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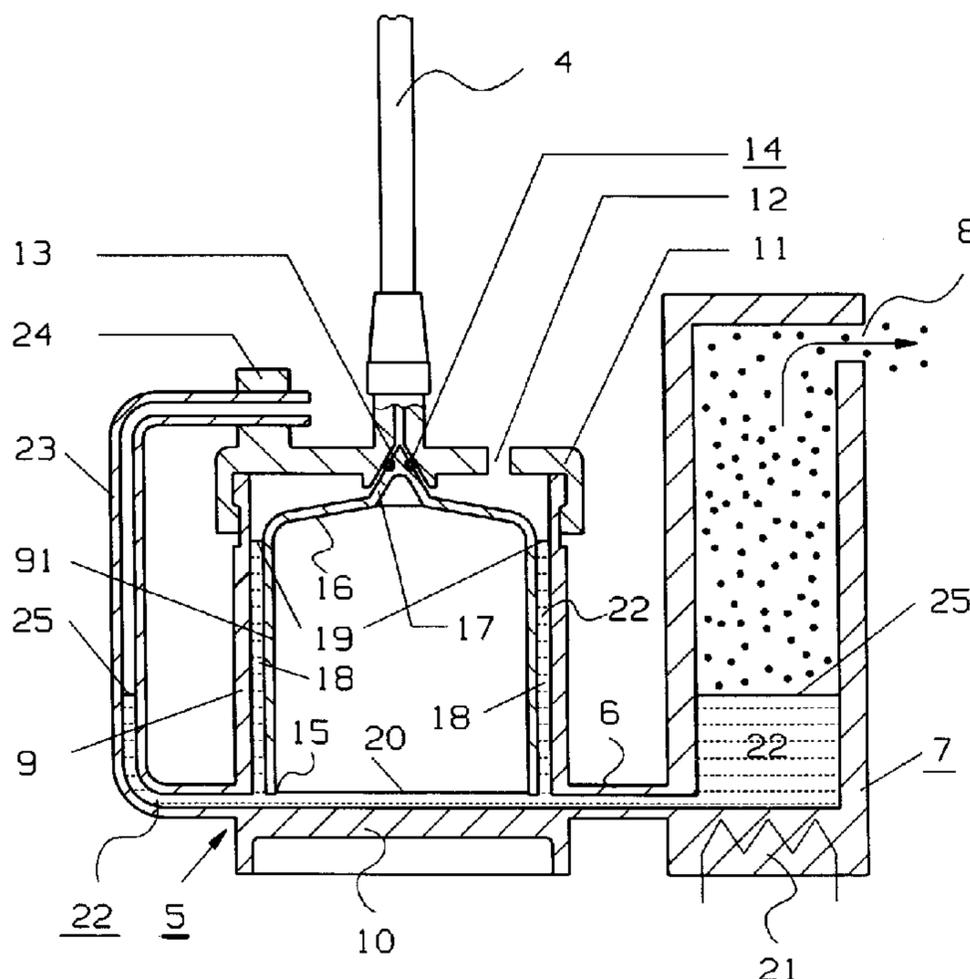
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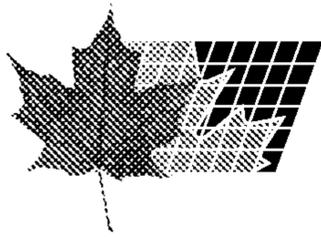
(54) **SYSTEME D'HUMIDIFICATION AVEC CONTROLE DU  
NIVEAU DE LIQUIDE A EVAPORER**

(54) **HUMIDIFYING SYSTEM WITH A LEVEL CONTROL SYSTEM  
FOR THE LIQUID THAT IS TO BE EVAPORATED**



(57) Appareil pour régler le niveau de liquide dans une chambre de vaporisation, même si la chambre de vaporisation est inclinée. L'appareil est constitué d'un sac souple que le liquide traverse via un tube pour se rendre à une soupape à flotteur et de là à une chambre de vaporisation chauffée. La soupape à flotteur est

(57) An apparatus for adjusting the level of liquid in a vaporization chamber even if the vaporization chamber is tilted. The device consists of a flexible bag through which liquid passes via a tube to a float valve and hence to a heated vaporization chamber. The float valve consists of a cylindrical float housing with a cylindrical



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constituée d'un logement cylindrique de flotteur avec un flotteur cylindrique à surface supérieure fermée et à surface inférieure ouverte. Le diamètre du flotteur est légèrement inférieur au diamètre de la chambre de flotteur, ce qui laisse un joint capillaire entre les deux. Un obturateur se trouve au sommet du flotteur pour contrôler le débit d'eau venant du tube pour passer dans le logement du tube et se rendre dans la chambre de vaporisation chauffée.

float having a closed top surface and an open bottom surface. The diameter of the float is slightly less than the diameter of the float chamber thereby forming a capillary gap therebetween. A valve member is situated at the top of the float for controlling the flow of water from the tube through the float housing into a heated vaporization chamber.

ABSTRACT

An apparatus for adjusting the level of liquid in a vaporization chamber even if the vaporization chamber is tilted. The device consists of a flexible bag through which liquid passes via a tube to a float valve and hence to a heated vaporization chamber. The float valve consists of a cylindrical float housing with a cylindrical float having a closed top surface and an open bottom surface. The diameter of the float is slightly less than the diameter of the float chamber thereby forming a capillary gap therebetween. A valve member is situated at the top of the float for controlling the flow of water from the tube through the float housing into a heated vaporization chamber.

Humidifying System with a Level Control System  
for the Liquid that is to be Evaporated

The present invention relates to an apparatus for adjusting the level of a liquid within an  
5 vaporization chamber, this having the features described in the preamble to Patent Claim 1.

Humidifying systems of this type are preferably used when a patient's respiration is being  
managed by a respirator. When this is done, the relative humidity of the inhaled air is  
conditioned to approximately 34 - 37°C and 80 - 100 per cent relative humidity. A  
10 humidifying system of this kind is described in DE-GM 93 07 380. In this known inhaled-air  
humidifier, the water that is to be vaporized passes from a supply container, through a line, and  
into heated vaporization chamber. The level of water in the vaporization chamber is  
maintained at a constant level by means of a float valve. The float valve, in this case a ball  
valve, is pressed more or less tightly against the outlet of the line leading into the supply  
15 container, depending on the level of the liquid within the vaporization chamber.

A disadvantage of this known inhaled-air humidifier is that if the vaporization chamber is  
tilted, the ball valve will permit only inadequate regulation of the level of the liquid.

20 It is the task of the present invention to so improve an apparatus of the type described  
heretofore that precise adjustment of the level of liquid within the vaporization chamber is  
ensured, even if the vaporization chamber is tilted.

This problem has been solved in that the float valve consists of a sleeve-shaped float housing within which there is a float body that can move axially, a choke valve that affects the flow of liquid being activated as a function of the movement of the float body relative to the float housing; and in that the outside diameter of the float body and the inside diameter of the float housing are such that a capillary gap that is wetted with liquid is formed.

The essential advantage of the present invention is that because of the configuration of the float valve as a hollow float body that can move axially within the float housing, with an annular capillary gap, which is filled with liquid, between the float body and the float housing, the reference level for adjusting the level of the liquid remains unchanged. Because of the capillary gap between the float housing and the float body, the emergence of air bubbles from the hollow float body is suppressed should the float valve be tilted to one side. In addition, the capillary gap that is filled with liquid results in a very low level of friction when the float body moves relative to the float housing, which means that the float body reacts with great sensitivity to changes in the level of the liquid.

Advantageous configurations of the present invention are set out in the secondary claims.

It is preferred that the capillary gap between the float body and the float housing be between 0.1 mm and 1 mm. The preferred width of the gap is 0.2 mm.

It is expedient that the choke valve consist of a valve body that is connected to the float body and a valve seat that is located in the float housing and forms the outlet of the line.

It is an advantage if the valve body and the valve seat be conical. If this is so, it is possible to meter small volumes of liquid particularly well.

5 The apparatus according to the present invention is very well suited to humidifying air within an incubator.

One embodiment of the present invention will be described below on the basis of the drawings appended hereto. These drawings show the following:

- 10 Figure 1: A diagrammatic view of a humidifying system;  
 Figure 2: A float valve and an vaporization chamber shown in longitudinal cross section when upright;  
 Figure 3: An arrangement as in Figure 2, but tilted.

15 In the humidifying system 1 shown in Figure 1, liquid passes from a flexible bag 2, through a tube clamp 3, a line 4, a float valve 5, and connecting line 6 to a heated vaporization chamber 7. The water vapour that emerges from an vaporization chamber outlet 8 is added to the inhaled gas in a medical apparatus, for example and incubator (not shown in Figure 1). In Figure 2, the float valve 5 and the vaporization chamber 7 are shown in longitudinal cross section. Identical components bear the same reference numbers as in Figure 1. The float  
 20 valve 5 consists of a cylindrical float housing 9 that is closed off at the bottom by a base plate 10 and at the top by a cover 11. Incorporated in the cover 11, there is a breather bore 12 and a valve seat 13 of a choke valve 14 that acts on the flow of liquid in the line 4. A hollow, cylindrical, pot-shaped float body 91 is accommodated within the float housing 9 with

clearance between it and the housing; the open end of this float body 91 is proximate to the base plate 10, whilst its upper end faces towards the cover 11 as dome 16. The cupola-shaped area of the dome 16 is in the form of a cone-like valve body 17 that fits into the valve seat 13 which is similarly cone-shaped. Together, the valve seat 13 and the valve body 17 form the choke valve 14. The liquid 22 in the line 4 passes through the choke valve 14 into the float housing 9. The outside diameter of the float body 91 and the inside diameter of the float housing 9 are such that they form a capillary gap 18 that is approximately 0.2 mm wide; this fills with liquid and seals the float body 91 relative to the float housing 9. In addition, the capillary gap 18 provides low-friction, axial guidance for the float body 91 within the float housing 9. The liquid levels 19, 20 occur within the float housing 9. The liquid level 20 is about level with the lower end 15 of the float body 91. Because of the capillary effect between the float body 91 and the float housing 9, the liquid level 19 lies in the upper area of the capillary gap 18. Within the area of the base plate 10, the connector line 6 branches off and opens out into the vaporization chamber 7. In its interior, the vaporization chamber 7 has a heater coil 21 to vapourize the liquid 22. In addition to the connector line 6, there is another tube 23 connected to the float housing 9, and this runs upward and is secured to an attachment point 24 on the cover 11. Since the vaporization chamber 7 is open to the atmosphere through the vaporization chamber outlet 8 and the tube 23 is open to the atmosphere at one end, the liquid will find a common level 25 by virtue of the law of connected pipes. The float body 91 is acted upon by a buoyancy force that corresponds to the specific weight of the water displaced by the float body 91.

Figure 3 shows the float valve 5 and the vaporization chamber 7 when tilted when, under normal circumstances, air would escape upward from the float body 91 through the capillary

gap 18 as can be seen from the liquid level line 22, and this would lead to a change in the level of the liquid, but because the gap 18 is configured as a capillary gap, the escape of air bubbles is suppressed. Depending on the width of the gap, the float valve 5, together with the vaporization chamber can be tilted by up to  $30^\circ$ . The preferred width of the capillary gap is

5 0.2 mm.

## Patent Claims

1. An apparatus for adjusting the level (25) of liquid in an vaporization chamber (7) of a humidifying system (1), with a float valve (5) that determines the level (25) of liquid, which acts on the flow of liquid in a line (4) that runs from a supply container (2) into the vaporization chamber (7) in such a way that the predetermined level (25) of liquid is set up in the vaporization chamber (7), characterized in that the float valve (5) consists of a sleeve-shaped valve housing (9) with a float body (91) that is accommodated therein and can move axially, a choke valve (14) that affects the flow of liquid being activated as a function of the movement of the float body (91) relative to the float housing (9); and in that the outside diameter of the float body (91) and the inside diameter of the float housing (9) are such that a capillary gap (18) that is wetted with liquid is formed.
2. An apparatus as defined in Claim 1, characterized in that the capillary gap (18) is between 0.1 mm and 1 mm wide, and is preferably approximately 0.2 mm wide.
3. An apparatus as defined in Claim 1 or Claim 2, characterized in that the choke valve (14) comprises a valve body (17) that is connected to the float body (91) and a valve seat (13) that is located on the float housing (9) and forms the outlet of the line (4).
4. An apparatus as defined in Claim 3, characterized in that the valve body (17) and the valve seat (13) are conical.

5. An apparatus as defined in one of the Claims 1 to 4, characterized in that the float body is pot-shaped and is accommodated in the float housing (9) with its open end (15) facing toward a base plate (10) of the float housing (9).
6. An apparatus as defined in Claim 5, characterized in that the valve body (17) is secured on a dome (16) of the valve body (91) that is opposite the open end (15).
7. An apparatus as defined in one of the Claims 4 to 6, characterized in that the valve seat (13) is attached to a cover (11) that closes off the float housing (9).
8. An apparatus as defined in one of the Claims 5 to 7, characterized in that in the area of the base plate (10) there is a connecting line (6) that delivers the liquid (22) from the float housing (9) to the vaporization chamber (7).
9. Use of an apparatus as defined in one of the Claims 1 to 8 for humidifying the air in an incubator.

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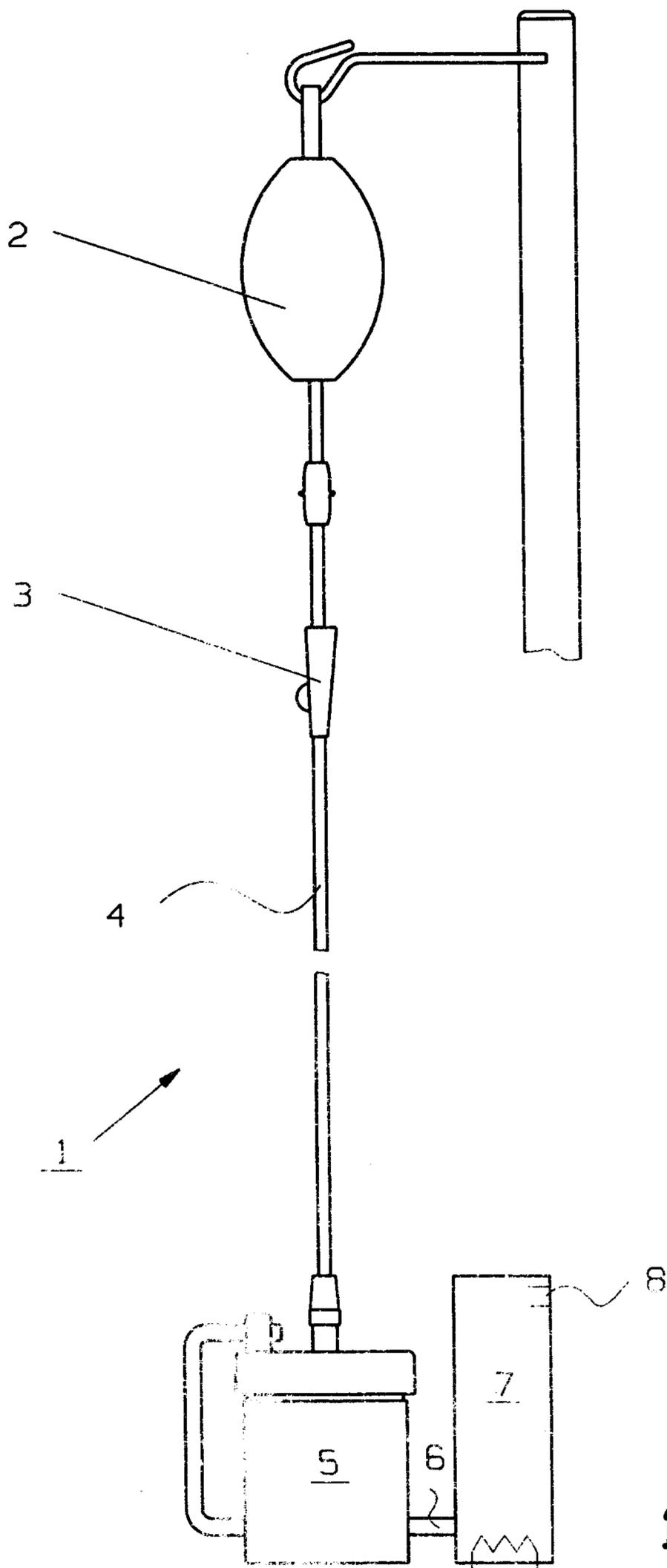


Fig. 1

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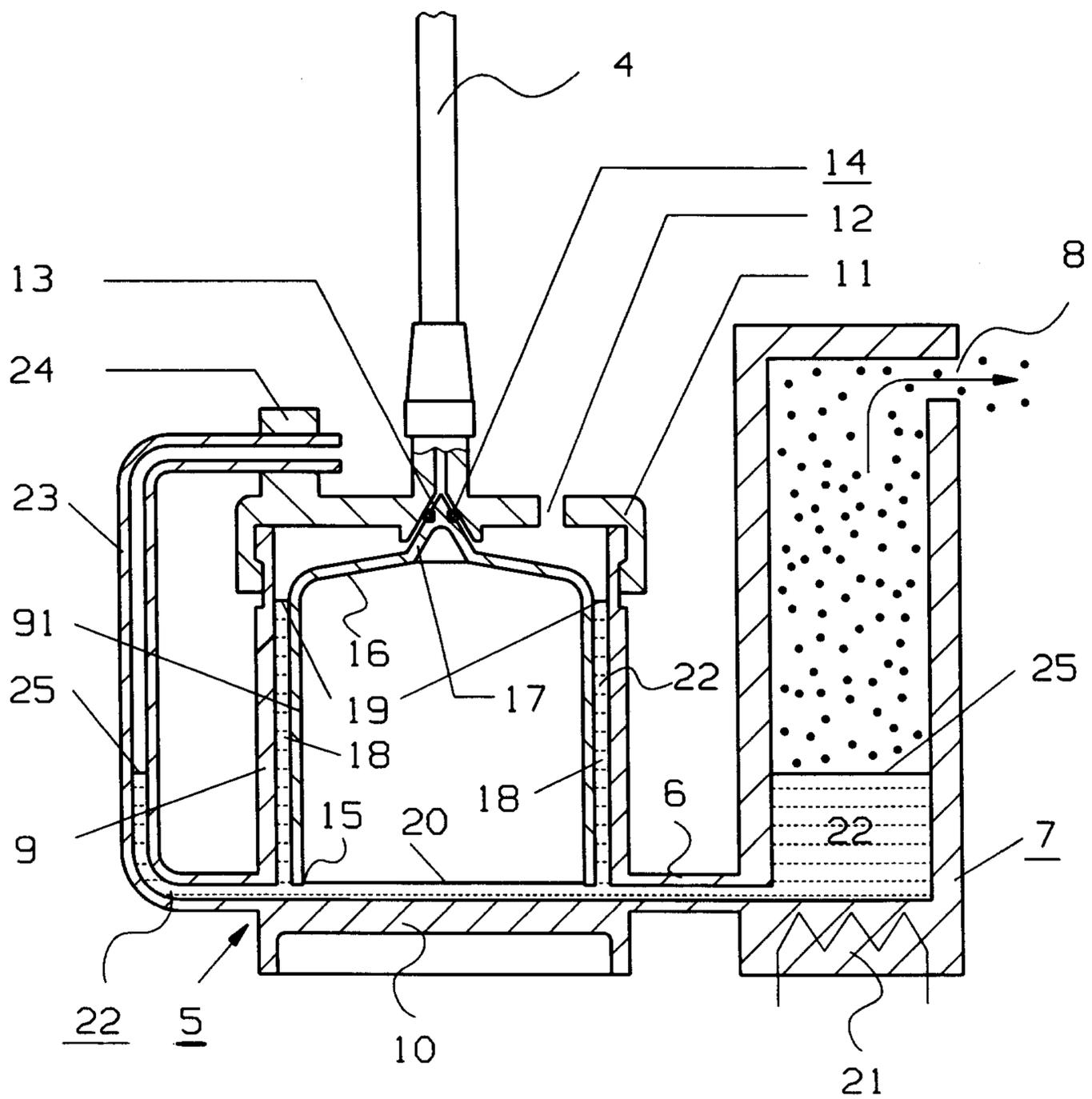


Fig. 2

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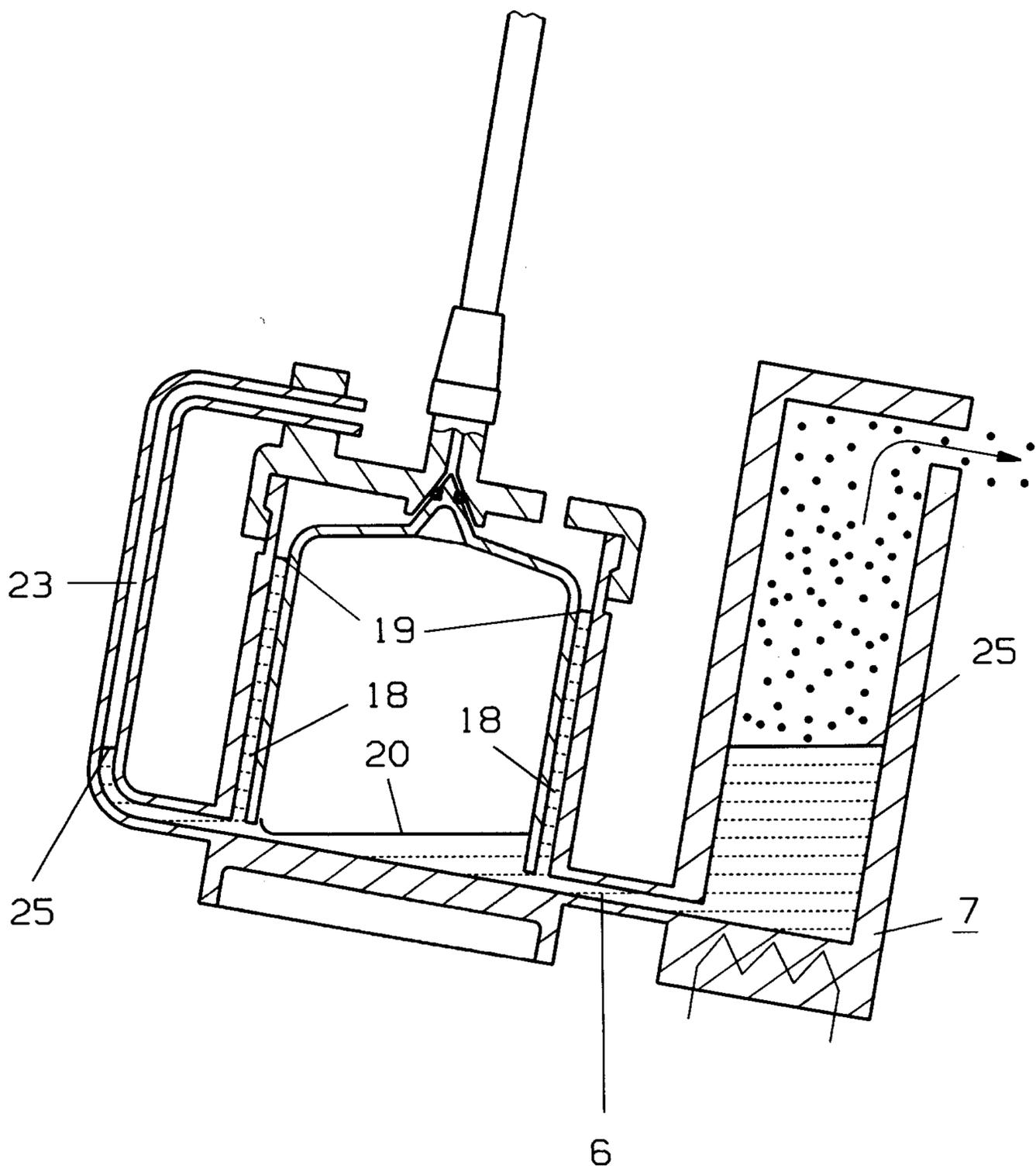


Fig. 3

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