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Application No.	Ref.	Date
17 197 276.3 - 1018	200 907 aa/iva	02.01.2019
Applicant D'Angelosante, Dino		

Communication under Rule 71(3) EPC

1. Intention to grant

You are informed that the examining division intends to grant a European patent on the basis of the above application, with the text and drawings and the related bibliographic data as indicated below.

A copy of the relevant documents is enclosed.

1.1 In the text for the Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

Description, Pages

1, 3-18	filed in electronic form on	14-11-2017
2, 2a	filed in electronic form on	26-06-2018

Claims, Numbers

1-7	filed in electronic form on	26-06-2018

Drawings, Sheets

1/5-5/5	filed in electronic form on	14-11-2017

With the following amendments to the above-mentioned documents proposed by the division

Description, Pages	15
Claims, Numbers	1

Comments

DESCRIPTION
The following amendments have been agreed to by the applicant by e-mail dated 30-11-2018.
Page 15: concordance between claims and description
CLAIMS
Page 1, Claim 1: Art. 123(2) EPC: an intermediate generalisation is to be avoided, the features of the circuit introduced from the originally filed description have been disclosed only with the here added feature.

1.2 Bibliographic data

The title of the invention in the three official languages of the European Patent Office, the international patent classification, the designated contracting states, the registered name(s) of the applicant(s) and the other bibliographic data are shown on **EPO Form 2056** (enclosed).

2. Invitation

You are invited, **within a non-extendable period of four months** of notification of this communication,

2.1 to EITHER approve the text communicated above and verify the bibliographic data (Rule 71(5) EPC)

(1) by filing a translation of the claim(s) in the other two official languages of the EPO

	Fee code	EUR
(2a) by paying the fee for grant including the fee for publication:	**007**	925.00
minus any amount already paid (Rule 71a(5) EPC):		0.00
	Total amount:	925.00
(3) by paying additional claims fees under Rule 71(4) EPC; number of claims fees payable: 0	**016**	0.00
minus any amount already paid (Rule 71a(5) EPC):		0.00
	Total amount:	0.00

Important: If the translations of the claims and fees have already been filed and paid respectively in reply to a previous communication under Rule 71(3) EPC, e.g. in the case of resumption of examination after approval (see Guidelines C-V, 6), **agreement as to the text to be granted** (Rule 71a(1) EPC) must be expressed within the same time limit (e.g. by approving the text and verifying the bibliographic data, by confirming that grant proceedings can go ahead with the documents on file and/or by stating which translations of the claims already on file are to be used).

Note 1: See "Notes concerning fee payments" below.
Note 2: Any overpaid "minus" amounts will be refunded when the decision to grant (EPO Form 2006A) has been issued.
Note 3: For the calculation of the grant fee under Article 2(2), No. 7, RFees (old fee structure), the number of pages is determined on the basis of a clean copy of the application documents, in which text deleted as a result of any amendments by the examining division is not shown.

Such clean copy is made available via on-line file inspection only.

2.2 OR, in the case of disapproval, to request reasoned amendments or corrections to the text communicated above or keep to the latest text submitted by you (Rule 71(6) EPC).

In this case the translations of the claims and fee payments mentioned under point 2.1 above are NOT due.

The terms "amendment(s)" and "correction(s)" refer only to amendments or corrections of the application documents and not of other documents (e.g. bibliographic data, the designation of the inventor, etc.).

If filing amendments, you must identify them and indicate the basis for them in the application as filed. Failure to meet either requirement may lead to a communication from the examining division requesting that you correct this deficiency (Rule 137(4) EPC).

2.3 Bibliographic data

Where you request a change or correction of bibliographic data in response to the Rule 71(3) communication, this will **not** cause the sending of a further communication under Rule 71(3) EPC. You will still have to pay the fees and file translations in reply to the Rule 71(3) communication in the case of 2.1 above, unless you also file a reasoned request for amendments or corrections in response to the Rule 71(3) communication (see case 2.2 above).

3. Loss of rights

If neither of the two possible actions above (see points 2.1 or 2.2) is performed in due time, the European patent application will be deemed to be withdrawn (Rule 71(7) EPC).

4. Further procedure

4.1 In the case of point 2.1 above

4.1.1 The decision to grant the European patent will be issued, and the **mention of the grant** of the patent will be published in the European Patent Bulletin, if the requirements concerning the translation of the claims and the payment of all fees are fulfilled and there is agreement as to the text to be granted (Rule 71a(1) EPC).

Note on payment of the renewal fee:
If a renewal fee becomes due before the next possible date for publication of the mention of the grant of the European patent, publication will be effected only after the renewal fee and any additional fee have been paid (Rule 71a(4) EPC).

Under Article 86(2) EPC, the obligation to pay renewal fees to the European Patent Office terminates with the payment of the renewal fee due in respect of the year in which the mention of the grant of the European patent is published.

Note on payment of the designation fee(s):
If the designation fee(s) become(s) due after the communication under Rule 71(3) EPC, the mention of the grant of the European patent will not be published until these fees have been paid (Rule 71a(3) EPC).

4.1.2 After publication, the **European patent specification** can be downloaded free of charge from the EPO publication server https://data.epo.org/publication-server.

4.1.3 Filing of translations in the contracting states

As regards translation requirements prescribed by the contracting states under Article 65(1) EPC, please consult the website of the European Patent Office
www.epo.org ➞Law & practice ➞Legal texts, National law relating to the EPC
www.epo.org ➞Law & practice ➞All Legal texts ➞London Agreement

In the case of a valid extension or validation

As regards translation requirements prescribed by the extension or validation states, please consult the website of the European Patent Office
www.epo.org ➞Law & practice ➞Legal texts, National law relating to the EPC

Failure to supply a prescribed translation in a contracting state, or in an extension or validation state may result in the patent being deemed to be void *ab initio* in the state concerned (Art. 65(3) EPC).

4.2 In the case of 2.2 above

If the present communication under Rule 71(3) EPC is based on an auxiliary request and, within the time limit, you maintain the main request or a higher ranking request which is not allowable, the application will be refused (Art. 97(2) EPC).

If the examining division gives its consent to the requested amendments or corrections, it will issue a new communication under Rule 71(3) EPC; otherwise, it shall resume the examination proceedings (Rule 71(6) EPC).

5. Filing of a divisional application

Any divisional application relating to this European patent application must be filed directly with the European Patent Office in Munich, The Hague or Berlin and will be in the language of the proceedings for the present application, or if the latter was not in an official language of the EPO, the divisional application may be filed in the language of the present application as filed (see Article 76(1) and Rule 36(2) EPC). Any such divisional application must be filed while the present application is still pending (Rule 36(1) EPC; Guidelines A-IV, 1.1.1).

6. Notes concerning fee payments

6.1 Making payments

For payments made via deposit account, please note that as from 1 December 2017 debit orders will only be carried out if filed in an electronically processable format (xml), using an accepted means of filing as laid down in the Arrangements for deposit accounts (ADA), published in the Supplementary publication in the Official Journal.

All relevant information related to the modes of payment of fees to the EPO can be retrieved from the EPO website at "**Making Payments**".

6.2 Information concerning fee amounts

Procedural fees are usually adjusted every two years, on even years, with effect from 1 April. Therefore, before making a payment, parties should verify the amounts actually due on the date of payment using the applicable version of the Schedule of fees and expenses, published as a Supplement to the Official Journal of the EPO, available on the EPO website (**www.epo.org**) at **www.epo.org/schedule-of-fees**. The "Schedule of fees" table allows the viewing, downloading and searching of individual fee amounts, both current and previous.

6.3 Note to users of the automatic debiting procedure

The fee for grant, including the fee for publication, and any additional claims fees due under Rule 71(4) EPC will be debited automatically on the date of filing of the translations of the claims, or on the last day of the period of this communication. However, if the designation fee(s) become(s) due as set out in Rule 71a(3) EPC and/or a renewal fee becomes due as set out in Rule 71a(4) EPC, these should be paid separately by another permitted way of payment in order not to delay the publication of the mention of the grant. The same applies in these circumstances to the payment of extension and validation fees. The same applies in these circumstances to the payment of extension and validation fees.

Note: If a waiver is expressed in response to a Rule 71(3) communication (see OJ EPO 2015, A52), the fee for grant, including the fee for publication/printing, and any additional claims fees will not be debited automatically. These fees must be paid separately by another means of payment allowed under the Rules relating to Fees.

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Enclosures: Text intended for grant

EPO Form 2056

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Annex to EPO Form 2004, Communication pursuant to Rule 71(3) EPC

Bibliographical data of European patent application No. 17 197 276.3

For the intended grant of the European patent, the bibliographical data are set out below, for information:

Title of invention:	- VORRICHTUNG ZUM SPEICHERN UND AUSGEBEN EINER FLÜSSIGKEIT - A DEVICE FOR STORING AND DISPENSING A LIQUID - DISPOSITIF POUR STOCKER ET DISTRIBUER UN LIQUIDE
Classification:	INV. B67D7/02 B67D1/04
Date of filing:	19.10.2017
Priority claimed:	IT / 19.10.2016 / ITA201600105150
Contracting States* for which fees have been paid:	AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Extension States* for which fees have been paid:	BA ME
Validation States* for which fees have been paid:	
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*)	If the time limit for the payment of designation fees according to Rule 39(1) EPC has not yet expired and the applicant has not withdrawn any designation, **all Contracting States/Extension States/Validation States** are currently still deemed to be designated. See also Rule 71a(3) EPC and, if applicable, the above Note to users of the automatic debiting procedure.
**)	If two or more applicants have designated different Contracting States, this is indicated here.

HE-Ref. 200 907

Device and method for storing and dispensing a liquid

DESCRIPTION

The present invention relates to a method and a device for storing and dispensing a liquid. In particular, the present invention can be advantageously applied to storing and dispensing liquids such as, for example, water, fuel, and food products such as, for example, wine and milk, and still others.

In the prior art, the storage and dispensing of liquids are satisfied with different systems. With reference to a classic system, the liquid is collected in a first collection tank of varying capacities depending on need. This system works through the use of a membrane expansion vessel and with the aid of electric pumps activated by actuators.

Another system envisages, in the place of actuators and the expansion vessel, an electronic regulator for controlling the pumps. This system is used mainly in domestic environments and requires the use of pumps, for example electric pumps.

A further system, called "airlift" system, is similar to the previous ones, but does not have a membrane and, thanks to an air supply unit directly on the pump intake, is more reliable and higher performing.

In the field of fire safety systems, storage and dispensing are entrusted to water supply tanks and electric pumps or motor pumps, and are used, for example, in residential, commercial and industrial buildings.

In fuel distribution, there are the systems typical of service stations, in which the liquid is dispensed from underground tanks by using electric pumps.

In the field of systems used in wine cellars for moving mixtures such as musts and skins from the first pressing, particular electric pumps are relied on.

Disadvantageously, the systems described make use of pumps, in general electric ones or compressed air membrane pumps. This imposes an operating limit when, for example, no electricity is available, or when the supply of electricity is interrupted, for example during a black-out.

US 5868280A relates to a pressurized device for distribution of a liquid. The device is aimed at overcoming the disadvantages of known systems using diaphragm or bladder as a barrier between air and water in a vessel. The document proposes a device without a barrier between air and water wherein a number of sensors controls the water level and, when the water level is below a certain threshold, a pump restores the water level, see column 4, lines 1-10. The residual air in the vessel pneumatically acts on the water by applying a pressure. The air pressure, when the water level is maximum, is monitored. If system pressure is lower than the pressure setting, air mass has been lost. On detection of lost air mass, a control means activates a pneumatic supply to compensate for it.

Further disadvantages of the known systems are the complexity of their construction and the high number of components. Consequently, there is a substantial likelihood of breakdowns occurring and maintenance requirements are stricter.

The object of the present invention is to obviate the problems tied to the prior art. In particular, it is an object of the present invention to provide a method and a device for storing and dispensing liquids also in the absence of an available source of electricity at the time of distribution.

A further object of the present invention is to offer a simple and reliable dispensing and storage method and a device capable of preventing possible malfunctions and simplifying maintenance.

These and other advantages are achieved by a device and method as defined in the independent claims. Advantageous embodiments are defined in the dependent claims.

According to a first aspect of the invention, a device for storing and dispensing a liquid comprises a tank for

containing a liquid having an inlet and an outlet, configured to be pre-charged with a gas, preferably air, at a first pressure that is higher than atmospheric pressure, and at least partially filled with the liquid until reaching a second pressure that is higher than first pressure. The device further comprises a fluid regulator connected to the outlet of the tank in order to regulate the passage of the liquid. The fluid regulator comprises an outflow conduit having an intake section and an outlet section, and a floating shutter. The fluid regulator is switchable between a closed configuration, wherein the shutter occludes the intake section of the outflow conduit when the level of liquid is in the intake section of the outflow conduit so as to prevent the passage of gas in the outflow direction of the liquid, and an open configuration, wherein the shutter is separated from the intake section of the outflow conduit so as to allow the transit of the liquid. The open configuration is determined by the hydrostatic thrust of the liquid on the shutter. This device enables a liquid to be stored and dispensed also in the absence of electricity because the stored liquid is dispensed thanks to the pressure of the gas with which the device is pre-charged.

According to a second aspect of the invention, in the device for storing and dispensing a liquid the shutter is configured to float freely on the liquid inside the fluid regulator when the fluid regulator is in the open configuration. This makes it possible to assure that the liquid flows out through the fluid regulator without the shutter constituting an obstacle.

According to a third aspect of the invention, in the device for storing and dispensing a liquid the fluid

regulator comprises a retaining means for retaining the shutter at a maximum predetermined distance from the intake section of the outflow conduit. This makes it possible to favour the occlusion of the outflow conduit by the shutter when the liquid level is below a certain height.

According to a fourth aspect of the invention, in the device for storing and dispensing a liquid the fluid regulator comprises at least one lateral wall connected to the intake section and having a inner surface with a decreasing cross section, preferably conical, towards the intake section of the outflow conduit so as to guide the shutter towards the intake section of the outflow conduit when the fluid regulator is switched from the open configuration to the closed configuration. This makes it possible to favour the occlusion of the outflow conduit by the shutter, by guiding it towards the intake section of the outflow conduit.

According to a fifth aspect of the invention, in the device for storing and dispensing a liquid the shutter has at least one circular section and preferably has a spherical shape. This favours simplicity of construction and enables an optimal occlusion of the outflow conduit by the shutter.

According to a sixth aspect of the invention, the device for storing and dispensing a liquid comprises an air enricher connected to the fluid regulator. The invention according to this aspect can be advantageously applied in the case, for example, of water systems such as autoclaves or systems for the formation of mixtures with water, such as mixtures of water and fertilisers and others, in order to enable the intake of air into the tank. If the gas used is air, this will enable the replenishment of any air that

has dissolved in (emulsified with) the liquid and flowed out of the tank therewith.

The air enricher comprises a sleeve connected to the fluid regulator and having an aperture to the outside, and a tube inside the sleeve connected to the outflow conduit of the fluid regulator. The tube has an inlet section and an outlet section with a smaller area than the inlet section. The sleeve and the tube define a space in fluid communication with the outflow conduit. A one-way valve that permits the intake of air into the enricher is preferably positioned at the side of the sleeve. This air, reintroduced into the tank, replenishes any that may dissolve or be emulsified and lost when the liquid is dispensed in the event that the gas is air.

According to a further aspect of the invention, the tank has a separate inlet for the pre-charging gas. This enables a simpler connection of the device to other devices, such as the one for supplying liquids and the one for supplying gas.

According to a further aspect of the invention, a method for storing and dispensing liquids by means of the previously described device is defined; it comprises a step of pre-charging the tank for containing a liquid with a gas, preferably air, at a first pressure that is higher than atmospheric pressure, a step of at least partially filling the tank with the liquid until reaching a second pressure that is higher than said first pressure, a dispensing step wherein the liquid passes through the fluid regulator in the open configuration and a switching step wherein the fluid regulator passes from the open configuration to the closed configuration. This method makes it possible to use the above-described device and to

resolve the problem of storing and dispensing a liquid also in the absence of electricity.

In the context of the present invention reference will be made to the appended figures, in which:

figure 1 shows a schematic view of a device for storing and dispensing a liquid in accordance with the present invention in two different operating conditions;

figures 2a and 2b each show a schematic view of a first detail of the device for storing and dispensing a liquid as per figure 1;

figure 3 shows a schematic view of a second detail of the device for storing and dispensing a liquid as per figure 1;

figure 4 shows a schematic view of a device for storing and dispensing a liquid having a re-charging circuit, in accordance with an alternative embodiment.

With reference to the appended figures, 100 here indicates a device for storing and dispensing a liquid in accordance with the present invention.

The device 100 for storing and dispensing a liquid in question is suitable for different types of liquid, e.g. water, petrol or fuel in general, and food substances such as milk, wine and oil. In general, in this context liquid means a fluid having a defined free surface which may have different viscosities and densities.

With reference to figure 1, the device 100 is provided with a tank 1. The tank 1 is suitable for withstanding and maintaining the operating pressures of the device which, purely by way of example, are comprised between 2 and 15 atmospheres. In greater detail, typical operating pressures may vary from a minimum pressure of a few millibars above

atmospheric pressure to a maximum pressure defined by the type of intended use.

The tank 1 has at least one inlet 2 for the introduction of the liquid and/or gas. In the embodiment illustrated in figure 1, there is also a further inlet 8 for the intake of gas. This inlet 8 can also be used to connect the device 100 for storing and dispensing a liquid to other apparatus, such as the one for supplying liquids and the one for supplying gas, as well as to create multiple systems in series or in parallel. In the embodiment illustrated in figure 1, the liquid inlet 2 and the gas inlet 8 are distinct. In unillustrated embodiments, optionally, the gas and liquid inlets could coincide. The tank 1 has at least one outlet 3 at a lower height than the inlet 2. The tank 1 can have any shape, e.g. cylindrical, spherical, conical or that of a truncated cone. In the latter two cases, the shape advantageously enables a nearly complete outflow of the liquid, except in the event of minimal sediment that may be deposited. Different shapes useful for the purpose may be created, taking into account the spaces of use. The tank 1 can be made of different materials, for example metal materials such steel or aluminium, or plastic materials. Advantageously, the choice of material is made on the basis of the liquid and gas it is intended to use, for example in consideration of use for wine with nitrogen, or water with air. The dimensions of the tank 1 are such as to permit capacities that are useful for the purpose.

As will become more clearly apparent below, the tank 1 is suitable for being pre-charged with a gas, preferably air, at a first pressure that is higher than atmospheric pressure and at least partially filled with the liquid

until reaching a second pressure that is higher than the first pressure. The gas with which the tank 1 is pre-charged can be of varying nature, e.g. air, nitrogen or other gases, also depending on the type of liquid to be used. The gas is introduced into the tank 1 through the inlet 8.

According to one example of the present invention, an isolated tank not connected with a municipal mains water supply is pre-charged, for example, by means of a tank of nitrogen or any other gas suited to the purpose. The device 100 comprises a fluid regulator 5 connected to the outlet 3 of the tank 1 in the lower part of the tank 1 so that all or nearly all of the liquid contained in the tank 1 can spontaneously reach the outlet 3 of the tank 1 thanks to the force of gravity. Preferably, the fluid regulator 5 is installed inside the tank 1 at the outlet 3. Even more preferably, the fluid regulator 5 is installed completely inside the tank 1 at the outlet 3. Advantageously, in the event that the tank 1 is cone- or truncated cone-shaped, positioning the fluid regulator 5 completely inside it will enable a nearly complete emptying of the tank 1 itself.

A fastening system (not illustrated in the figures) is placed between the fluid regulator 5 and the outlet 3 of the tank 1. By way of example, the fastening system consists of a flange with which both the fluid regulator 5 and outlet 3 of the tank 1 are provided. The flanges are coupled by means of screws and/or bolts. Other examples of a fastening system are a thread and a quick-connect coupling.

The fluid regulator 5 regulates the passage of fluids, enabling or preventing the passage thereof. In particular, the fluid regulator 5 can allow the liquid contained in the

tank 1 to flow out. Furthermore, the fluid regulator 5 prevents the passage of the gas towards the outside in the direction K.

With reference to figures 2a and 2b, the fluid regulator 5 comprises an outflow conduit 20 having an intake section 20a and an outlet section 20b. The outflow conduit 20 extends along a prevalent longitudinal axis of extension thereof and has a cross section transversal to the longitudinal direction, by way of example, a circular one. The cross section can have other shapes, e.g. oval, polygonal and still others. The fluid regulator 5 comprises at least one lateral wall 14 having an inner surface with a decreasing cross section transversal to the flow K of the liquid towards the intake section 20a of the outflow conduit 20, for example conical. In the illustrated embodiment, the wall 14 has a truncated cone shape and is structurally connected to the intake section 20a of the outflow conduit 20. In the illustrated embodiment, the conical lateral wall 14 is coaxial with the outflow conduit 20. In accordance with what has been illustrated, the fluid regulator 5 further comprises an additional wall 18 fixed to the lateral wall 14 in an opposite position relative to the intake section 20a of the outflow conduit 20. Preferably, the wall 18 has a circular section. In the illustrated embodiment, the wall 18 is coaxial with the outflow conduit 20.

The fluid regulator 5 further comprises a shutter 15. The shutter 15 is a floating element, where floating means capable of floating on the liquid with which the tank 1 is filled. In this regard, the specific weight of the shutter 15 is, overall, less than that of the liquid, so that the

hydrostatic thrust of the liquid on the shutter 15 is sufficient to enable it to float on the liquid.

In this regard, the shutter 15 can be hollow or solid. For example, the shutter 15 can be made of plastic, rubber, metal or metal alloys, composite materials, cork and still others.

The weight and material of the shutter 15 will be determined each time in relation to the liquid to be treated (water, fuel, wine, acids and still others).

As shown in figure 2a, the fluid regulator 5 can take on a closed configuration, wherein the shutter 15 occludes the intake section 20a of the outflow conduit 20. This configuration presents itself when the liquid has completely or almost completely flowed out of the tank and the shutter 15 is no longer held up by floating on the liquid and is deposited on the intake section 20a of the outflow conduit 20, thus coming into contact with the latter and obstructing it. In accordance with Figure 2a, the level of the liquid in this configuration is indicated with L3.

The obstruction is made possible by the fact that the shutter 15 has a shape complementary to that of the intake section 20a of the outflow conduit 20. More in particular, the shutter 15 has at least one section with a shape complementary to that of the intake section 20a of the outflow conduit 20. In the closed configuration, the shutter 15 completely closes the intake section 20a of the outflow conduit 20, thus eliminating any passage opening.

In particular, the illustrated shutter 15 has a spherical shape. However, in the case of a circular intake section 20a, the shutter 15 can also have other shapes,

such as, for example, a conical, or truncated cone shape, and others.

The intake section 20a of the outflow conduit 20 may optionally have a gasket (not illustrated) to ensure a seal in contact with the shutter 15. In particular, the gaskets to be used will depend on the coupling types of the system.

As illustrated in figure 2b, the fluid regulator 5 can have an open configuration, in which the presence of liquid causes the shutter 15 to float due to the hydrostatic thrust of the liquid itself on the shutter 15. In accordance with Figure 2b, the level of the liquid in this configuration is indicated as L2.

This means that the shutter 15 will not be in contact with or in direct proximity to the intake section 20a of the outflow conduit 20, and therefore the liquid can flow through said intake section 20a, passing between the shutter 15 and the intake section 20a of the outflow conduit 20.

When, because of the outflow of liquid from the tank 1, the level of the liquid inside the tank 1 decreases, the level of the shutter 15 floating on the liquid is lowered towards level L3, bringing the shutter 15 to levels that are increasingly close to that of the intake section 20a of the outflow conduit 20. Below a certain level, the weight of the shutter 15 is no longer balanced by the hydrostatic thrust of the liquid on the shutter 15, thus determining the end of the floating of the shutter 15.

The inner surface of the cone-shaped lateral wall 14 is thus configured so as to guide the shutter 15 towards the intake section 20a of the outflow conduit 20. In this manner, the nearing of the shutter 15 to the intake section 20a of the outflow conduit 20 is facilitated in order to

favour the closed configuration of the fluid regulator 5, thus preventing the gas contained in the tank from flowing out through the outflow conduit 20. In other words, the nearing of the shutter 15 to the intake section 20a of the outflow conduit 20 is facilitated in order to favour a configuration in which the shutter 15 has a section thereof in the intake section 20a of the outflow conduit 20.

This is facilitated by the fact that the gas exerts a certain pressure on the shutter 15 towards the outflow conduit 20, increasing the tightness thereof.

The fluid regulator 5 preferably further comprises a retaining means 16 for keeping the shutter 15 at a certain maximum distance from the intake section 20a of the outflow conduit 20. The maximum distance is determined so that the shutter 15 remains in the vicinity of the outflow conduit 20. In this manner, if the liquid in the tank 1 is close to being depleted, the shutter 15 will also be in proximity to the intake section 20a of the outflow conduit 20, since the retaining means 16 will prevent it from moving away. When the level exceeds the level L2 and it is in a position completely outside the fluid regulator 5, as indicated, for example, by the level L1, the retaining means 16 will prevent the shutter 15 from coming out of the fluid regulator 5.

The retaining means 16 must enable a free passage of liquid and gas, but must prevent the floating shutter 15 from moving away from the outflow conduit 20. The retaining means 16 can thus be made up, for example, of a net, mesh, grille, or bars, cables, wires, or even a single wire connected to the float 15 and to the fluid regulator 5.

Preferably, the shutter 15 of the fluid regulator 5 can float freely on the liquid inside the fluid regulator 5

when the fluid regulator 5 is in the open configuration. In other words, according to what has been illustrated, the shutter 15 is not rigidly constrained relative to other parts of the fluid regulator 5. In this manner, the shutter 15 can reach all points inside the fluid regulator 5. The fact that the shutter 15 is free to float on the liquid inside the fluid regulator 5 brings the advantage that, during the emptying of the tank as a result of the dispensing of the liquid, the shutter 15 will not constitute an obstacle to the outflow of the liquid, for example by creating turbulences that condition the flow of the liquid and limit the velocity of the outflow thereof under the push of the pressure inside the tank 1 and gravity.

The device 100 further comprises an air enricher 11 connected to the outflow conduit 20 of the fluid regulator 5 so as to enable the intake of air from the environment into the tank 1. The connection can take place by means of a fastening means such as, for example, a flange or thread or quick-connect coupling (not illustrated).

As may be seen from figure 3, the air enricher 11 further comprises a sleeve 40 connected to the fluid regulator 5 and a tube 32 inside the sleeve 40. The tube 32 is configured in such a way as to have an inlet section 32a connected to the outflow conduit 20 of the fluid regulator 5, and an outlet section 32b. According to what has been illustrated, the outlet section 32b has a smaller area than the inlet section 32a. The tube 32 preferably has a truncated cone shape. According to what is shown in figure 3, the tube 32 has a truncated cone portion and a cylindrical portion connected to each other. In this case, the inlet section 32a is disposed on the truncated cone

portion, and the outlet section 32b is disposed on the cylindrical portion. This difference between the inlet 32a and outlet 32b sections determines the fact that, the flow through said sections being equal, the liquid exiting the outlet section 32b will have a greater velocity than the liquid entering the inlet section 32a.

A space 70 is defined within the overall space comprised between the sleeve 40 and the tube 32. The space 70 is in fluid communication with the outflow conduit 20 of the fluid regulator 5. In this space 70, during the passage of liquid in the direction K, a relative negative pressure can come to be created as a result of the conformation of the tube 32, which, by virtue of the Venturi effect, allows the outside air to enter the space 70 of the enricher 11 through an opening 50 on the sleeve 40. The opening 50 is preferably fitted with a one-way valve (not illustrated) to allow exclusively the intake of air from the outside environment into the space 70 and to prevent the outflow of liquid from the space 70 to the outside of the air enricher 11.

The air which entered the space 70 rises in the direction W, opposite to that of the liquid K, and passes into the fluid regulator 5 so as to reach the tank and, in particular, to be added to the gas contained in the tank.

The passage between the space 70 and the outflow conduit 20 can take place, for example, by means of one or more passages 60. The passage 60 can be, for example, a hole, a slot, a set of holes, etc.

The air inlet has the function of enabling the intake of air into the tank. If the gas used is air, in fact, this permits the replenishment of any air that has dissolved in

(emulsified with) the liquid and flowed therewith outside the tank.

The device 100 further comprises ~~In an alternative embodiment, the device 100 can further comprise~~ a recharging circuit in fluid communication with the outlet of the air enricher 11. In such a case, the enricher 11 preferably does not comprise the passage 60. Outlet of the air enricher 11 means the aperture in the sleeve 40 from which the liquid flows out after having passed through the air enricher 11 in the direction K.

The recharging circuit comprises a chamber 12 in fluid communication with the air enricher 11 and dimensioned in proportion to the tank 1.

The recharging circuit comprises a conduit 14 in fluid communication with the chamber 12 and the upper part of the tank 1. Upper part of the tank 1 means the portion of the tank 1 above the level of the liquid in the tank 1. The connection between the conduit 14 and the tank 1 can take place by means of a one-way valve so as to prevent a return of pressure from the tank 1 towards the chamber 12.

During the dispensing of the liquid from the tank 1, the gas inside the tank 1 expands and the level of the liquid falls, whilst the enricher favours the intake of outside air into the system, thus compensating for the loss of any dissolved air and the reduction of pressure due to dispensing.

The air introduced by the enricher can reach the chamber 12 and rise up the conduit 14 under the pressure of the liquid itself, at least partially restoring the pressure in the tank 1 lost due to the outflow of liquid.

One part of the outside air entering the system through the air enricher 11 can also be emulsified with

and/or entrained in the liquid flowing out of the system, reducing the consumption thereof.

The chamber 12 is optionally transparent in order to enable observation of the level of liquid and thus of the intake of air into the tank via the conduit 14.

The recharging circuit advantageously allows a more efficient replenishment of the air in the tank during use, and thus makes it possible to improve the liquid dispensing performance during independent operation of the device. In other words, the device can dispense the liquid until the depletion thereof without the aid of pumps that maintain or restore the pressure conditions necessary for dispensing. As mentioned, part of the present invention relates to a method that uses the above-described device.

In a first step of the method of use, the tank 1 is pre-charged with a gas at a first pressure that is higher than atmospheric pressure. Subsequently, the tank 1 is at least partially filled through the aperture 2 with the liquid until reaching a second pressure that is higher than the first pressure with which it was pre-charged with the gas. The second pressure will depend on the amount of liquid introduced. The liquid introduced into the tank 1 is located in the lower part, in which the outlet 3 is positioned. The liquid, when present, prevents the outflow of gas from the outlet 3 of the tank 1.

During use, the expansion of gas from the second pressure to the first pressure enables the expulsion and thus dispensing of the liquid through the fluid regulator 5 in the direction K while the fluid regulator 5 is in the open configuration. When the liquid is depleted, the fluid regulator 5 will switch from the open configuration to the closed configuration because of the fact that the level of

the liquid no longer allows the shutter 15 to float, so that the latter obstructs the intake section 20a of the outflow conduit 20, preventing the outflow of the gas contained in the tank 1.

The present invention makes it possible to store, besides the liquid to be distributed, also a certain amount of energy that will be used subsequently for the distribution of the liquid. This is possible thanks to the pressurised gas with which the present device 100 is pre-charged. At the time of introduction of the liquid into the device 100, moreover, the pre-compressed gas is further compressed by the entry of the liquid at the expense, for example, of the mains pressure or that with which the liquid is introduced into the tank 1, and constitutes an energy reserve capable of satisfying dispensing needs also at heights greater than those at which the device is located, for example in an apartment building where the tank 1 is on the ground floor, or in a service station where the tank 1 is underground.

In order to enable a lasting functionality of the device, it is necessary that the gas with which the device 100 is pre-charged does not leak from the tank 1. This makes it possible to avoid a new pre-charging step. Preferably, pre-charging is carried out only once, or whenever the tank 1 must be completely emptied and opened for maintenance reasons.

Maintaining the pre-charging gas inside the tank 1 is made possible by the fluid regulator 5, which has the function of preventing the outflow of gas when the liquid is depleted. Thanks to the fluid regulator 5, the pre-compressed gas remains inside the tank 1 and the pre-compression pressure thereof is safeguarded for the

subsequent cycle of use. Cycle of use means the introduction of liquid into the tank 1 and the dispensing of all or part of the liquid from the tank 1 through the fluid regulator 5.

The present invention can be used, for example, to dispense a liquid towards a distribution network or towards another tank 1. Examples of a possible distribution network can be the plumbing system of a home, a fuel pump in a service station, an industrial facility for the treatment of liquids, a domestic distribution system, or even an internal circuit of machinery that requires the dispensing and distribution of a liquid in one or more parts of the machinery itself. The present invention enables the preset object to be achieved, making it possible, among other advantages, to store and dispense liquids in the absence of electricity for many liquid filling and emptying cycles, while not requiring maintenance for long periods of time.

Amended CLAIMS

1. A device for storing and dispensing a liquid (100), the device comprising:

a tank (1) for containing a liquid having an inlet (2; 8) and an outlet (3), configured to be pre-charged with a gas, preferably air, at a first pressure that is higher than atmospheric pressure and at least partially filled with the liquid until reaching a second pressure that is higher than said first pressure; and

a fluid regulator (5) connected to the outlet (3) of the tank (1) in order to regulate the passage of the liquid, the fluid regulator (5) comprising an outflow conduit (20) having an intake section (20a) and an outlet section (20b), and a floating shutter (15); the fluid regulator (5) being switchable between a closed configuration, wherein the shutter (15) occludes the intake section (20a) of the outflow conduit (20) when the level of liquid is in the intake section (20a) of the outflow conduit (20) so as to prevent the passage of gas in the outflow direction of the liquid (K), and an open configuration, wherein the shutter (15) is separated from the intake section (20a) of the outflow conduit (20) so as to allow the transit of the liquid; the open configuration being determined by the hydrostatic thrust of the liquid on the shutter (15); characterized by further comprising:

an air enricher (11) connected to the fluid regulator (5) so as to enable the intake of air into the tank (1), and

a recharging circuit connected to an outlet of the air enricher (11), the recharging circuit comprising a chamber (12), being dimensioned in proportion to the tank (1), ~~chamber~~ (12) and a conduit (14) connected to a portion of the tank (1) above the level of the liquid in the tank (1),

wherein the tank (1), the an air enricher (11), the chamber (12) and the conduit (14) are in fluid communication.

2. The device for storing and dispensing a liquid (100) according to any one of the preceding claims, wherein the shutter (15) is configured to float freely on the liquid inside the fluid regulator (5) when the fluid regulator (5) is in the open configuration.

3. The device for storing and dispensing a liquid (100) according to claim 1, wherein the fluid regulator (5) further comprises a retaining means (16) for retaining the shutter (15) at a maximum predetermined distance from the intake section (20a) of the outflow conduit (20).

4. The device for storing and dispensing a liquid (100) according to any one of the preceding claims, wherein the fluid regulator (5) comprises at least one lateral wall (14) connected to the intake section (20a) and having an inner surface with a decreasing cross section, preferably conical, towards the intake section (20a) of the outflow conduit (20) so as to guide the shutter (15) towards the intake section (20a) of the outflow conduit (20) when the fluid regulator (5) is switched from the open configuration to the closed configuration.

5. The device for storing and dispensing a liquid (100) according to any one of the preceding claims, wherein the shutter (15) has at least one circular section, the shutter (15) preferably having a spherical shape.

6. The device for storing and dispensing a liquid (100) according to any of the preceding claims, wherein the air enricher (11) comprises:

a sleeve (40) connected to the fluid regulator (5), the sleeve (40) having an aperture (50) to the outside which preferably has a one-way valve on the outside;

a tube (32) inside the sleeve (40) connected to the outflow conduit (20) of the fluid regulator (5), the tube (32) having an inlet section (32a) and an outlet section (32b) with a smaller area than the inlet section (32a);

a space (70) being defined between the sleeve (40) and the tube (32) and being in fluid communication with the outflow conduit (20).

7. The device for storing and dispensing a liquid (100) according to any one of the preceding claims, wherein the tank (1) further has an inlet (8) for the pre-charging gas.

HE-Ref. 200 907

Fig. 1

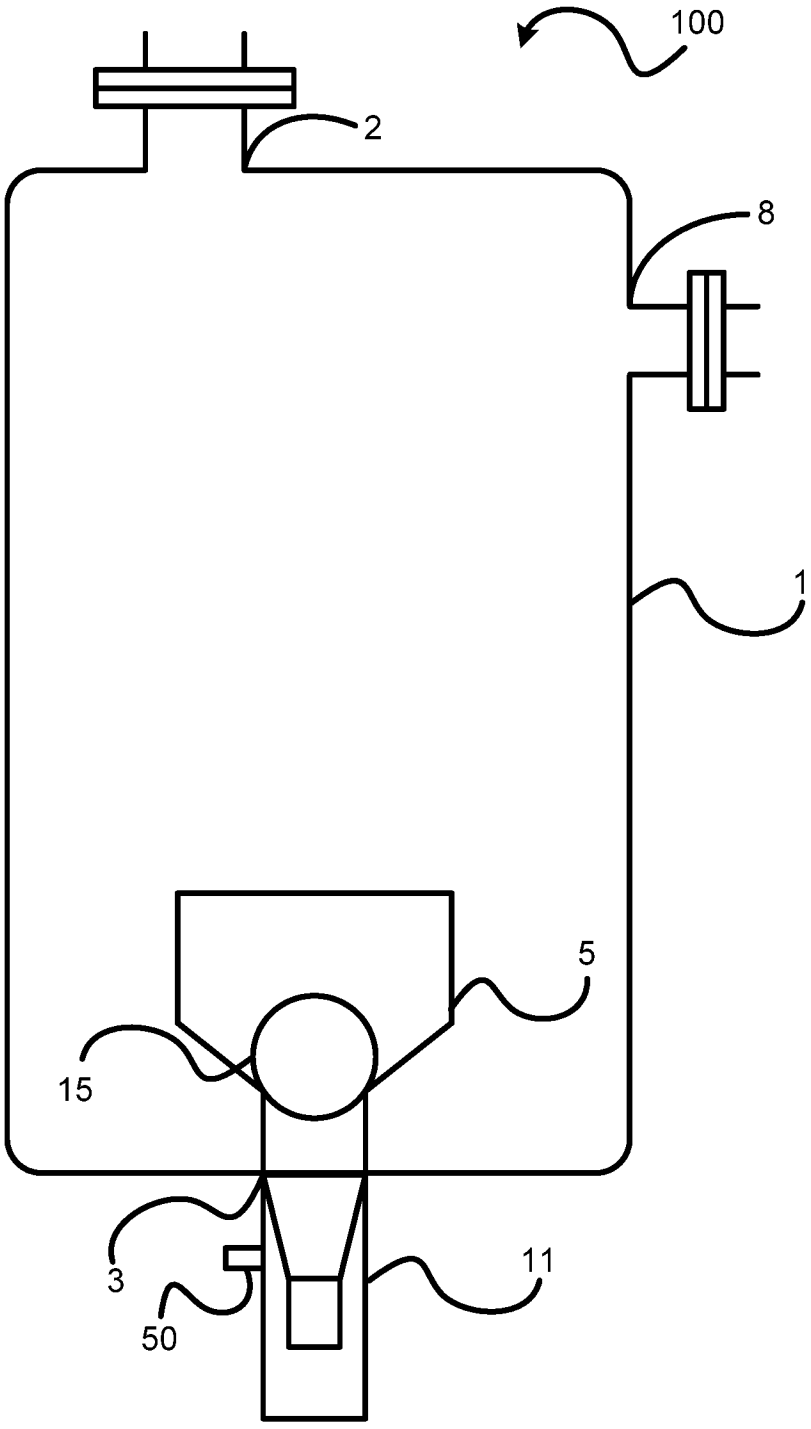

Fig. 2a

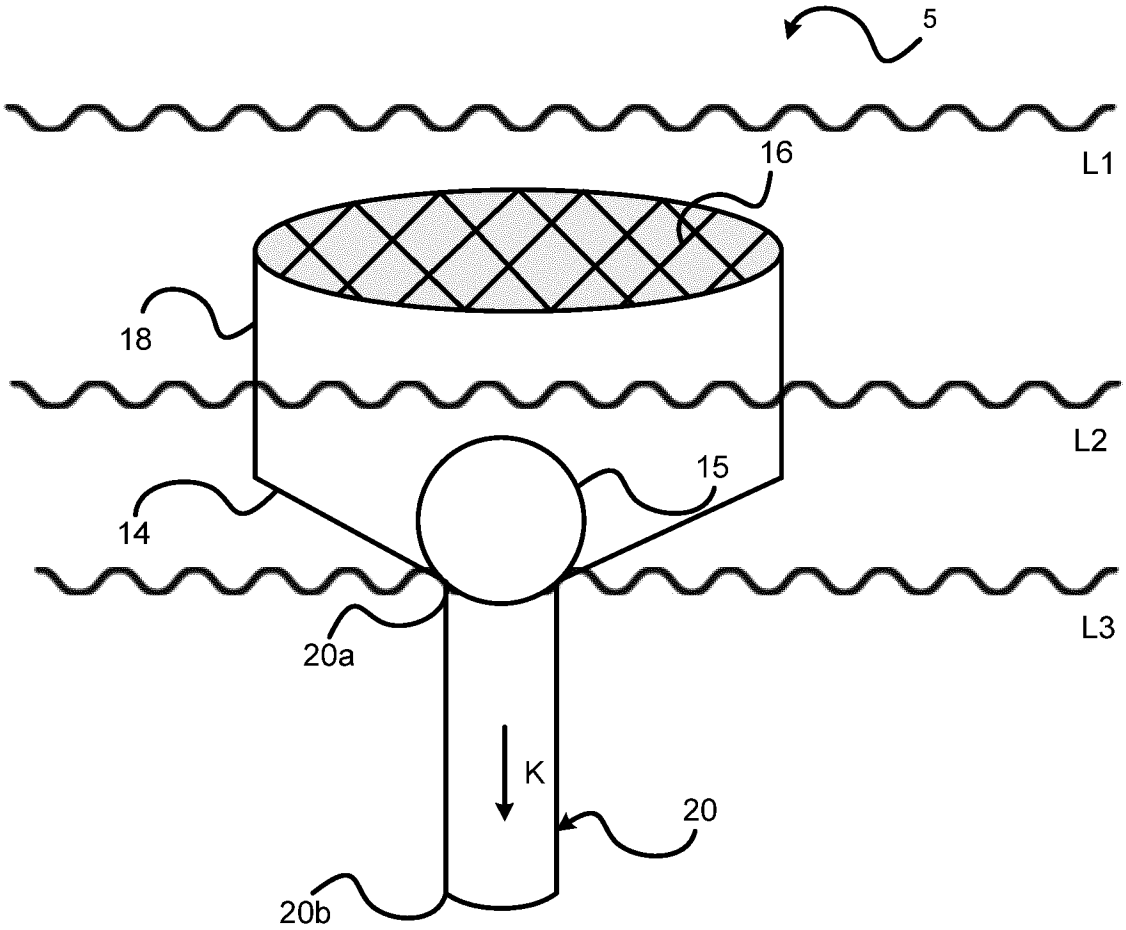

Fig. 2b

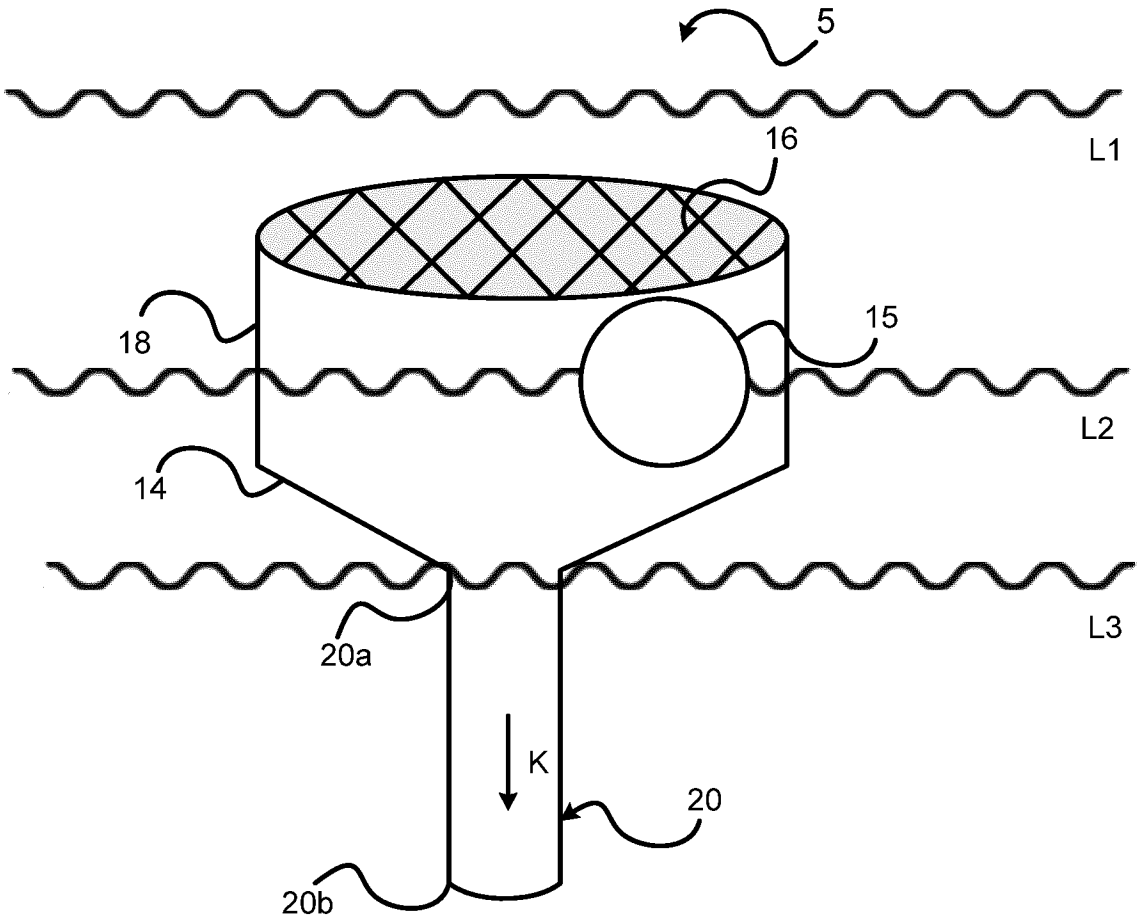

Fig. 3

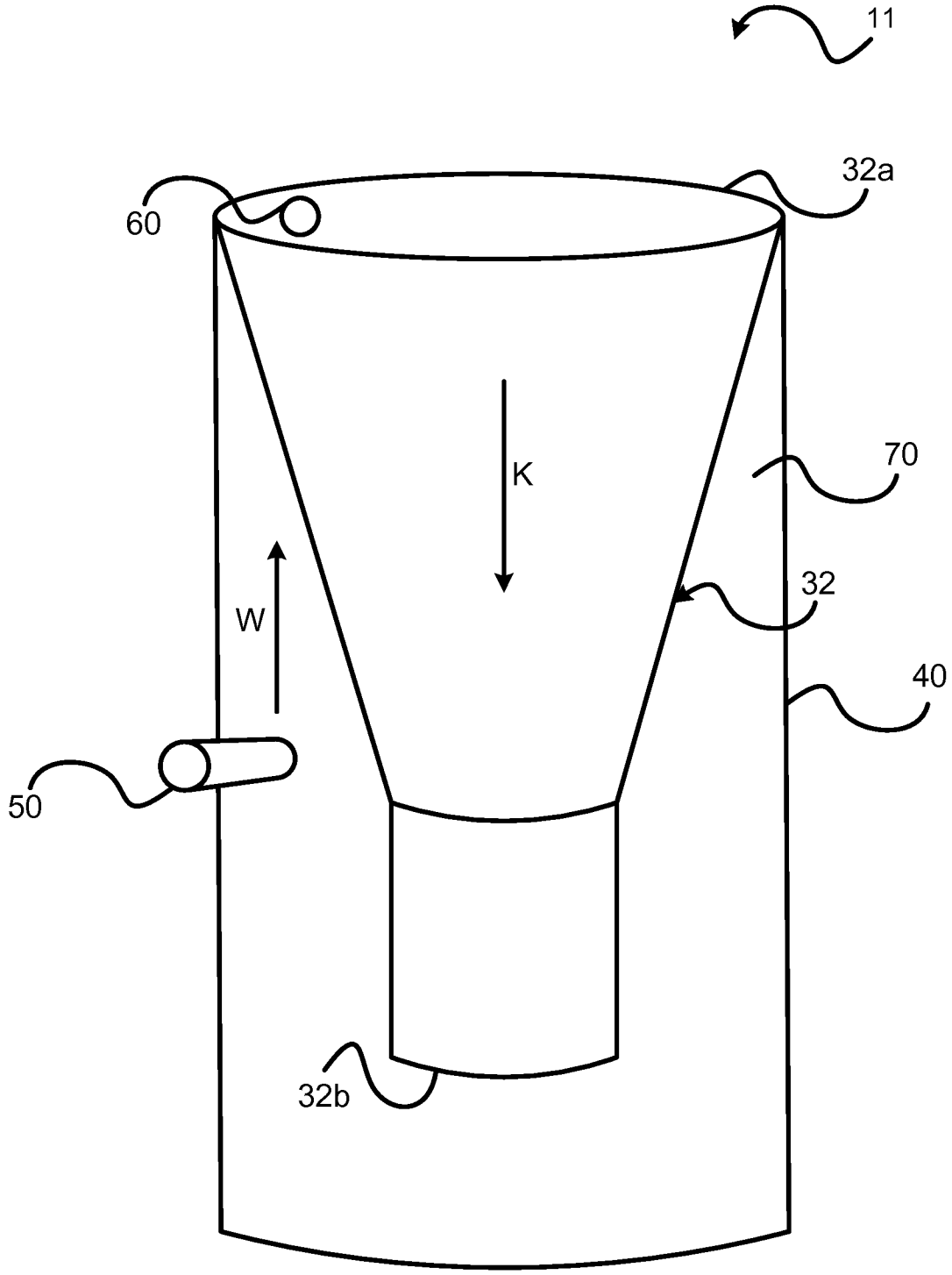

Fig. 4