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(54) Title: NOISE REDUCING DEVICE FOR APPARATUS TO BE FILLED WITH WATER

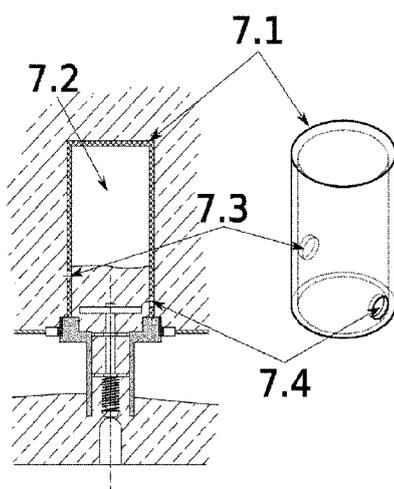


Fig. 3

(57) Abstract: A noise reducing device for an apparatus to be filled with water, the apparatus comprising a valve (4) connecting a water tank (1) with a tray (3) arranged under the water tank (1), is placed above the valve (4). The device comprises a shell (7.1; 8.1; 9.1; 10.1; 11.1) with a top cover and an open lower end, the shell (7.1; 8.1; 9.1; 10.1; 11.1) defining an air chamber (7.2; 8.2; 9.2; 10.2, 11.2) to enclose air coming from the tray (3), and a port (7.3; 8.3; 9.3; 10.3, 11.3) arranged under the air chamber for passing water towards the valve to the tray (3) and passing air from the air chamber and/or the tray (3).



## NOISE REDUCING DEVICE FOR APPARATUS TO BE FILLED WITH WATER

### TECHNICAL FIELD

- 5 The present disclosure relates to a noise reducing device for an apparatus to be filled with water comprising a valve connecting a water tank with a tray arranged under the water tank such as an air humidifier.

### BACKGROUND

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Most of the household portable humidifiers, although being efficient in terms of increasing the air humidity in living quarters, produce noise in the range from 30 to 45 dB.

A conventional design of a household air humidifier is schematically shown in Fig. 1. The device consists of a top water tank **1** with water **2** inside, which can flow from the water tank **1** to a tray **3** through a valve **4**. The household air humidifier is just an example of an apparatus to be filled with water that comprises the valve **4** connecting the water tank **1** with the tray **3** arranged under the water tank **1**. Apparatuses of this type comprise indoor hydroponics growing devices, coffee makers and etc.

20

In household air humidifiers there are several sources of noise, depending on a type of the humidifier: the noise of a ventilator providing air flow (in almost all humidifier models); the noise of an ultrasonic generator (in ultrasonic humidifiers); the noise of moving parts of the drive (in conventional evaporation humidifiers) and the sound of water heating (in steam humidifiers). All these noises are relatively quiet and uniform in comparison with the main periodical noise related to sudden reducing of the water level in the water tank **1** caused by its pouring into the tray **3**. It is a noise which does not attract people's attention when they are in the room, involved in their activities, but during rest, especially at night, it becomes arduous and irritating. It may also cause bad effectiveness of sleep, in which case it causes feeling of tiredness, irritation and distraction. Such noise is occurred in all apparatuses to be filled with water comprising a valve connecting a water tank with a tray arranged under the water tank.

Solutions aimed at suppressing noise caused by the operation of a humidifier are known from the prior art. For example, CN 204202075U discloses an air humidifier consisting of a water tank and a base. In a bottom cover of the water tank a port with a valve for refilling  
5 it with water is placed. A cavity is formed in the base, in which the water flowing from the water tank is stored. The humidifier also has an air replenishing device in the form of a through-pipe connecting the water storage cavity with the interior of the water tank and an air outlet. An air inlet is arranged in the middle of the cavity in the base and the air outlet is in the top center part inside the water tank. By connecting the base with the water tank, air  
10 is replenished in the water tank without passing through the water in the tank, which eliminates the problem of air entering the water tank through the valve and formation of loud bubbles. However, a noise reducing device in this technical solution has a complex configuration consisting of a number of components. Moreover, when the water tank is full of water the air outlet may be buried and the air issuing from the air outlet will pass  
15 through the water over the distance left between the air outlet and the top of the water tank producing some noise. In addition, when the full water tank is upturned to be placed on the base water may leak through the pipe of the air replenishing device.

CN 205897485U discloses an air humidifier with a silencer. The humidifier has a conventional design and consists of a tray and a water tank with a valve at the bottom that  
20 allows water to flow between the tank and the tray. In order to prevent air bubbles in the water tank, a silencer in the form of a tube having a porous structure (for example, in the form of laminated grids, a honeycomb structure, etc.) inside is placed over the valve. Passing air bubbles disintegrate inside the silencer, which reduces the noise related to the use of the device.

25  
Probably due to complexity of a theory, the prior art solutions overly simplify the process of creating bubbles and associate the bubbles with the resulting sound. Experience has shown, however, that the sound is produced by the rapid pressure change process that differs from the bubble growth process. Therefore, the assumption of the authors of the  
30 solution CN205897485U that the sound is directly related to the bubble size is questionable. Moreover, the presence of the porous structure in the silencer complicates manufacturing process and increases the cost of the device.

The objective of the present disclosure is to propose a simple and cost-effective noise reducing device providing significant noise reduction in an apparatus to be filled with water such as an air humidifier.

- 5 Another objective of the present disclosure is to provide a noise reducing device having increased efficiency and being compatible with the conventional apparatuses to be filled with water, in particular with air humidifiers.

### SUMMARY

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In accordance with the present disclosure, there is provided a noise reducing device for an apparatus to be filled with water, the apparatus comprising a valve connecting a water tank with a tray arranged under the water tank, the valve being adapted for passing water from the water tank towards the tray and passing air coming from the tray, when a water level in  
15 the tray is below a bottom of the valve,

the noise reducing device is adapted to be placed above the valve and is characterized in that it comprises:

- a shell with a top cover and an open lower end, the shell defining an air chamber adapted to enclose, during operation of the apparatus, air coming from the tray, and  
20 - a port arranged under the air chamber and adapted for passing water towards the valve to the tray and passing air from the air chamber and/or the tray.

Due to the complexity of the water-air flow process between the water tank and the tray during the operation of the apparatus, it is difficult to say exactly at which level of water in  
25 the tray air will go to the water tank as well as its amount and number of bubbles generated at one cycle.

In conventional air humidifiers when the water tank filled with water is placed on the tray the water starts to pass through a limited opening of the valve, expelling air from the tray.  
30 At a moment when a bubble of air comes into the water tank it rapidly changes the pressure inside the water tank, especially near the valve opening. Experience has shown that it is said change of the pressure that creates a sound.

It is reasonable to assume that the water tank, not the tray is the main sound emitter, because the pressure changes there, not in the tray, which is always under atmospheric pressure. Plastic walls of the water tank and water inside can also “amplify” the sound.

5

Many experiments have been carried out by the author of the present disclosure. The experiments have shown that bubbles sizes and a volume of sound produced in a humidifier are not directly connected to each other. But it was noticed there is a nonlinear dependence of sound volume on a level of water in the tank. When the tank is almost empty (the water level is less than 1 cm), the sound volume decreases rapidly and its timbre changes. These observations served as a basis for creating an inventive concept of the present disclosure.

The experiments carried out during the work on the present disclosure shown that the noise reducing device as described above significantly reduces the sound volume without reducing the size of the bubbles. This can be explained by a transfer of the rapid pressure changes from the water in the water tank to an air buffer created in the air chamber, which significantly reduces the generated sound.

Thus, the inventive concept consists in creating an air chamber above the valve. Once the water tank filled with water is placed on the tray, the water starts spilling into the tray through the valve and the air chamber is filled with air from air bubbles coming from the tray through the valve. The air chamber stays full of air for a long time, during the whole time of operation of the humidifier. Thereby, the bubbles do not go freely upwards from the valve after entering the water tank; instead, the bubbles from the valve pass a short distance and enter the air chamber. Then, when the air chamber is overfilled with air, a new bubble is generated at the port of the noise reducing device and goes to a top of the water tank. At that, the air chamber operates as a pressure damper. It significantly changes the air-water flow process between the tray and the water tank and reduces the sound volume.

25  
30

One of the advantages of the noise reducing device according to the disclosure is remarkable simplicity, and thus a low production cost. Moreover, the noise reducing device

can be installed as an additional element into a conventional air humidifier or another apparatus to be filled with water such as an indoor hydroponics growing device. The noise reducing device according to the disclosure effectively suppresses the sounds of air bubbles released from the valve so that almost complete silence is achieved during  
5 operation of the air humidifier with the noise reducing device. Contrary to the solutions of the prior art, the noise reducing device according to the present disclosure is configured to reduce the sound, but not to reduce sizes of air bubbles, which significantly increases its efficiency.

10 In an embodiment of the disclosure, the shell is adapted to be attached to a housing of the valve, and the port is made in the form of a hole in a lower part of the shell so as the air chamber is formed above the hole during operation of the apparatus.

The noise reducing device may comprise one or more additional holes in the lower part of  
15 the shell.

In this embodiment of the disclosure, the shell may further comprise an insert arranged inside the lower part of the shell, preceding the valve, wherein the insert is configured for filtering and/or softening water passing towards the valve.

20

In another embodiment of the disclosure the noise reducing device comprises one or more pillars attached to the shell, the pillars being adapted to be attached to a housing of the valve so as the lower end of the shell is spaced from a top of the valve housing, forming the port between the lower end of the shell and the top of the valve housing, and the air  
25 chamber is formed above the lower end of the shell.

The noise reducing device may comprise two or more pillars, wherein the port is formed between the adjacent pillars.

30 In still another embodiment of the disclosure the noise reducing device comprises one or more pillars attached to the shell, the pillars being adapted to be attached to a bottom of the water tank so as the lower end of the shell is spaced from the bottom of the tank forming

the port between the lower end of the shell and the bottom of the tank, and the air chamber is formed above the lower end of the shell.

The noise reducing device may comprise two or more pillars, wherein the port is formed  
5 between the adjacent pillars.

In yet another embodiment of the disclosure the shell is adapted to be attached to a top of the water tank above the valve so as the lower end of the shell is spaced from a bottom of the water tank, forming the port between the lower end of the shell and the bottom of the  
10 water tank, and the air chamber is formed above the lower end of the shell.

Advantageously, the apparatus to be filled with water is an air humidifier.

Further benefits and advantages of the present disclosure will become apparent after  
15 reading of the below detailed description with appropriate reference to the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

- 20 - Fig. 1 is a schematic view of a conventional air humidifier;
- Fig. 2 is a schematic view of a valve and a valve housing as generally used in air humidifiers;
- Fig. 3 is a schematic view of a noise reducing device in accordance with the first embodiment of the present disclosure;
- 25 - Fig. 4 is a schematic view of a noise reducing device in accordance with the second embodiment of the present disclosure;
- Fig. 5 is a schematic view of a noise reducing device in accordance with the third embodiment of the present disclosure;
- Fig. 6 is a schematic view of a noise reducing device in accordance with the fourth  
30 embodiment of the present disclosure;
- Fig. 7 is a schematic view of a noise reducing device in accordance with another embodiment of the present disclosure with a shell of irregular shape.

## DETAILED DESCRIPTION OF EMBODIMENTS

Although the embodiments are described below in relation to a noise reducing device for  
5 an air humidifier, it shall be understood that they can equally be used in any apparatus to  
be filled with water of appropriate design.

Fig. 1 shows a conventional household air humidifier. The apparatus consists of a water  
tank **1** with water **2** inside. The water can flow from the water tank **1** to a tray **3** through a  
10 valve **4** illustrated in detail in Fig. 2. The valve **4** has a housing **4.1** and a shaft **4.3**. The  
valve **4** is inserted and fixed in a mounting opening in the water tank **1** by means of a tread  
**4.2** which is provided with a sealing (not shown) to protect the valve **4** from leakage. At  
that, the valve **4** is always open during operation of the apparatus. Therefore, the flow of  
water **2** from the water tank **1** is controlled not by the valve **4**, but by atmospheric pressure.

15

Briefly, a typical process of the tray refilling in the apparatus consists of several stages:

- A. when the water level in the tray **3** is higher than a bottom of the valve **4**, the  
atmospheric pressure stops water flow from the water tank **1**;
- 20 B. as a result of an evaporation **6** from the tray **3** the water level in the tray **3** goes  
down;
- C. when the water level in the tray **3** becomes below the bottom of the valve **4**, some  
air **5** goes inside the water tank **1**; simultaneously some water **2** flows from the  
water tank **1** to the tray **3** and refills it;
- 25 D. the water level in the tray goes up and the flow stops until the next cycle.

The phenomenon of water overflow from the water tank **1** to the tray **3** is more complex  
than it seems at first sight. The most adequate theory to describe processes taking place at  
the stage C. it is a process called Rayleigh-Taylor instability (RT). This phenomenon  
30 includes perturbation theory, fundamental nonlinear effects, and turbulence. The process of  
the water flow consists of several stages. For the first one, there is an approximate

analytical theory, but at a later stage of the process, where the sound appears and the bubbles grow significantly, the process can only be described by numerical simulations.

5 Fig. 3 illustrates a noise reducing device according to the first embodiment of the present disclosure.

The noise reducing device comprises a shell 7.1 with a top cover and an open lower end. The shell defines an air chamber 7.2 adapted to enclose, during operation of the apparatus, air coming from the tray. The noise reducing device also includes a port 7.3 arranged under  
10 the air chamber 7.2 and adapted for passing water towards the valve and passing air from the air chamber 7.2 and/or the tray.

The shell 7.1 may have different size and shape and may be, for example, implemented in the form of a tube as in the embodiments shown in Fig. 3-6.

15

In accordance with this first embodiment the shell 7.1 is attached directly to the valve housing and the port 7.3 is made in the form of a hole in the lower part of the shell so as the air chamber 7.2 is formed above the hole during operation of the apparatus.

20 The shell 7.1 may also comprise one or more additional holes 7.4 in the lower part of the shell.

This hole 7.4 or holes are placed below the port 7.3 and intended for passing water from the water tank 1 to the tray 3. In the non-limiting example illustrated in Fig. 3 there is an  
25 only hole 7.4 but the noise reducing device according to the present disclosure may comprise a few additional holes 7.4. In such a case the holes 7.4 may have equal or different sizes and be placed on the same or different height from the lower end of the shell. The number and size of the holes is determined by a required water flow for proper operation of the air humidifier.

30

As it has been mentioned above, the port 7.3 is placed above the additional holes 7.4 in respect of the lower end of the shell 7.1. In accordance with the present disclosure the port

7.3 is mainly intended for passing air coming from the air chamber 7.2 and air issuing from the tray 3 during operation of the apparatus. However, when the water tank 1 is full so as the water level is above the port 7.3 water from the water tank 1 can also pass through the port 7.3 to the tray 3.

5

In the non-limiting example illustrated in Fig. 3 there is an only port 7.3 but the noise reducing device according to the present disclosure may comprise two or more ports 7.3 arranged above one or more the additional holes 7.4.

10 The noise reducing device according to the present disclosure may comprise an insert (not shown) arranged inside the lower part of the shell 7.1, preceding the valve, for filtering and/or softening water passing towards the valve.

The insert may be implemented with use of any known means appropriate for filtering and/or softening water. The insert enables deleting water impurities which may enter the air and, therefore, be inhaled by people or deposit on interior objects.

15 The noise reducing device according to the present disclosure is compatible with conventional air humidifiers or other apparatuses of appropriate design to be filled with water. Before use of the air humidifier the noise reducing device is placed on the valve  
20 housing and attached to it via any appropriate means which are known per se from the art, for example, by gluing or welding.

During operation of the air humidifier air bubbles coming from the tray 3 enter the air chamber 7.2 and stay in it for a long time, during the whole time of operation of the  
25 humidifier, forming a pressure damper. With an increase of the pressure in the air chamber 7.1 bubbles come from it to the water tank 1 through the port 7.3 without producing the sound caused by the rapid pressure change near a valve. Due to the pressure damper there is no rapid lowering of the water level in the water tank when the air bubbles enter into the valve from the tray. Instead of entering directly into the water tank each air bubble passes a  
30 short distance to the air chamber to be enclosed in it. Thereby, a rapid pressure change as well as a water level change associated with each air bubble entering the water tank essentially happen within a limited volume of the shell of the noise reducing device

comprising the pressure damping air chamber. As a result, each air bubble entering the water tank through the valve does not cause a rapid pressure and water volume change in the water tank as a whole. At that, some of air bubbles may come from the tray directly to the port 7.3 flattened by the water surface tension force.

5

Fig. 4 illustrates a noise reducing device according to the second embodiment of the present disclosure.

The noise reducing device comprises a shell 8.1 with a top cover and an open lower end.

10 The shell 8.1 defines an air chamber 8.2 adapted to enclose, during operation of the apparatus, air coming from the tray.

In accordance with the second embodiment of the present disclosure the noise reducing device comprises one or more pillars 8.4 attached to the shell. The pillars 8.4 are adapted to  
15 be attached to the housing of the valve so as the lower end of the shell 8.1 is spaced from a top of the valve housing, forming the port 8.3 between the lower end of the shell 8.1 and the top of the valve housing. The air chamber 8.2 is formed above the lower end of the shell 8.1.

20 According to a non-shown example of the noise reducing device the pillars 8.4 can be attached to the valve housing so that the top of the valve housing is within the shell 8.1, that is, surrounded by the shell 8.1. In such a case the space between the lower end of the shell 8.1 and the top of the valve housing will be defined in a horizontal direction.

25 The pillars 8.4 can be attached to the housing of the valve by any appropriate means known from the art, for example, by gluing or welding.

Advantageously, the noise reducing device comprises two or more pillars 8.4. In such a case the ports 8.3 are formed between the adjacent pillars.

30

Operation principle of the noise reducing device according to the second embodiment is similar to that described in relation to the first embodiment.

Fig. 5 illustrates a noise reducing device according to the third embodiment of the present disclosure.

- 5 The noise reducing device comprises a shell **9.1** with a top cover and an open lower end. The shell **9.1** defines an air chamber **9.2** adapted to enclose, during operation of the apparatus, air coming from the tray.

In accordance with the third embodiment of the present disclosure the noise reducing  
10 device comprises one or more pillars **9.4** attached to the shell. The pillars **9.4** are adapted to be attached to a bottom of the water tank so as the lower end of the shell **9.1** is spaced from the bottom of the water tank forming the port **9.3** between the lower end of the shell and the bottom of the water tank, and the air chamber **9.2** is formed above the lower end of the shell.

15

Advantageously, the noise reducing device comprises two or more pillars **9.4**, and the ports **9.3** are formed between the adjacent pillars **9.4**.

The pillars **9.4** can be attached to a bottom of the water tank by any appropriate means  
20 known from the art, for example, by gluing or welding.

The height of the pillars **9.4** is determined by required water flow for proper operation of the air humidifier and usability during initial filling of the water tank.

- 25 Operation principle of the noise reducing device according to the third embodiment is similar to that described in relation to the first embodiment.

Fig. 6 illustrates a noise reducing device according to the fourth embodiment of the present disclosure.

30

The noise reducing device comprises a shell **10.1** with a top cover and an open lower end. The shell **10.1** defines an air chamber **10.2** adapted to enclose, during operation of the apparatus, air coming from the tray.

5 In accordance with the fourth embodiment of the present disclosure the shell **10.1** is adapted to be attached to a top of the water tank above the valve so as the lower end of the shell **10.1** is spaced from a bottom of the water tank, forming the port **10.3** between the lower end of the shell and the bottom of the water tank. The air chamber **10.2** is formed above the lower end of the shell **10.1**.

10

The height of the shell **10.1** and, therefore, the size of the port **10.3**, is determined by required water flow during an operational mode and usability during initial filling of the water tank.

15 According to this embodiment the shell **10.3** can be attached to the top of the water tank by any appropriate means known from the prior art. Alternatively, the shell can be molded as a part of the water tank in the process of manufacturing.

20 Operation principle of the noise reducing device according to the fourth embodiment is similar to that described in relation to the first embodiment.

In yet another embodiment, the shell, and correspondingly the air chamber, may have an irregular shape, for example, as shown in Fig. 7. Fig. 7 illustrates a noise reducing device where a shell **11.1** is attached, by its lower end, directly to a valve housing in a watertight  
25 manner, and has the irregular shape with a cylindrical channel extending vertically in the middle of an air chamber **11.2**. Thereby, a volume of the air chamber **11.2** has a cylindrical cutout in the middle thereof, wherein a lower end of the cylindrical channel of the shell **11.1** forms a port **11.3** which position defines a lower end of the air chamber **11.2**.

30 Operation principle of the noise reducing device in this embodiment is similar to that described in relation to the first embodiment, except of the arrangement of the port **11.3** at the end of the cylindrical channel extending in the middle of the air chamber **11.2**.

The noise reducing device according to the present disclosure is compatible with conventional air humidifiers or other apparatuses of appropriate design to be filled with water, such as hydroponics growing devices, coffee makers and etc. So, the noise reducing  
5 device according to the present disclosure can be installed in the apparatus in the manufacturing process or supplied separately to be placed in the apparatus by a user.

It shall be understood that the invention is not limited to the examples that have just been described and many modifications may be brought to these examples yet without departing  
10 from the scope of the invention defined by the accompanying claims.

## CLAIMS

1. A noise reducing device for an apparatus to be filled with water, the apparatus comprising a valve (4) connecting a water tank (1) with a tray (3) arranged under the water tank (1),  
5 the valve (4) being adapted for passing water from the water tank (1) towards the tray (3) and passing air coming from the tray (3), when a water level in the tray (3) is below a bottom of the valve (4),

the noise reducing device is adapted to be placed above the valve (4) and is characterized in that it comprises:

10 - a shell (7.1; 8.1; 9.1; 10.1, 11.1) with a top cover and an open lower end, the shell (7.1; 8.1; 9.1; 10.1, 11.1) defining an air chamber (7.2; 8.2; 9.2; 10.2, 11.2) adapted to enclose, during operation of the apparatus, air coming from the tray (3), and

- a port (7.3; 8.3; 9.3; 10.3, 11.3) arranged under the air chamber and adapted for passing water towards the valve to the tray (3) and passing air from the air chamber and/or the tray (3).

15

2. The noise reducing device of claim 1, wherein the shell (7.1) is adapted to be attached to a housing (4.1) of the valve (4), and the port (7.3) is made in the form of a hole in a lower part of the shell (7.1) so as the air chamber (7.2) is formed above the hole during operation of the apparatus.

20

3. The noise reducing device of claim 2, comprising one or more additional holes (7.4) in the lower part of the shell (7.1) for passing water towards the valve (4).

4. The noise reducing device of claim 2 or 3, further comprising an insert arranged inside  
25 the lower part of the shell (7.1), preceding the valve (4), wherein the insert is configured for filtering and/or softening water passing towards the valve (4).

5. The noise reducing device of claim 1, comprising one or more pillars (8.4) attached to the shell (8.1), the pillars (8.4) being adapted to be attached to a housing (4.1) of the valve (4) so  
30 as the lower end of the shell (8.1) is spaced from a top of the valve housing (4.1), forming the

port (8.3) between the lower end of the shell (8.1) and the top of the valve housing (4.1), and the air chamber (8.2) is formed above the lower end of the shell (8.1).

6. The noise reducing device of claim 5, comprising two or more pillars (8.4), wherein  
5 the port (8.3) is formed between the adjacent pillars (8.4).

7. The noise reducing device of claim 1, comprising one or more pillars (9.4) attached to  
the shell (9.1), the pillars (9.4) being adapted to be attached to a bottom of the water tank (1) so  
as the lower end of the shell (9.1) is spaced from the bottom of the water tank (1) forming the  
10 port (9.3) between the lower end of the shell (9.1) and the bottom of the water tank (1), and the  
air chamber (9.2) is formed above the lower end of the shell (9.1).

8. The noise reducing device of claim 7, comprising two or more pillars (9.4), wherein  
the port (9.3) is formed between the adjacent pillars (9.4).  
15

9. The noise reducing device of claim 1, wherein the shell (10.1) is adapted to be attached  
to a top of the water tank (1) above the valve (4) so as the lower end of the shell (10.1) is spaced  
from a bottom of the water tank (1), forming the port (10.3) between the lower end of the shell  
(10.1) and the bottom of the water tank (1), and the air chamber (10.2) is formed above the lower  
20 end of the shell (10.1).

10. The noise reducing device of anyone of claims 1 to 9, wherein the apparatus to be  
filled with water is an air humidifier.

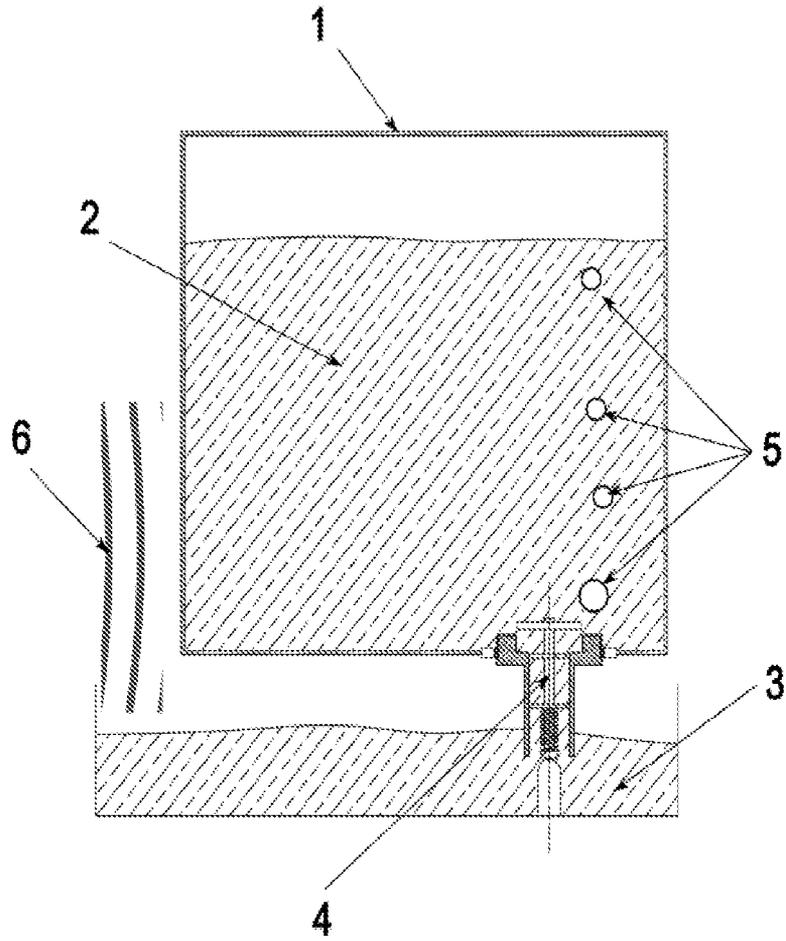


Fig. 1

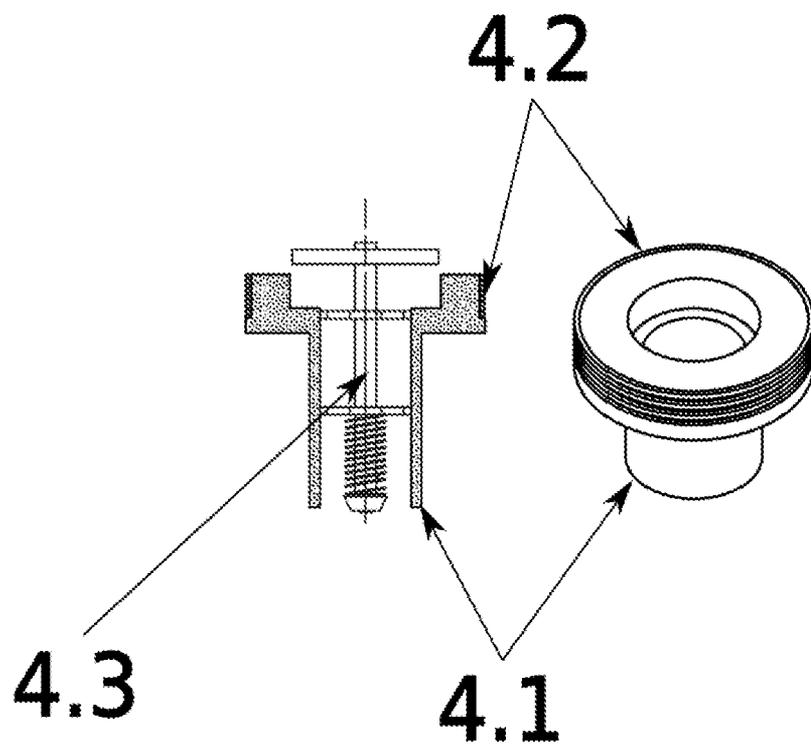


Fig. 2

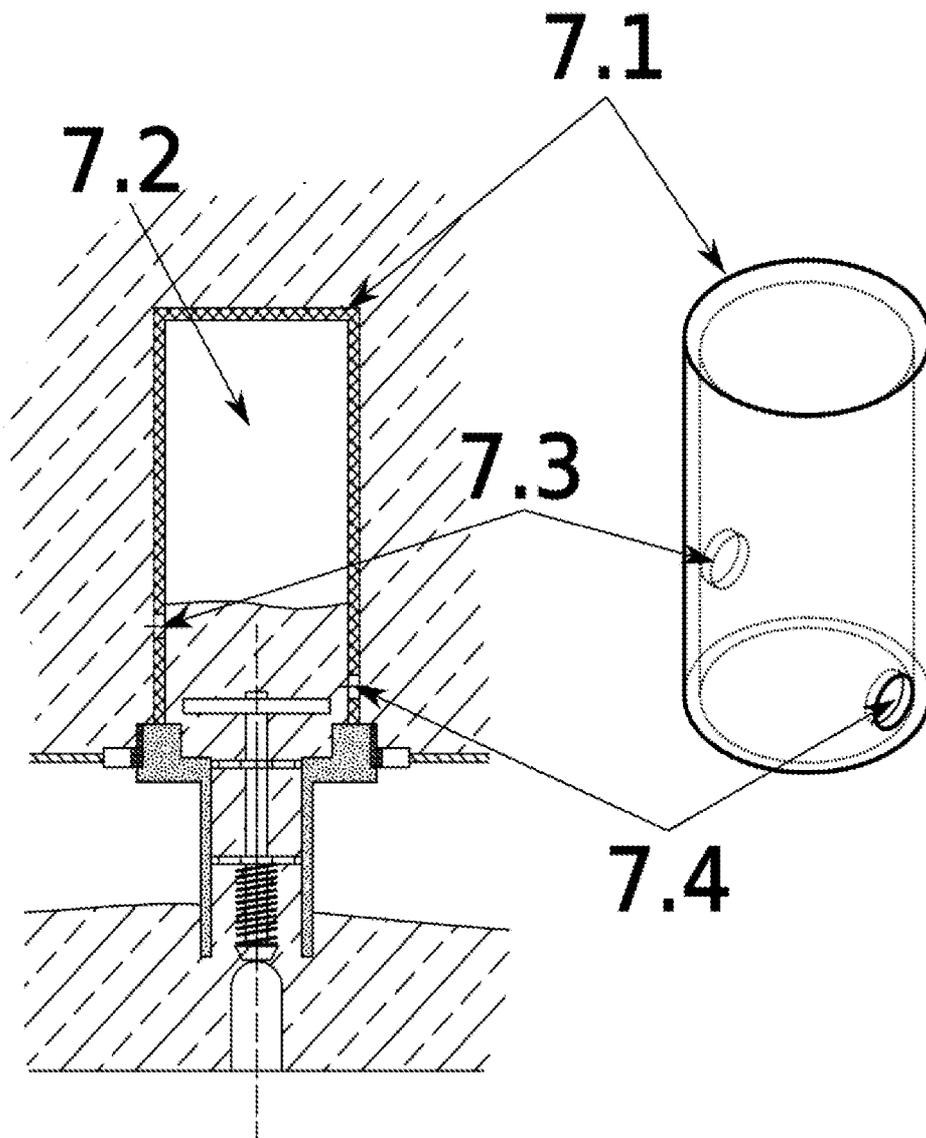


Fig. 3

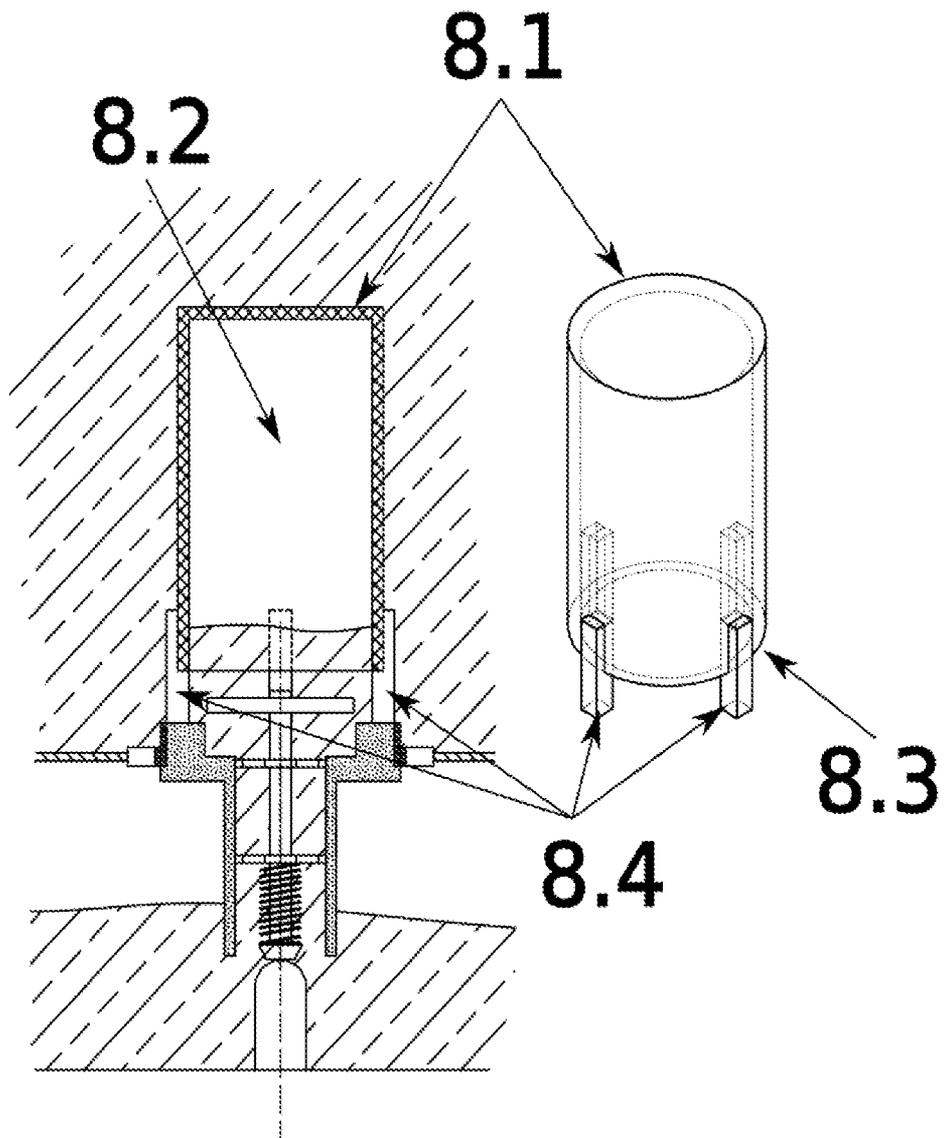


Fig. 4

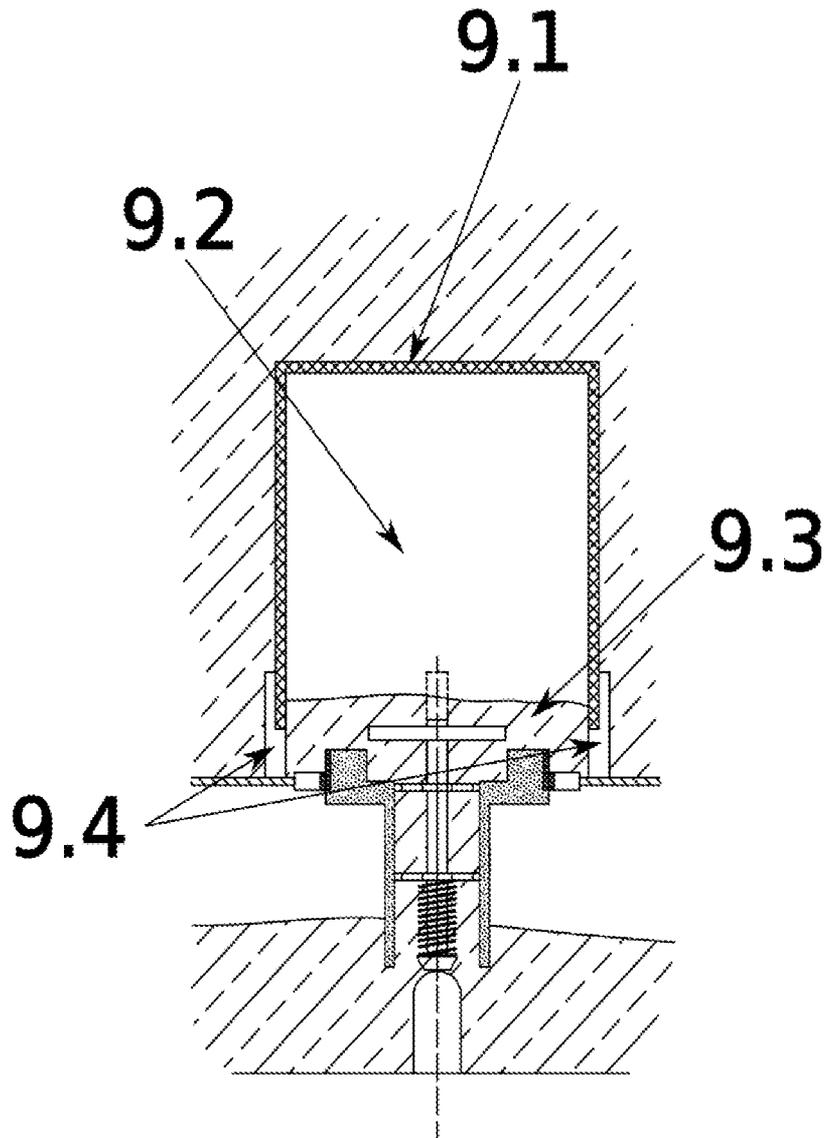


Fig. 5

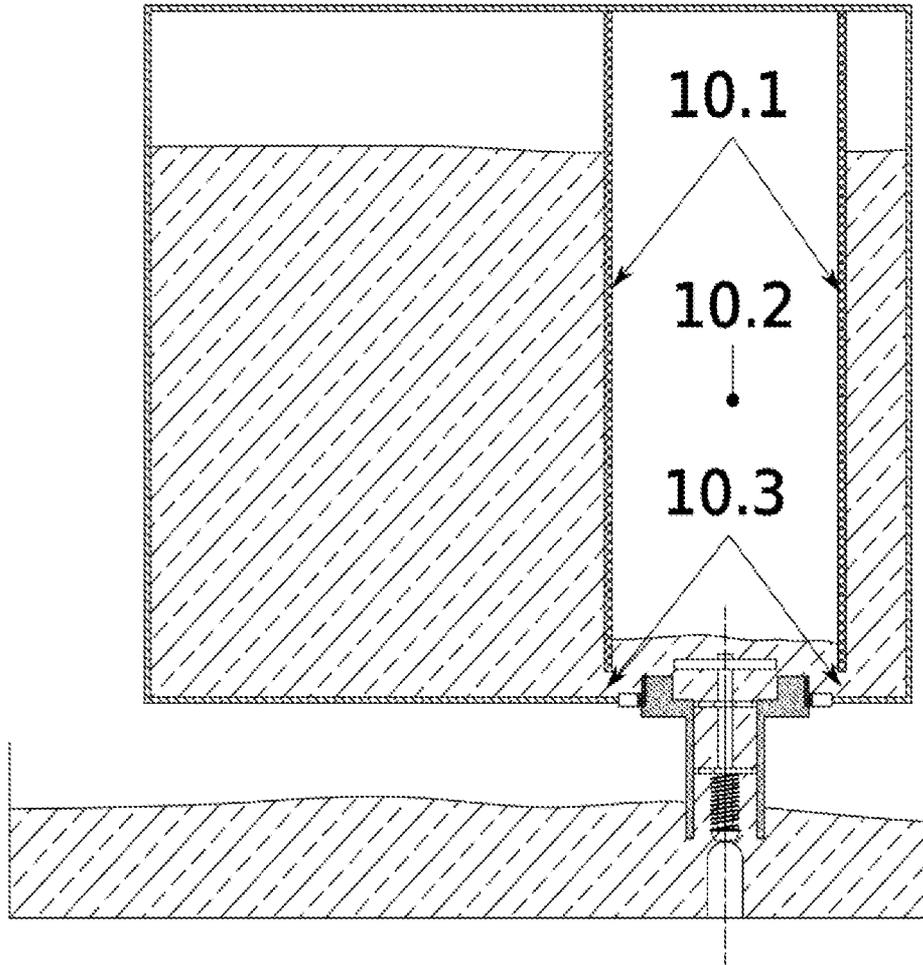


Fig. 6

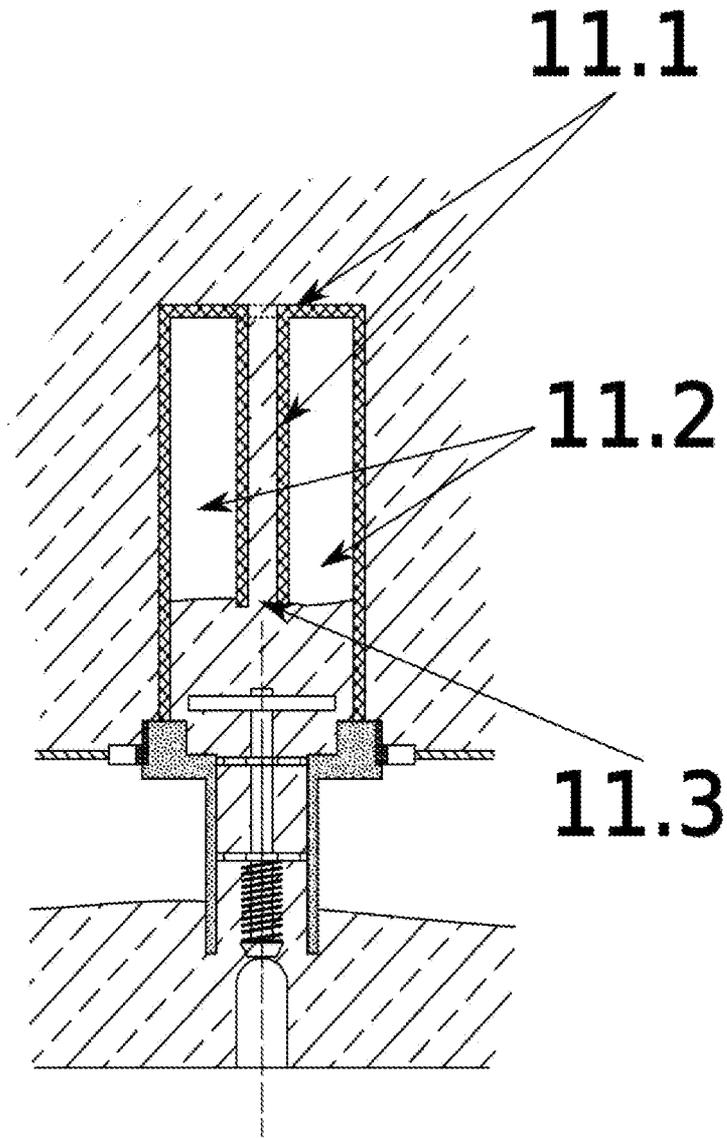


Fig. 7

**INTERNATIONAL SEARCH REPORT**

International application No  
**PCT/IB2021/055986**

**A. CLASSIFICATION OF SUBJECT MATTER**  
**INV. F24F13/24 F24F6/00**  
**ADD.**

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
**F24F**

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
**EPO-Internal, WPI Data**

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
<b>X</b>	<b>WO 2015/039259 A2 (PLASTON AG [CH])</b> <b>26 March 2015 (2015-03-26)</b> <b>page 8, line 8 - page 12, line 20; figures 1-3</b> <p align="center">-----</p>	<b>1-10</b>
<b>X</b>	<b>CN 205 897 485 U (BAN XIAOZHONG)</b> <b>18 January 2017 (2017-01-18)</b> <b>cited in the application</b> <b>paragraph [0014] - paragraph [0034];</b> <b>figures 1-5</b> <p align="center">-----</p>	<b>1-4, 9, 10</b>
<b>A</b>	<b>ES 2 442 006 T3 (LG ELECTRONICS INC [KR])</b> <b>7 February 2014 (2014-02-07)</b> <b>paragraph [0136] - paragraph [0146];</b> <b>figure 4</b> <p align="center">-----</p>	<b>4</b>
<b>A</b>	<b>EP 3 081 872 A1 (SAMSUNG ELECTRONICS CO LTD [KR])</b> <b>19 October 2016 (2016-10-19)</b> <b>the whole document</b> <p align="center">-----</p>	<b>1, 10</b>

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

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- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search  
**11 March 2022**

Date of mailing of the international search report  
**29/03/2022**

Name and mailing address of the ISA/  
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 Fax: (+31-70) 340-3016

Authorized officer  
**Ast, Gabor**

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

**PCT/IB2021/055986**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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<b>CN 205897485 U</b>	<b>18-01-2017</b>	<b>NONE</b>	
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<b>ES 2442006 T3</b>	<b>07-02-2014</b>	<b>CN 101749819 A</b> <b>EP 2364420 A1</b> <b>ES 2442006 T3</b> <b>US 2012064817 A1</b> <b>WO 2010062005 A1</b>	<b>23-06-2010</b> <b>14-09-2011</b> <b>07-02-2014</b> <b>15-03-2012</b> <b>03-06-2010</b>
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<b>EP 3081872 A1</b>	<b>19-10-2016</b>	<b>AU 2016249637 A1</b> <b>CN 107810370 A</b> <b>CN 111238020 A</b> <b>EP 3081872 A1</b> <b>KR 20160123624 A</b> <b>US 2016305674 A1</b> <b>US 2019383503 A1</b> <b>WO 2016167465 A1</b>	<b>02-11-2017</b> <b>16-03-2018</b> <b>05-06-2020</b> <b>19-10-2016</b> <b>26-10-2016</b> <b>20-10-2016</b> <b>19-12-2019</b> <b>20-10-2016</b>
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