-weight bladder container filled with fresh foam concentrate, instead of refilling the flexible bladder inside the bladder container. For this purpose, a stock of the light-weight bladder containers filled with fresh foam concentrate may

be kept at or near the location of use. The used bladder container may be recycled, or scrapped and disposed of or burned. The invention provides the opportunity of assembling a system for proportioning foam which comprises a plurality of easily exchangeable light-weight bladder containers, the number of which may be in accordance with the foam capacity of the system required. Such systems may suitably have flexible tubes for connection with the exchangeable bladder containers. The bladder containers may be arranged relative to each other according to the available space. For example, they may be stacked, and/or they may be positioned next to each other. This provides a significant and advantageous flexibility in the design of the system.

[0006] The invention provides a system for proportioning foam, which system comprises

- a bladder container comprising a vessel having a wall which is at least partly made of a plastic material and inside the vessel a flexible bladder for holding a foam concentrate, which bladder container is configured to receive water from a water source into a space defined by the wall of the vessel and the flexible bladder, and to discharge the foam concentrate from the flexible bladder, and
- a mixing device for diluting the concentrate with water, which mixing device is configured to receive water from the water source and the foam concentrate from the flexible bladder, and to discharge a diluted foam concentrate.

[0007] The invention also provides an apparatus suitable for use in a system for proportioning foam, which apparatus comprises

- a water supply conduit for receiving water from a water source,
- a holding device for holding a bladder container comprising a vessel having a wall which is at least partly made of a plastic material; inside the vessel a flexible bladder containing a foam concentrate; a first conduit for feeding water into a space defined by the wall of the vessel and the flexible bladder; and a second conduit for discharging the foam concentrate from inside the flexible bladder to outside the bladder container,
- a mixing device for diluting the foam concentrate with water, which mixing device comprises a first inlet fluidly connected to the water supply conduit, a second inlet for receiving the foam concentrate from the bladder container when installed, and an outlet for discharging a diluted foam concentrate,
- a third conduit for fluidly connecting the first conduit of the bladder container, when installed, to the water supply conduit, of which third conduit at least a part is flexible, and
- a fourth conduit for fluidly connecting the second conduit of the bladder container, when installed, to

the second inlet of the mixing device, of which fourth conduit at least a part is flexible.

[0008] The invention also provides a bladder container suitable for use in a system for proportioning foam, which bladder container comprises

- a vessel having a wall which is at least partly made of a plastic material,
- inside the vessel a flexible bladder, and
- a foam concentrate contained in the flexible bladder.

[0009] The invention also provides a method of use of a system for proportioning foam according to the invention, which method comprises using the system for proportioning foam.

[0010] The invention also provides a method of use of a system for proportioning foam according to the invention, which method comprises refreshing the foam concentrate by replacing in the system a bladder container by a fresh bladder container according to the invention.

FIG. 1 provides a cross sectional view of an embodiment of the bladder container suitable for use in a system for proportioning foam in accordance with this invention.

FIG. 2 provides a side view of an embodiment of the apparatus suitable for use in a system for proportioning foam in accordance with this invention.

[0011] The bladder container for use in the invention comprises a vessel having a wall which is at least partly made of a plastic material. Preferably the wall is made of the plastic material. The plastic material may be an unfilled, a filled or a reinforced plastic material. The plastic material may be a thermo hardening resin or a thermoplastic polymer. The thermoplastic polymer may be selected from, for example polyolefins, polyesters, polycarbonates and polyamides. A preferred thermoplastic polymer is poly(ethylene terephthalate), which is well recyclable. Alternatively, the plastic material may be a fibre reinforced elastomeric material, as disclosed in EP 626338 A.

[0012] The vessel may have any shape. However, in view of the water pressure which may be applied, it is suitable for the vessel to have the shape of a hollow sphere or a hollow ellipsoid. A hollow cylindrical shape is preferred, in particular the shape of a hollow cylinder provided with an outwardly directed hollow half-spherical first end and an outwardly directed hollow half-spherical second end. The terms "top end" and "bottom end" may be used hereinafter to designate the first end and second end, respectively.

[0013] As indicated hereinbefore, inside the vessel a flexible bladder is located. When fully filled the flexible bladder may have the internal shape and volume of the vessel. The flexible bladder may be made of any flexible material, in particular a flexible plastic material, such as

a thermoplastic polymer. The flexible bladder may be made of a multilayer system, which may assist in balancing the mechanical properties against the barrier properties of the flexible bladder. A metal foil may be included in a layer.

[0014] The top end may be provided with the first conduit for feeding water into the space defined by the wall of the vessel and the flexible bladder inside the vessel. The top end may also be provided with the second conduit for discharging the foam concentrate from inside the flexible bladder to outside the bladder container.

[0015] Suitably, the bladder container has an internal volume in the range of from 1 to 100 dm³, in particular in the range of from 5 to 50 dm³. The term "internal volume" is used herein to designate the volume of the inside of the empty vessel, which is the vessel without the flexible bladder installed. A bladder container having a cylindrical shape may suitably have a diameter in the range of from 10 to 100 cm, in particular in the range of from 20 to 70 cm, for example 40 cm. A bladder container having a cylindrical shape may suitably have a length in the range of from 10 to 100 cm, in particular in the range of from 20 to 70 cm, for example 40 cm. The wall thickness is such that the vessel can withstand the water pressure which may be applied. Suitably, the wall thickness is in the range of from 0.05 to 1 mm, in particular in the range of from 0.1 to 0.5 mm.

[0016] The bladder container for use in this invention is known per se, for example from US 6036046 and WO 00/07902. A very suitable bladder container is the KeyKeg 20 Slimline container, which is available from Lightweight Containers B.V., located in Den Helder, The Netherlands. ("KeyKeg" and "Slimline" are trademarks).

[0017] A plurality of the bladder containers may be installed in accordance with the foam capacity of the system required. Typically the number of bladder containers may be in the range of from 1 to 50 (inclusive), in particular in the range of from 2 to 40 (inclusive), more in particular in the range of from 5 to 20 (inclusive).

[0018] The foam concentrate comprises typically an aqueous detergent composition, in particular an aqueous detergent composition suitable for fire suppression. The foam concentrates are well known in the art and may be obtained, for example, from InnoVfoam B.V., located in Oudkarspel, The Netherlands. Suitably, the foam concentrate is a fluorine free foam concentrate, available as "RE-HEALING FOAM" concentrate ("RE-HEALING FOAM" is a trademark); an aqueous film forming foam concentrate (frequently designated as "AFFF concentrate"); an alcohol resistant aqueous film forming foam concentrate (frequently designated as "AR-AFFF concentrate"); or a detergent type foam concentrate.

[0019] The bladder container is configured to receive water from a water source into a space defined by the wall of the vessel and the flexible bladder. To this end, the bladder container may comprise a first conduit for feeding water into the space defined by the wall of the vessel and the flexible bladder. The skilled person will

appreciate that when the flexible bladder is fully filled, the volume of the space defined by the wall of the vessel and the flexible bladder may approach a zero volume, or may be virtually non-existent. Still, the skilled person will understand that the water pressure applied forces water to enter the vessel enlarging the space defined by the wall of the vessel and to force foam concentrate to be discharged from the flexible bladder.

[0020] A water supply conduit may receive water from the water source. The water obtained from the water source may be fresh water, brackish water or salt water. A third conduit may fluidly connect the first conduit of the bladder container to the water supply conduit. At least a part of the third conduit may be flexible in order to assist in replacing a used bladder container by a bladder container containing fresh foam concentrate.

[0021] The bladder container is configured to discharge the foam concentrate from the flexible bladder. The mixing device for diluting the concentrate with water is configured to receive the foam concentrate from the flexible bladder. The mixing device is also configured to receive water from the water source and to discharge the diluted foam concentrate. Thus, the mixing device may comprise a first inlet fluidly connected to the water supply conduit, a second inlet for receiving the foam concentrate from the bladder container when installed, and an outlet for discharging a diluted foam concentrate. A fourth conduit may fluidly connect the second conduit of the bladder container to the second inlet of the mixing device. At least a part of the fourth conduit may be flexible in order to assist in replacing a used bladder container by a bladder container containing fresh foam concentrate.

[0022] The third and fourth conduits may be fluidly connected to the first and second conduits, respectively, by means of a common coupling device, in particular a coupling device which allows quickly making the fluid connections and quickly disconnecting for convenient and rapid replacement of the bladder containers.

[0023] The dimensions of the water supply conduit, the third and fourth conduit and other equipment which may be used in the system of this invention are such that they can withstand the water pressure which may be applied. Typically, the water pressure applied is in the range of from 0.1 to 1.6 MPa, in particular in the range of from 0.5 to 1 MPa. As used herein, water pressure is specified as absolute pressure.

[0024] Suitable mixing devices are known in the art. For example, the mixing device may be a mixing device provided with a mechanical stirring mechanism for mixing the foam concentrate with water.

[0025] Preferably, the mixing device may be a venturi mixer, which is known from, for example, US 2010/0324137 A1. A suitable venturi mixer may be a Bladder Tank Proportioner (BTP) type venturi mixer or a Matre Wide Range Proportioner (MWP) type venturi mixer, which types are available from Matre Maskin A.S., located in Rubbestadneset, Norway. Water entering the venturi mixer through the first inlet may pass through a

venturi which may be a conduit having gradually decreasing diameter to form a throat, with downstream from the throat a gradually increasing diameter. In the venturi mixer a pressure drop in the water flow is created as needed for dilution of foam concentrate in the venturi mixer. The foam concentrate entering through the second inlet may pass an orifice and meet the flow of water in or in the proximity of the throat, to form the diluted foam concentrate within the portion of the conduit having the gradually increasing diameter, and to be discharged through the outlet.

[0026] Suitably, the foam concentrate is mixed with water in a quantity in the range of from 0.1 to 6 %w, in particular in the range of from 1 to 3 %w, relative to the weight of the diluted foam concentrate. Valves may or may not be installed for control of the ratio of mixing the foam concentrate with water. When the mixing device is a venturi mixer, the relative proportions of the throat and the orifice determines the ratio at which the foam concentrate is mixed with water.

[0027] Now turning to the Figures, FIG. 1 provides a schematic of an embodiment of bladder container 10 suitable for use in a system for proportioning foam in accordance with this invention. Bladder container 10 comprises a vessel 12 having a plastic wall 14. Flexible bladder 16 is positioned inside vessel 12. Flexible bladder 16 may contain a foam concentrate. Bladder container 10 comprises first conduit 18 for feeding water into space 20 defined by wall 14 of vessel 12 and flexible bladder 16, and second conduit 22 for discharging foam concentrate from inside flexible bladder 16 to outside bladder container 10. Vessel 12 may be in the shape of a hollow cylinder provided with outwardly directed half-spherical ends 26. Bladder container 10 may be provided with supports 24 to support bladder container 10 when standing in an upright position.

[0028] FIG. 2 provides a side view of an embodiment of apparatus 30 suitable for use in a system for proportioning foam in accordance with this invention. Apparatus 30 comprises water supply conduits 32, 33 for receiving water from a water source (not drawn). A plurality of holding devices 34 has been installed for holding a plurality of bladder containers (FIG. 1). A plurality of conduits 36 has been installed for fluidly connecting first conduits 18 of the bladder containers (FIG. 1), when installed, to water supply conduit 33. Apparatus 30 comprises mixing device 38 for diluting foam concentrate with water. Water supply conduit 32 is fluidly connected to first inlet 40 of mixing device 38. A central conduit 42 is installed to receive foam concentrate from the bladder containers, when installed. Conduits 44 are fluidly connect to second conduits 22 of the bladder container (FIG. 1), when installed. At least a part of each of conduits 36 and at least a part of each of conduits 44 are flexible, to accommodate disconnecting and connecting first conduits 18 to water supply conduit 33, disconnecting and connecting second conduits 22 to central conduit 42, and the replacement of the bladder containers. In apparatus 30, the third con-

duit comprises water supply conduit 33 and conduit 36, and the fourth conduit comprises conduit 44 and central conduit 42. When the bladder containers are installed, conduits 18, 22, 36 and 44 may end in common coupling device 41 for making the connections and disconnections between conduits 18 and 36 and conduits 22 and 44, respectively, simultaneously and rapidly. Central conduit 42 is fluidly connected to second inlet 46 of mixing device 38. Outlet 48 of mixing device 38 for discharging diluted foam concentrate is fluidly connected to discharge conduit 50. Discharge conduit 50 may be fluidly connected to an apparatus (not drawn) for producing a fire extinguishing foam. Water supply conduit 32 and discharge conduit 50 may be provided with flanges 52, 54 for making the fluid connections to the water source and to the foam producing apparatus, respectively.

[0029] Parts of apparatus 30 may be attached to and supported by a frame (not drawn). The frame is preferably a light-weight frame. The frame may be made of metal, wood or plastic, or a combination. Apparatus 30 may be assembled at any location and transported to the location of use.

[0030] The shape of holding devices 34 is typically such that the bladder containers of FIG. 1 can be inserted into the holding device. For a bladder container provided with a vessel having a cylindrical shape, the holding device may suitably have a hollow cylindrical shape having a bottom, typically a flat bottom. The holding devices may preferably be installed in a manner such that, in the event of a spilling of water and/or foam concentrate from the bladder container, the holding device may receive the spillage. Accordingly, the holding device is preferably adapted to hold a bladder container of which the vessel has a hollow cylindrical shape preferably with the axis of the cylinder, when in use, inclined by an angle in the range of from 20 to 50 degrees relative to the horizon, in particular 20 to 40 degrees, for example 30 degrees, and the bladder container is installed, when in use, with the top end, which may be provided with the first and second conduits 18, 22, positioned above the bottom end.

[0031] Valves may be installed for example for shutting off third and fourth conduits 36 and 44, in order to facilitate the replacement of the bladder containers without taking the system for proportioning foam out of operation. Valves 56, 58 may be installed so that foam concentrate may be fed to mixing device 38 only at times that there is a need to add a foam concentrate to fire extinguishing water. Valves 56, 58 may be controlled remotely. Further control and measuring devices may be installed, such as further valves, manometers and flow meters. Apparatus 30 is preferably built in such a manner that, when in use, mixing device 38 is located at a lower level than holding devices 34 and flanges 52, 54 are at a higher level than holding devices 34. This will ease flow of water and foam concentrate through the conduits positioned between the valves 56 and 58.

Claims

1. A system for proportioning foam, which system comprises
 - a bladder container comprising a vessel having a wall which is at least partly made of a plastic material and, inside the vessel, a flexible bladder for holding a foam concentrate, which bladder container is configured to receive water from a water source into a space defined by the wall of the vessel and the flexible bladder, and to discharge the foam concentrate from the flexible bladder, and
 - a mixing device for diluting the concentrate with water, which mixing device is configured to receive water from the water source and the foam concentrate from the flexible bladder, and to discharge a diluted foam concentrate.
2. A system as claimed in claim 1, wherein the vessel has a hollow cylindrical shape provided with an outwardly directed hollow half-spherical first end and an outwardly directed hollow half-spherical second end.
3. A system as claimed in claim 1 or 2, wherein the vessel has an internal volume in the range of from 1 to 100 dm³.
4. A system as claimed in claim 3, wherein the internal volume is in the range of from 5 to 50 dm³.
5. A system as claimed in any of claims 1- 4, wherein the number of bladder containers is in the range of from 1 to 50 (inclusive), in particular in the range of from 2 to 40 (inclusive), more in particular in the range of from 5 to 20 (inclusive).
6. A system as claimed in any of claims 1- 5, wherein the mixing device comprises a venturi mixer.
7. A system as claimed in any of claims 1- 6, wherein the flexible bladder contains the foam concentrate.
8. An apparatus suitable for use in a system for proportioning foam as claimed in any of claims 1 - 7, which apparatus comprises
 - a water supply conduit for receiving water from a water source,
 - a holding device for holding a bladder container comprising a vessel having a wall which is at least partly made of a plastic material; inside the vessel a flexible bladder containing a foam concentrate; a first conduit for feeding water into a space defined by the wall of the vessel and the flexible bladder; and a second conduit for dis-

charging the foam concentrate from inside the flexible bladder to outside the bladder container,
 - a mixing device for diluting the foam concentrate with water, which mixing device comprises a first inlet fluidly connected to the water supply conduit, a second inlet for receiving the foam concentrate from the bladder container when installed, and an outlet for discharging a diluted foam concentrate, 5
 - a third conduit for fluidly connecting the first conduit of the bladder container, when installed, to the water supply conduit, of which third conduit at least a part is flexible, and 10
 - a fourth conduit for fluidly connecting the second conduit of the bladder container, when installed, to the second inlet of the mixing device, of which fourth conduit at least a part is flexible. 15

claims 1 - 7, which method comprises refreshing the foam concentrate by replacing in the system a bladder container by a fresh bladder container as claimed in claim 12 or 13.

9. An apparatus as claimed in claim 8, wherein the apparatus additionally comprises the bladder container installed in the holding device and wherein the third and fourth conduits are fluidly connected to the first and second conduits, respectively, by means of a common coupling device. 20
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10. An apparatus as claimed in claim 9, wherein the vessel of the bladder container has a hollow cylindrical shape, and the holding device is adapted to hold the bladder container with the axis of the cylinder, when in use, inclined by an angle in the range of from 20 to 50 degrees relative to the horizon. 30
11. An apparatus as claimed in claim 10, wherein the angle is in the range of from 20 to 40 degrees. 35
12. A bladder container suitable for use in a system for proportioning foam as claimed in any of claims 1 - 7, or in an apparatus as claimed in any of claims 8 - 11, which bladder container comprises 40
 - a vessel having a wall which is at least partly made of a plastic material,
 - inside the vessel a flexible bladder, and
 - a foam concentrate contained in the flexible bladder. 45
13. A bladder container as claimed in claim 12, wherein the foam concentrate comprises a fluorine free foam concentrate, an aqueous film forming foam concentrate, or an alcohol resistant aqueous film forming foam concentrate, or a detergent type foam concentrate. 50
14. A method of use of a system as claimed in any of claims 1 - 7, which method comprises using the system for proportioning foam. 55
15. A method of use of a system as claimed in any of

FIG. 1

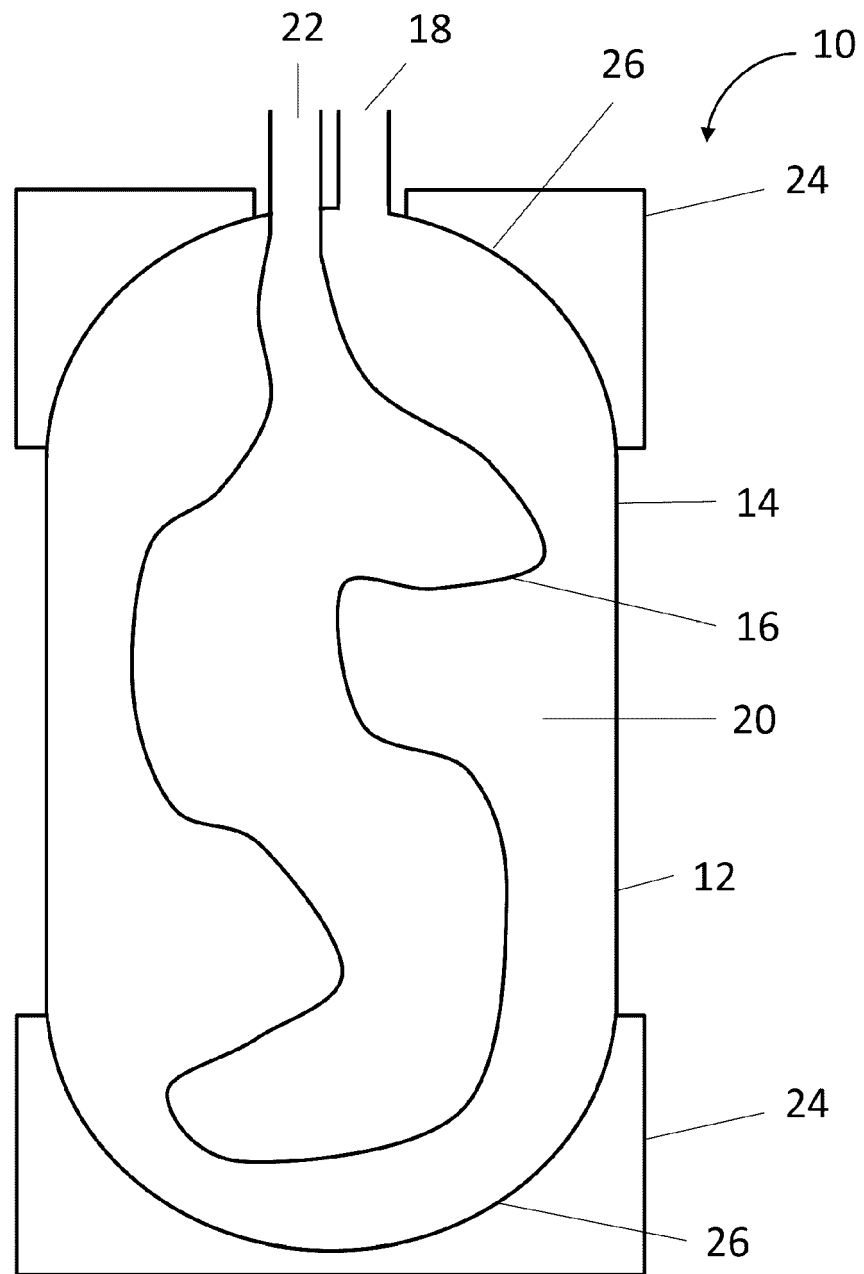
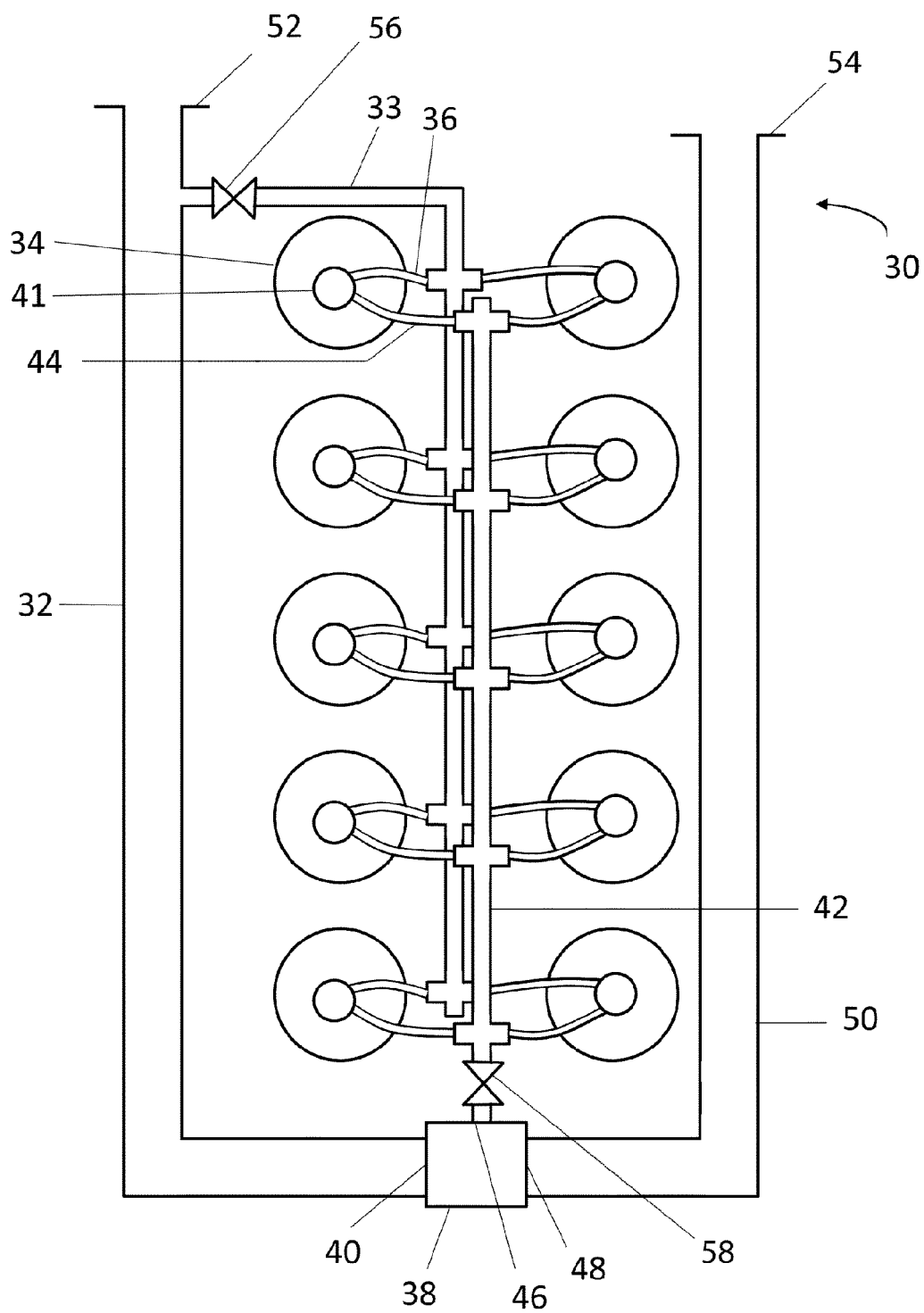


FIG. 2





EUROPEAN SEARCH REPORT

Application Number
EP 13 19 6088

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