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(54) **AEROSOL GENERATING SYSTEMS**

(57) A handheld aerosol generating system comprises a cartridge (4) removably attached to an aerosol generating device (2), the cartridge (4) supplying an aerosol generating liquid (31) to mixing chamber (14) along a fluid flow path (32). The system is primed before use by reducing the pressure in at least part of the mixing chamber (14) below ambient pressure to draw fluid along the fluid flow path (32) and expel any air that entered the fluid flow path (32) when the cartridge (4) was attached. The said part of the mixing chamber (14) may be isolated from a mouthpiece (10) during the priming operation. A liquid jet head (82) may be used to deliver aerosol generating liquid (31) into the mixing chamber (14).

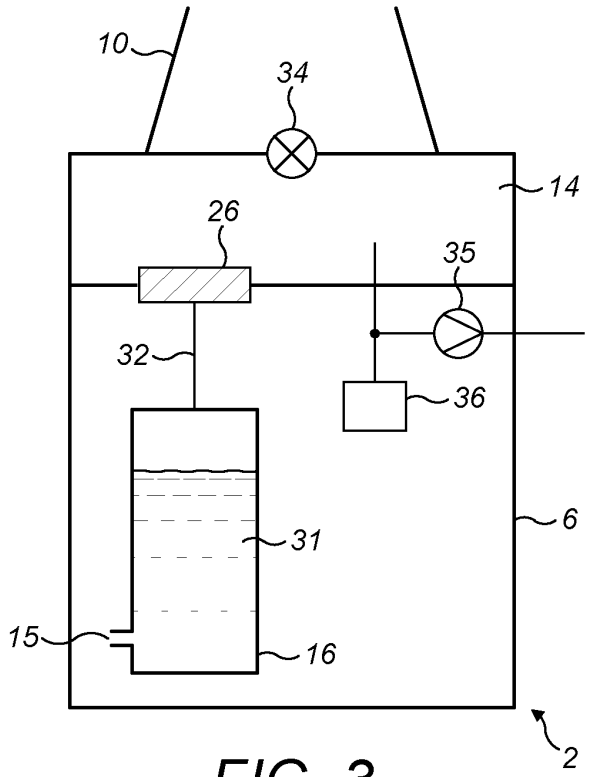

FIG. 3

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Description

Technical Field

[0001] The present disclosure relates generally to handheld aerosol generating systems, which are configured to convert a liquid into an aerosol for inhalation by a user of the system. More specifically, it relates to such aerosol generating systems, in which the aerosol is generated in a device and the aerosol generating liquid is supplied from a cartridge that is removably coupled to the device.

Technical Background

[0002] The term aerosol generating system (or more commonly electronic cigarette or e-cigarette) refers to handheld electronic apparatus that is intended to simulate the feeling or experience of smoking tobacco in a traditional cigarette. Electronic cigarettes typically work by heating an aerosol generating liquid to generate a vapour that cools and condenses to form an aerosol which is then inhaled by the user. Accordingly, using e-cigarettes is also sometimes referred to as "vaping". The aerosol generating liquid usually comprises nicotine, propylene glycol, glycerine and flavourings.

[0003] In general terms, a vapour is a substance in the gas phase at a temperature lower than its critical temperature, which means that the vapour can be condensed to a liquid by increasing its pressure without reducing the temperature, whereas an aerosol is a suspension of fine solid particles or liquid droplets, in air or another gas.

[0004] Typical e-cigarettes generate the aerosol from liquid stored in a capsule, tank or reservoir. When a user operates the e-cigarette, liquid from the reservoir is transported along a fluid flow path to an aerosol generating unit. The aerosol generating unit comprises a liquid transfer element, e.g. a cotton wick or a permeable ceramic block, to control the rate at which the liquid enters a mixing chamber. Inside the mixing chamber, the liquid is heated by a heating element to produce a vapour, which mixes with air drawn into the device by the user. The vapour then cools and condenses to form an aerosol that can be inhaled by the user.

[0005] To facilitate the ease of use of e-cigarettes, the reservoir of aerosol generating liquid is often housed in a removable cartridge, which can be replaced when its supply of liquid is exhausted or when the user wishes to change to a different type or flavour of liquid. Such cartridges may be disposable, i.e. not intended to be capable of re-use after the supply of liquid in the reservoir has been exhausted. Alternatively, they may be reusable, being provided with means allowing the reservoir to be refilled with a new supply of aerosol generating liquid.

[0006] When a cartridge is replaced, the conduit that forms the fluid flow path from the reservoir to the mixing chamber is necessarily interrupted, which allows air to enter the fluid flow path. This can cause a problem with the use of the new, replacement cartridge because a bubble of air in the fluid flow path will at best cause a gap in the flow of aerosol generating liquid into the mixing chamber and may at worst obstruct the supply of aerosol generating liquid from the reservoir. A similar and potentially greater problem may arise when the aerosol generating system is first used because such systems are typically shipped and supplied without being loaded with a cartridge, whereby the fluid flow path may initially be full of air. Air bubbles or airlocks in the fluid flow path may be a particular problem for systems that rely on micro-electromechanical systems (MEMS) or microfluidics technologies for transport of the liquid through very narrow conduits. In this specification, "fluid" is used to describe a liquid or a gas or a mixture of both liquid and gas.

[0007] By a "handheld" aerosol generating system is meant one that is small enough and light enough to be held comfortably in one hand during use. Because of their small size - typically no more than 15cm long or 6cm wide - handheld aerosol generating systems are limited in battery power and in space to accommodate complex components.

Summary of the invention

[0008] The invention provides a handheld aerosol generating system comprising:

an aerosol generating device containing a mixing chamber, in which an aerosol generating liquid can be heated to generate an aerosol;
a cartridge removably attached to the aerosol generating device, the cartridge comprising a reservoir that contains a supply of the aerosol generating liquid;
a fluid flow path for conducting the aerosol generating liquid in a forward direction from the reservoir towards the mixing chamber when the system is being used to generate an aerosol; and
priming means configured to apply a pressure below ambient pressure to at least a part of the mixing chamber, thereby drawing fluid in the forward direction along the fluid flow path when the system is not being used to generate an aerosol.

[0009] The invention further provides a method of priming a handheld aerosol generating system, the system comprising an aerosol generating device containing a mixing chamber, in which an aerosol generating liquid can be heated to generate an aerosol, and a cartridge removably attached to the aerosol generating device, the cartridge comprising a reservoir that contains a supply of the aerosol generating liquid; the method comprising, when the system is not being used to generate an aerosol, operating a priming means to apply a pressure below ambient pressure to at least a part of the mixing chamber, thereby drawing fluid along a fluid flow path from the reservoir towards the mixing chamber.

[0010] The fluid drawn along the fluid flow path by the priming means may comprise the aerosol generating liquid, air or a mixture of the two. The priming means and method according to the invention can therefore be used to "prime" the system by expelling air from the fluid flow path before a new cartridge is used or at any other time if it is suspected that air has entered the path, for example if a seal has been broken or after a long period of non-use.

[0011] A handheld aerosol generating system according to the invention preferably further comprises a liquid transfer element for introducing the aerosol generating liquid from the fluid flow path into the said part of the mixing chamber. The liquid transfer element may be, for example, a wick or a permeable ceramic block. In preferred embodiments of the invention, the liquid transfer element is a liquid jet head, which works in a similar way to ink-jet heads used in printing to expel droplets of the aerosol generating liquid into the mixing chamber. One type of liquid jet head is a thermal jet head, in which one or more heating elements superheat a very small volume (less than 1%) of the aerosol generating liquid to vaporize it and push a drop of the remaining liquid drop out of the jet head and into the air in the mixing chamber. An alternative to a thermal jet head is a piezoelectric jet head, which uses a piezoelectric element to generate pressure pulses in the aerosol generating liquid and push drops of it out of the jet head and into the air in the mixing chamber.

[0012] Liquid jet heads have the advantage that the delivery of the vapour generating liquid into the mixing chamber can be carefully controlled. They may also enable the system to operate at a lower temperature and therefore with a lower energy requirement because they do not depend on heat to vaporize at least the majority of the liquid. Because liquid jet heads generate an aerosol directly, the size of droplets in the aerosol can be more carefully controlled and more uniform compared with traditional aerosol generating devices that form an aerosol indirectly by condensing vapour. Traditional devices may need to be designed to promote the condensation of vapour, e.g. by providing a passage downstream from the mixing chamber in which this can occur, but this is not necessary with jet head technology, thereby removing a constraint on the design of such devices. Traditional devices can also suffer from vapour condensing preferentially on internal surfaces of the device, where it collects into liquid that can flow out of the device and cause leakage. Because jet head technologies inject droplets directly into the air, this problem may be avoided.

[0013] The priming means preferably comprises a suction pump in the aerosol generating device. The suction pump may be electrically operated under at least partially automatic control of circuitry within the device. Alternatively, the aerosol generating device may further comprise a mouthpiece through which aerosol generated by the device can be inhaled; and an impeller in fluid communication with the mouthpiece, the impeller being coupled to the suction pump to drive the suction pump when a user rotates the impeller by blowing into the mouthpiece during the priming process. This avoids the need to use power from the limited supply in the aerosol generating device to operate the suction pump.

[0014] In a further alternative, the priming means is a suction pump that is removably attached to the aerosol generating device. This avoids the need for the suction pump to be accommodated within the housing of the aerosol generating device, given that it will normally only be used occasionally to prime the system when a cartridge has been replaced.

[0015] Such a handheld aerosol generating system may further comprise a mouthpiece removably attached to the aerosol generating device, whereby removal of the mouthpiece permits attachment of the suction pump. Preferably, attachment of the mouthpiece to the aerosol generating device requires the mouthpiece to move generally parallel to a surface of the liquid transfer element; and the mouthpiece comprises means for wiping aerosol generating liquid from the surface of the liquid transfer element. Alternatively, the suction pump is comprised in a priming unit that is removably attached to the aerosol generating device; removal of the suction pump from the aerosol generating device requires the priming unit to move generally parallel to a surface of the liquid transfer element; and the priming unit further comprises means for wiping aerosol generating liquid from the surface of the liquid transfer element. Because the priming process draws aerosol generating liquid through the fluid flow path when aerosol is not being generated, liquid is liable to collect on the surface of the liquid transfer element. If it remains there in a liquid state or dries to form a solid, it may obstruct the transfer of liquid during subsequent use of the system - particularly in the case that the liquid transfer element is a liquid jet head. This aspect of the invention, in either alternative, conveniently enables the liquid transfer element to be wiped clean as an automatic part of either detaching the suction pump or re-attaching the mouthpiece after priming has been carried out.

[0016] The aerosol generating device preferably further comprises a mouthpiece and isolating means capable of selectively placing the said part of the mixing chamber in fluid communication with the mouthpiece when the system is being used to generate an aerosol or isolating the said part of the mixing chamber from the mouthpiece during operation of the priming means. The mouthpiece is necessarily open to the atmosphere so, by isolating the said part of the mixing chamber from it, the priming means is better able to effect reduced pressure in that part of the mixing chamber in accordance with the invention.

[0017] The isolating means may comprise a valve between the mouthpiece and the mixing chamber. Alternatively, a handheld aerosol generating system according to the invention may further comprise a movable portion that is capable of movement between a priming position in which the isolating means forms an enclosure about the said part of the mixing chamber and an aerosol gen-

erating position in which the isolating means does not form an enclosure about the said part of the mixing chamber. A valve between the mouthpiece and the mixing chamber would require the user to inhale through the valve when the system is being used to generate an aerosol. In contrast, a movable portion that can be manually reconfigured between a priming position and an aerosol generating position permits - if desired - a substantially unobstructed flow of air from the mixing chamber to the mouthpiece during aerosol generation, while forming a sealed enclosure about the said part of the mixing chamber during priming.

[0018] The moveable portion preferably includes the mouthpiece. This makes it easy to arrange that movement of the movable portion should isolate the mouthpiece from the said part of the mixing chamber. It also provides a strong visual indication to the user that, because the mouthpiece is displaced from its position in normal use, the system is in its priming state.

[0019] In some embodiments of handheld aerosol generating system according to the invention, the movement of the movable portion from the priming position to the aerosol generating position is generally parallel to a surface of the liquid transfer element; and the movable portion comprises means for wiping aerosol generating liquid from the surface of the liquid transfer element. Because the priming process draws aerosol generating liquid through the fluid flow path when aerosol is not being generated, unvaporized liquid is liable to collect on the surface of the liquid transfer element. If remains there in a liquid state or dries to form a solid, it may obstruct the transfer of liquid during subsequent use of the system - particularly in the case that the liquid transfer element is a liquid jet head. This aspect of the invention conveniently enables the liquid transfer element to be wiped clean as an automatic part of reconfiguring the system for aerosol generation after priming has been carried out.

[0020] The cartridge may further comprise a vent for admitting air into the reservoir to replace aerosol generating liquid that is conducted away from the cartridge. This allows the air pressure inside the cartridge to remain substantially equal to atmospheric pressure so that there is no pressure difference to resist the transport of liquid along the fluid flow path.

The drawings

[0021]

Figure 1 is a perspective view of an example of a handheld aerosol generating system of a kind in which the invention may be used.

Figure 2 is a view, in longitudinal section, showing the fluid flow path from a reservoir.

Figure 3 is a schematic diagram of a first embodiment of the invention.

Figure 4 is a schematic diagram of a second embodiment of the invention.

Figures 5a and 5b are schematic diagrams of a third embodiment of the invention, respectively in two configurations.

Figure 6 is a schematic diagram of a fourth embodiment of the invention.

Figure 7 is a perspective view of the handheld aerosol generating system of Figure 1, in which the mouthpiece has been moved to a priming position.

Figures 8a and 8b are schematic, longitudinal sections through a fifth embodiment of the invention, respectively in two configurations.

Figures 9a and 9b are schematic, longitudinal sections through a sixth embodiment of the invention, respectively in two configurations.

[0022] Figure 1 illustrates a handheld aerosol generating system, comprising an aerosol generating device 2 and a replaceable cartridge 4 that is removably received in the aerosol generating device 2. The device 2 is enclosed by a housing 6. A door 8 in the housing 6 may be opened to permit access to the interior of the housing 6 for the insertion or removal of the cartridge 4. The cartridge 4 provides a supply of aerosol generating liquid, which can be heated by the device 2 to generate an aerosol, which subsequently cools and condenses to form an aerosol. A proximal end of the device 2 comprises a mouthpiece 10, through which a user of the system can inhale the aerosol generated by the system. A distal end 12 of the housing 6 contains a battery (not visible in the drawing) to provide a power supply for the system and electronic circuits (not visible in the drawing) for controlling the operation of the system.

[0023] The configuration and operation of the system during normal use to generate an aerosol may be conventional. They do not form part of the present invention and are not described in any detail here. The system may take forms that are very different from that illustrated in Figure 1, provided it can accommodate removable cartridges 4, which are coupled via a fluid flow path to a mixing chamber in the aerosol generating device 2.

[0024] Figure 2 is a longitudinal section through the replaceable cartridge 4, which illustrates a fluid flow path for supplying the aerosol generating liquid from the cartridge 4 to a mixing chamber 14 of the aerosol generating device. The housing 6, mouthpiece 10 and other components of the aerosol generating device 2 are not shown in Figure 2. It will be understood that the mixing chamber 14 shown as an open space at the top of Figure 2 will in reality be enclosed by one or more of those components to form a space that is substantially sealed apart from an air inlet and an air outlet in communication with the mouthpiece 10.

[0025] In the cartridge 4 illustrated in Figure 2, the aerosol generating liquid is supplied from two independent reservoirs 16, although this is not essential for the invention. In alternative embodiments of the invention, the cartridge 4 may comprise a single reservoir or more than two reservoirs and, if it comprises a plurality of reservoirs,

they may be interconnected rather than being independent. In the illustrated embodiment, a separate fluid flow path is provided from each reservoir 16 to a common mixing chamber 14. As the quantity of liquid in each reservoir 16 is depleted, ambient air is allowed to flow into the reservoir 16 to replace the volume of liquid lost, as indicated schematically by arrows 17. The air enters the reservoir 16 via a vent 15, which is not visible in the plane of Figure 2. The vent 15 may comprise a "micropore" or "pinhole" opening that is sufficiently small to allow air to enter, while aerosol generating liquid is prevented from leaking out of the opening by surface tension.

[0026] A first portion of each fluid flow path is formed by a first tube 18, which has an inlet 20 inside the reservoir 16, preferably close to its distal end, and extends longitudinally through the reservoir 16 to emerge from its proximal end. A second portion of the fluid flow path is formed by a second tube 22, which extends between the cartridge 4 and the aerosol generating device 2. In use, the second tube 22 is in fluid communication with first tube 18 and conducts aerosol generating fluid from the cartridge 4 into the aerosol generating device 2. Accordingly, when the cartridge 4 is replaced, the second tube 22 needs to be detached from either the cartridge 4 or the aerosol generating device 2. Preferably, the second tube 22 is anchored to the aerosol generating device 2, whereby, when the cartridge 4 is replaced, the second tube 22 becomes detached from the cartridge 4. Prior to use, a new cartridge 4 may be sealed by a septum 23 across the proximal end of the reservoir 16, which prevents leakage of the aerosol generating fluid from the cartridge 4 and prevents contamination of the aerosol generating fluid from the environment. In that case, the second tube 22 may take the form of a rigid, hollow needle, which is anchored to the aerosol generating device 2 and pierces the septum 23 of a new cartridge 4 when it is installed in the aerosol generating device 2 to establish fluid communication between the first and second tubes 18,22.

[0027] Sealing means (which may include the septum 23, if present) are provided around the second tube 22 to prevent air entering the fluid flow path from the gap between the aerosol generating device 2 and the cartridge 4.

[0028] A third portion of each fluid flow path is formed by a conduit 24 within the aerosol generating device 2. In the illustrated embodiment, the conduit 24 is formed as a channel through a solid body of the aerosol generating device 2 but in alternative embodiments of the invention, part or all of the conduit 24 could be formed as a separate tubular component. In the illustrated embodiment, each conduit 24 includes a substantially transverse portion to bring the two conduits 24 from the respective reservoirs 16 closer together near the mixing chamber 14 but that is a mere design feature of this particular embodiment and is not essential to the invention. In use, the conduit 24 is in fluid communication with the second tube 22 so that the aerosol generating liquid travels along the fluid flow path in series through the first tube 18, the second tube 22 and the conduit 24, as indicated by arrows 25.

[0029] A proximal end of the conduit 24 is coupled to a liquid transfer element 26, which receives liquid supplied via the fluid flow path and transfers it into the mixing chamber 14 at a controlled rate. Ideally, the rate of transfer should match the rate at which the liquid is converted into aerosol and is consumed by the user of the system drawing air through the mixing chamber 14 to carry the aerosol away. The rate of transfer may in practice determine the rate at which the liquid is converted into aerosol and/or it may respond to the demand for aerosol to be supplied. The liquid transfer element 26 may comprise, for example, a wick of cotton or other fibrous material, which absorbs liquid from the fluid flow path and is exposed to the interior of the mixing chamber 14, whereby the liquid may evaporate from the wick in the elevated temperature of the mixing chamber 14. Another passive form of liquid transfer element 26 comprises a permeable ceramic block, which similarly absorbs liquid from the fluid flow path and is exposed to the interior of the mixing chamber 14, whereby the liquid may evaporate from an exposed surface of the block. Another alternative form of liquid transfer element 26 comprises a liquid jet head, similar to that used in an ink-jet printer, which receives a supply of the aerosol generating liquid from the fluid flow path and actively ejects controlled quantities of the liquid as minute droplets 28 into the mixing chamber 14.

[0030] When a cartridge 4 is removed from the aerosol generating device 2, the fluid flow path is interrupted, for example by the second tube 22 being withdrawn from the cartridge 4. Accordingly, when a new cartridge 4 is installed in the device 2 (including the first time a cartridge 4 is installed in it) there is a strong likelihood that air will have entered the fluid flow path and will become trapped in it. As previously mentioned, air bubbles or airlocks in the fluid flow path may cause problems with the supply of aerosol generating liquid therethrough, particularly in the case of narrow conduits that may be used with liquid transfer elements in the form of liquid jet heads. In accordance with the present invention, the aerosol generating system comprises priming means 35 (not shown in Figure 2) configured to apply a pressure below ambient pressure to at least a part of the mixing chamber 14, thereby drawing fluid in the forward direction along the fluid flow path when the system is not being used to generate an aerosol, as will be described in more detail below.

[0031] After installation of a cartridge 4, the fluid in the downstream end of the fluid flow path may comprise a mixture of the aerosol generating liquid and air. Because of the vent 15, the air pressure inside the reservoir 16 should be substantially equal to the ambient atmospheric pressure. Therefore, by sealing the mixing chamber 14 from the atmosphere and decreasing the pressure inside it, the priming means 35 creates a pressure difference that draws fluid along the fluid flow path towards the mixing chamber 14. The fluid mixture passes through the

liquid transfer element 26 to be discharged into the mixing chamber 14. The process continues until there can be reasonable confidence that no air remains in the fluid flow path. Particularly on first use of the device 2, this might entail expelling fluid - principally air, in this case - from the entire volume of the fluid flow path. However, particularly during replacement of a cartridge 4 in a device 2 that has previously been used, it might be sufficient to expel fluid only from the portion of the fluid flow path that lies downstream from a point close to where the path has been interrupted and air is likely to have been admitted.

[0032] Figure 3 schematically shows a first embodiment of the invention, in which the reservoir 16 of a replaceable cartridge 4 (not shown) is in communication with the mixing chamber 14 of the aerosol generating device 2 via a fluid flow path 32. An aerosol generating liquid 31 may flow along the fluid flow path 32 and be introduced into the mixing chamber 14 via a liquid transfer element 26. The volume of liquid 31 that flows out of the reservoir 16 may be replaced by an inflow of atmospheric air via a bleed valve 15. The mixing chamber 14 may selectively be placed in fluid communication with the mouthpiece 10 or be isolated from the mouthpiece 10 to make it possible to maintain a pressure difference between the mixing chamber 14 and the atmosphere. During normal use of the device 2, the liquid transfer element 26 introduces aerosol generating liquid 31 into the mixing chamber 14 to generate an aerosol comprising droplets of the liquid 31 mixed with air. The mouthpiece 10 is in fluid communication with the mixing chamber 14, whereby a user can draw the aerosol from the device 2 by inhaling through the mouthpiece 10.

[0033] During priming of the device 2, the isolating means 34 isolates the mixing chamber 14 from the mouthpiece 10 and a suction pump 35 is operated to withdraw air from the mixing chamber 14, thereby decreasing the pressure in the mixing chamber 14 below the ambient pressure and drawing fluid along the fluid flow path 32. In order to expel any air bubbles from the fluid flow path 32, a quantity of the aerosol generating liquid 31 may also need to be expelled into the mixing chamber 14. The suction pump 35 may be employed to remove some of this excess liquid 31 from the mixing chamber 14 and a sump 36 may be provided in the device 2 to trap the liquid 31 thus removed, so that it cannot leak to the exterior or cause damage to other internal elements of the device 2.

[0034] The suction pump 35 is preferably an electronic pump under the automatic control of circuitry built into the aerosol generating device 2. However, it may be manually controlled, e.g. by the user holding and releasing a button; and a pump that is fully manually operated is not intended to be excluded from the scope of the claimed invention. A window (not illustrated) may be provided to allow the user to see into the mixing chamber 14 and observe when aerosol generating liquid or air bubbles appear at the surface of the liquid transfer element 26, to assist them in judging when to end the priming process. Figure 3 shows the suction pump 35 configured to pump air directly to the exterior of the housing 6 but it may alternatively discharge air into the interior of the housing 6. The housing 6 is not normally constructed to be airtight with respect to the atmosphere so its interior will remain substantially at atmospheric pressure.

[0035] Although Figure 3 shows the isolating means 34 symbolically as a valve in a wall 36 between the mouthpiece 10 and the mixing chamber 14, it may take very different forms. For example, the isolating means 34 may be a valve in a conduit (not illustrated in Figure 3) that couples the mouthpiece 10 to the mixing chamber 14. If the isolating means 34 is a valve, then it may be manually operated or under the automatic control of circuitry built into the aerosol generating device 2. However, the isolating means 34 may take forms very different from a conventional valve. For example, it may be in the form of a pivoting or sliding door (not illustrated) between the mouthpiece 10 and the mixing chamber 14. In another example, described in more detail in relation to Figures 7 to 9 below, a portion of the device 2 may be movable into a priming position to form a sealed enclosure that is isolated from the mouthpiece 10 within at least part of the mixing chamber 14.

[0036] Figure 4 schematically shows a second embodiment of the invention, which is very similar to the first embodiment and the identical elements will not be described again. In Figure 3, the isolating means 34 is positioned between the mouthpiece 10 and the mixing chamber 14; the suction pump 35 is permanently in communication with the mixing chamber 14 but is not operated during use of the device 2 to generate an aerosol. In Figure 4, the isolating means 34 is a two-way valve that can selectively be set to an aerosol generating position, in which it couples the mixing chamber 14 to the mouthpiece 10 and isolates the suction pump 35; or to a priming position, in which it couples the mixing chamber 14 to the suction pump 35 and isolates the mouthpiece 10. This provides an advantage compared with the first embodiment in that, during use of the device to generate an aerosol, there is a reduced risk that by drawing on mouthpiece 10, the user may suck excess, unvaporized aerosol generating liquid 31 out of the sump 36.

[0037] Figures 5a and 5b schematically show a third embodiment of the invention. Again, elements that are identical to those in the first and second embodiments will not be described again. In the first and second embodiments, the suction pump 35 is built into the housing 6 of the device 2 but in the third embodiment the suction pump 35 forms part of a separate priming unit 38. Specifically, in the third embodiment, the mouthpiece 10 and at least part of the mixing chamber 14 are formed by a removable mouthpiece portion 40 of the device 2, which can be detached from the housing 6 as shown in Figure 5a. The priming unit 38 can then be attached to the housing 6 in place of the mouthpiece portion 40 to form a sealed priming chamber 42 around the liquid transfer element 26. (The priming chamber 42 encloses at least

part of the volume of the former mixing chamber 14.) The suction pump 35 in the priming unit 38 pumps air out of the priming chamber 42 to draw fluid along the fluid flow path 32 as previously described. The suction pump 35 may be temporarily connected to the aerosol generating device 2 via electrical contacts 44 so that it can draw power from a battery in the device 2. Alternatively, the priming unit 38 may be connected to an external power source, such as a charging unit (not illustrated) for the aerosol generating device 2. The priming unit 38 may even form part of such a charging unit.

[0038] The means for attaching the removable mouthpiece unit 40 and the priming unit 38 to the housing 6 may be configured such that at during detachment of the priming unit 38 and/or during attachment of the mouthpiece unit 40, the respective unit 38,40 slides parallel to a surface of the liquid transfer element 26. In that case, one or both of the mouthpiece unit 40 and the priming unit 38 may be provided with means for wiping excess aerosol generating liquid 31 from the surface of the liquid transfer element 26 when the device 2 is reconfigured at the end of the priming process. Such wiping means are described below in relation to Figure 8.

[0039] Figure 6 schematically shows a fourth embodiment of the invention, in which again the suction pump 35 is not provided in the aerosol generating device 2 itself. It differs from the third embodiment in that the mouthpiece 10 does not need to be removed from the device 2 during the priming process. Instead, the suction pump 35 is provided in an external priming unit 46 that can accommodate the mouthpiece 10 and form a sealed priming chamber 48 around it. The suction pump 35 can then be operated to pump air out of the priming chamber 48 and draw fluid along the fluid flow path 32. The aerosol generating device 2 may be coupled to the external priming unit 46 in any suitable manner, e.g. with a screw thread. Preferably, the user simply pushes the device 2 against the priming unit 46 sufficiently firmly to form a seal around their mutual contact surfaces 50, which may be provided with a sealing element (not shown). The action of pushing the device 2 against the priming unit 46 may initiate the operation of the suction pump 35. As illustrated, a projection 52 of the priming unit 46 extends through the mouthpiece 10 into the mixing chamber 14. This has the advantage that the suction pump 35 does not tend to draw excess aerosol generating liquid towards the mouthpiece 10 but whether such an arrangement is possible in practice will depend on the form of the mouthpiece 10 and the mixing chamber 14 in any given design of aerosol generating device 2.

[0040] In a variant of the fourth embodiment (not illustrated), the external priming unit 46 may form a seal against the rim 54 of the mouthpiece 10, in which case the contact surfaces 50 may be omitted and no distinct priming chamber 48 is created. However, for reasons of hygiene, it may be considered undesirable to push the rim 54 of the mouthpiece into contact with a surface that has been exposed to the environment before the user receives it in their mouth.

[0041] Figure 7 is a perspective view of the handheld aerosol generating system of Figure 1, in which a movable portion 56 of the aerosol generating device 2 has been moved from an aerosol generating position to a priming position. The movable portion 56 includes the mouthpiece 10 and is capable of sliding laterally between the two positions along a pair of tracks 58. In the aerosol generating position seen in Figure 1, the movable portion 56 is aligned with the housing 6 of the device 2 and the mouthpiece 10 is in fluid communication with the mixing chamber 14 so the user can draw air and aerosol from the mixing chamber 14. In the priming position seen in Figure 7, isolating means of the movable portion 56 form a sealed enclosure 60 about part of the mixing chamber 14, which isolates the liquid transfer element 26 from the mouthpiece 10 and enables a suction pump 35 to reduce the pressure in the sealed enclosure 60 in accordance with the invention. This will be explained in more detail with reference to Figures 8 and 9 below.

[0042] Figures 8a and 8b are schematic, longitudinal sections through a fifth embodiment of the invention, with the movable portion 56 in the aerosol generating position and the priming position respectively. In the aerosol generating position seen in Figure 8a, the movable portion 56 is aligned with the housing 6 of the device 2 and the mouthpiece 10 is in fluid communication with the mixing chamber 14. In Figure 8a, the mouthpiece 10 is shown to open directly into the mixing chamber 14 but in other embodiments of the invention a narrower or more convoluted airflow path may be provided between the mouthpiece 10 and the mixing chamber 14. As aerosol generating liquid 31 evaporates from the surface 62 of the liquid transfer element 26, more of the liquid 31 is drawn along the fluid flow path 32 from the reservoir 16 in the cartridge 4 (not shown in Figures 8a and 8b). A suction pump 35 is provided in the device 2 and is in fluid communication with the mixing chamber 14 via a pump conduit 64 but the pump 35 is not operated when the system is being used to generate an aerosol.

[0043] In the priming position seen in Figure 8b, the user has displaced the movable portion 56 laterally. This brings a cover 66, which forms part of the movable portion 56, into sealing engagement with a stationary wall 68, which remains fixed in relation to the housing 6. The cover 66 and the wall 68 thereby form between them a sealed enclosure 60, which surrounds the liquid transfer element 26 and isolates it from the mouthpiece 10. (The reader will understand that the cover and wall(s) of the sealed enclosure could be configured in ways quite different from the illustrated example, while achieving the same purpose.) The pump conduit 64 also opens into the sealed enclosure 60, whereby the suction pump 35 can be operated to pump air out of the enclosure 60. This causes fluid - which may contain a mixture of air bubbles and the aerosol generating liquid 31 - to be drawn along the fluid flow path 32, thereby priming the system by expelling air from the fluid flow path 32 before the system

is used to generate an aerosol.

[0044] The priming process may cause excess aerosol generating liquid 31 to pass through the liquid transfer element 26 and to collect in the sealed enclosure 60. Operation of the suction pump 35 may assist in clearing such excess liquid from the sealed enclosure 60. A sump 36 may be provided inside the housing 6 to collect excess liquid that is drawn along the pump conduit 64 and prevent the liquid leaking from the exterior of the aerosol generating device 2. Additionally or alternatively, an absorbing pad 70 may be provided in the sealed enclosure 60 to absorb excess liquid that accumulates there and prevent it from interfering with aerosol generation during further use of the system.

[0045] In the embodiment of the invention illustrated in Figures 8a and 8b, the surface 62 of the liquid transfer element 26 is parallel to the direction in which the movable portion 56 moves laterally from the priming position of Figure 8b to the aerosol generating position of Figure 8a. During this movement, a wiper 72 mounted on the underside of the cover 66 is drawn across the surface 62 and removes any droplets of excess liquid therefrom so that they do not interfere with the transfer of aerosol generating liquid 31 into the mixing chamber 14 during subsequent use of the system to generate an aerosol. This is particularly important if the liquid transfer element 26 is a liquid jet head. The wiper 72 may itself be a pad to absorb the excess liquid or it may, as illustrated, be a flexible blade that sweeps any excess liquid from the surface 62 towards the absorptive pad 70. Despite possible appearances in the cross-section of Figure 8a, the wiper 72 does not normally isolate the mixing chamber 14 from the inlet of the pump conduit 64 in the aerosol generating position. However, it will be apparent how such isolation could be achieved if it were found to be desirable, e.g. to reduce the risk that inhalation by the user through the mouthpiece could draw air backwards through the suction pump 35 or could suck excess aerosol generating liquid from the sump 36.

[0046] In the embodiment of Figures 8a and 8b, the suction pump 35 is electrically operated, drawing power from the power supply 74 of the aerosol generating device 2. When the user slides the movable portion 56 to the priming position, this may operate a switch (not shown) to initiate the priming process and the suction pump 35 can thereafter be operated under the automatic control of circuitry within the device 2. In particular, the duration of operation of the suction pump 35 can be determined automatically, without user intervention. Operation of the pump 35 should continue until there can be reasonable confidence that no air remains in the fluid flow path 32. Particularly on first use of the system, it may be expected that air initially fills the entire volume of the fluid flow path 32 so the suction pump 35 will need to draw a quantity of aerosol generating liquid 31 from the reservoir 16 that is sufficient to fill the flow path 32. Because the suction pump 35 is automatically operated, the capacity of the pump 35 and the volume of the fluid flow path 32 may be used to calculate a suitable duration. Alternatively, at extra cost, a sensor (not illustrated) may be provided in the mixing chamber 14 or in the fluid flow path 32 close to the mixing chamber 14, which detects the presence of aerosol generating liquid 31 and indicates that the priming process should stop. A shorter duration may be appropriate after a replacement cartridge 4 has been inserted in the device 2 because at least an upstream portion of the fluid flow path 32 can be assumed to be already full of the liquid 31.

[0047] Figures 9a and 9b are schematic, longitudinal sections through a sixth embodiment of the invention, which is very similar to the fifth embodiment except that the suction pump 35 does not draw power from the device 2. Instead, the pump 35 is driven by the user blowing air through an impeller 76. At least when the movable portion 56 is in the priming position, an impeller inlet conduit 78 is in fluid communication with the mouthpiece 10 but is isolated from the sealed enclosure 60. (In the illustrated embodiment, the impeller inlet conduit 78 is closed when the movable portion 56 is in the aerosol generating position but that is not essential.) An impeller outlet conduit 80 passes through the housing 6 to the exterior of the device 2. Some form of one-way valve, illustrated as a simple flap 82 on the outside of the housing 6, may be provided to prevent air being drawn through the impeller 76 in the opposite direction. Accordingly, when the movable portion 56 is in the priming position, the user can blow into the mouthpiece 10 and air passing through the impeller 76 will cause its rotor to spin. An axle 84 - shown schematically in the drawings by a dashed line - connects the rotor of the impeller 76 to a rotor of the suction pump 35 so that rotation of the impeller 76 causes the suction pump 35 to operate. The capacities of the impeller 76 and the pump 35 can be chosen to achieve a suitable balance between the volume of air blown by the user and the volume of air pumped by the pump 35. The user should continue this priming process until there can be reasonable confidence that no air remains in the fluid flow path 32. They may be assisted by control circuitry of the device 2, which may be programmed to alert the user by visual, audible or haptic means when the priming process can be terminated. Such an alert may be triggered after a certain time duration or, given that the way the user will drive the impeller is unpredictable, preferably based on a detected number of rotations of the suction pump 35.

[0048] The reader will understand that the illustrations of the embodiments of the invention herein are schematic and do not show all the elements that will be present in a practical aerosol generating system. For example, they do not show a battery that provides power; control circuitry; optional means for heating the mixing chamber 14; or the means for admitting air to the mixing chamber when the user inhales aerosol from it. The details of such features are not relevant to the invention and any suitable means that are currently known or may become known in future may be used in conjunction with the invention.

Claims

1. A handheld aerosol generating system comprising:

   an aerosol generating device (2) containing a mixing chamber (14), in which an aerosol can be generated from an aerosol generating liquid (31);
   a cartridge (4) removably attached to the aerosol generating device (2), the cartridge (4) comprising a reservoir (16) that contains a supply of the aerosol generating liquid (31);
   a fluid flow path (32) for conducting the aerosol generating liquid (31) in a forward direction from the reservoir (16) towards the mixing chamber (14) when the system is being used to generate an aerosol; and
   priming means (35) configured to apply a pressure below ambient pressure to at least a part of the mixing chamber (14), thereby drawing fluid in the forward direction along the fluid flow path (32) when the system is not being used to generate an aerosol.

2. A handheld aerosol generating system according to any preceding claim, further comprising a liquid transfer element (26) for introducing the aerosol generating liquid (31) from the fluid flow path (32) into the said part of the mixing chamber (14).

3. A handheld aerosol generating system according to claim 2, wherein the liquid transfer element (26) is a liquid jet head (82).

4. A handheld aerosol generating system according to claim 2 or claim 3, wherein the priming means comprises a suction pump (35) in the aerosol generating device (2).

5. A handheld aerosol generating system according to claim 4, wherein the aerosol generating device (2) further comprises:

   a mouthpiece (10); and
   isolating means (34) capable of selectively placing the said part of the mixing chamber (14) in fluid communication with the mouthpiece (10) when the system is being used to generate an aerosol or isolating the said part of the mixing chamber (14) from the mouthpiece (10) during operation of the priming means (35).

6. A handheld aerosol generating system according to claim 5, further comprising a movable portion (78) that is capable of movement between a priming position in which the isolating means (34) forms an enclosure about the said part of the mixing chamber (14) and an aerosol generating position in which the isolating means (34) does not form an enclosure about the said part of the mixing chamber (14).

7. A handheld aerosol generating system according to claim 6, wherein the moveable portion (78) includes the mouthpiece (10).

8. A handheld aerosol generating system according to claim 6 or claim 7, wherein:

   the movement of the movable portion (78) from the priming position to the aerosol generating position is generally parallel to a surface of the liquid transfer element (26); and
   the movable portion (78) comprises means for wiping aerosol generating liquid (31) from the surface of the liquid transfer element (26).

9. A handheld aerosol generating system according to any of claims 4 to 8, wherein the aerosol generating device (2) further comprises an impeller (76) in fluid communication with the mouthpiece (10), the impeller (76) being coupled to the suction pump (35) to drive the suction pump (35) when a user rotates the impeller (76) by blowing into the mouthpiece (10).

10. A handheld aerosol generating system according to claim 2 or claim 3, wherein the priming means is a suction pump (35) removably attached to the aerosol generating device (2).

11. A handheld aerosol generating system according to claim 10, further comprising a mouthpiece (10) removably attached to the aerosol generating device (2), whereby removal of the mouthpiece (10) permits attachment of the suction pump (35).

12. A handheld aerosol generating system according to claim 11, wherein:

   attachment of the mouthpiece (10) to the aerosol generating device (2) requires the mouthpiece (10) to move generally parallel to a surface of the liquid transfer element (26); and
   the mouthpiece (10) comprises means for wiping aerosol generating liquid (31) from the surface of the liquid transfer element (26).

13. A handheld aerosol generating system according to claim 10 or claim 11, wherein:

   the suction pump (35) is comprised in a priming unit (38) that is removably attached to the aerosol generating device (2);
   removal of the suction pump (35) from the aerosol generating device (2) requires the priming unit (38) to move generally parallel to a surface of the liquid transfer element (26); and

the priming unit (38) further comprises means for wiping aerosol generating liquid (31) from the surface of the liquid transfer element (26).

14. A method of priming a handheld aerosol generating system, the system comprising:

an aerosol generating device (2) containing a mixing chamber (14), in which an aerosol can be generated from an aerosol generating liquid (31); and
a cartridge (4) removably attached to the aerosol generating device (2), the cartridge (4) comprising a reservoir (16) that contains a supply of the aerosol generating liquid (31);
the method comprising, when the system is not being used to generate an aerosol, operating a priming means (35) to apply a pressure below ambient pressure to at least a part of the mixing chamber (14), thereby drawing fluid along a fluid flow path (32) from the reservoir (16) towards the mixing chamber (14).

15. A method according to claim 14, wherein:

the aerosol generating device (2) further comprises a mouthpiece (10) that is in fluid communication with the mixing chamber (14) when the system is being used to generate an aerosol;
the method further comprising isolating the said part of the mixing chamber (14) from the mouthpiece (10) during operation of the priming means (35).

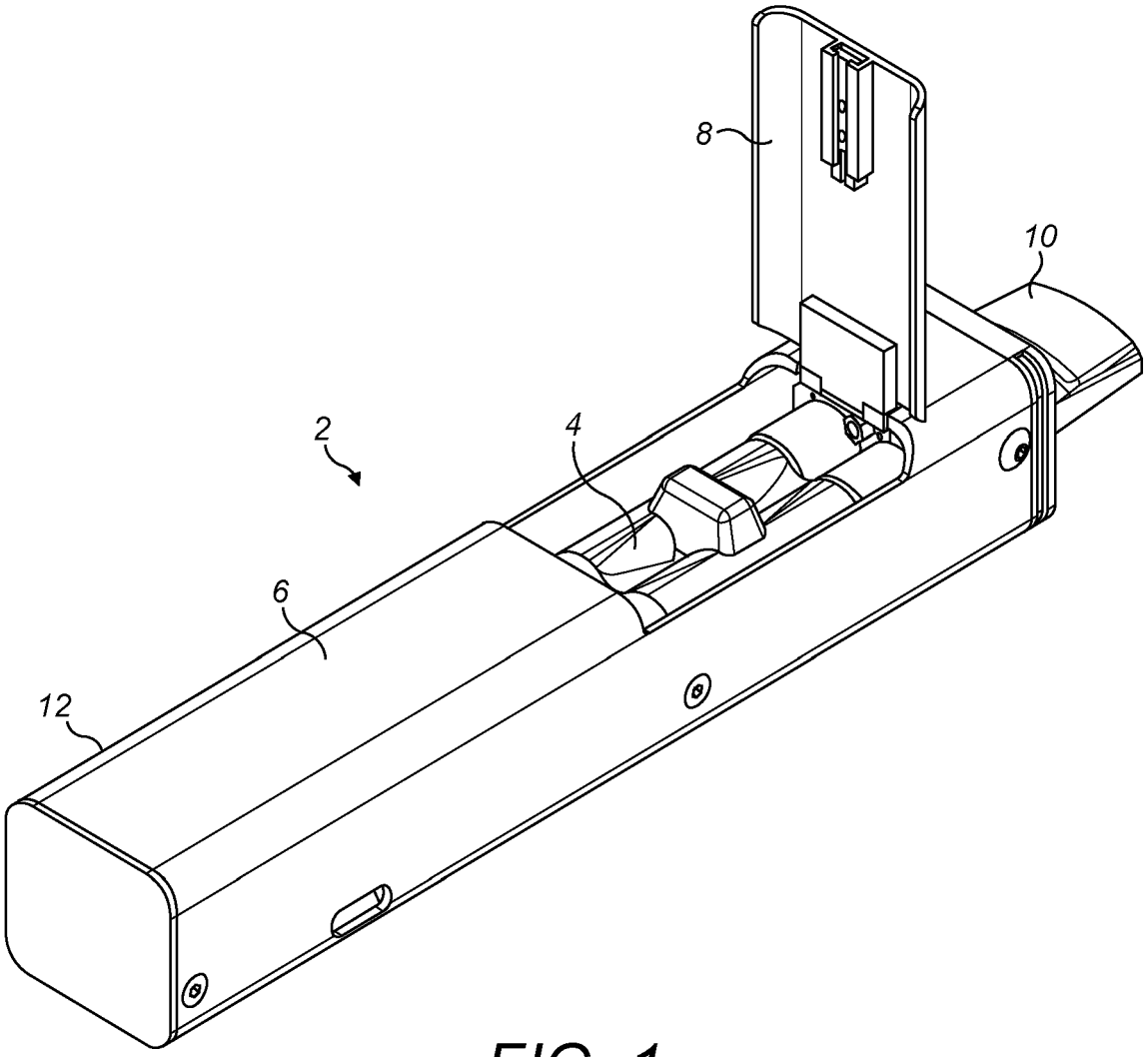

FIG. 1

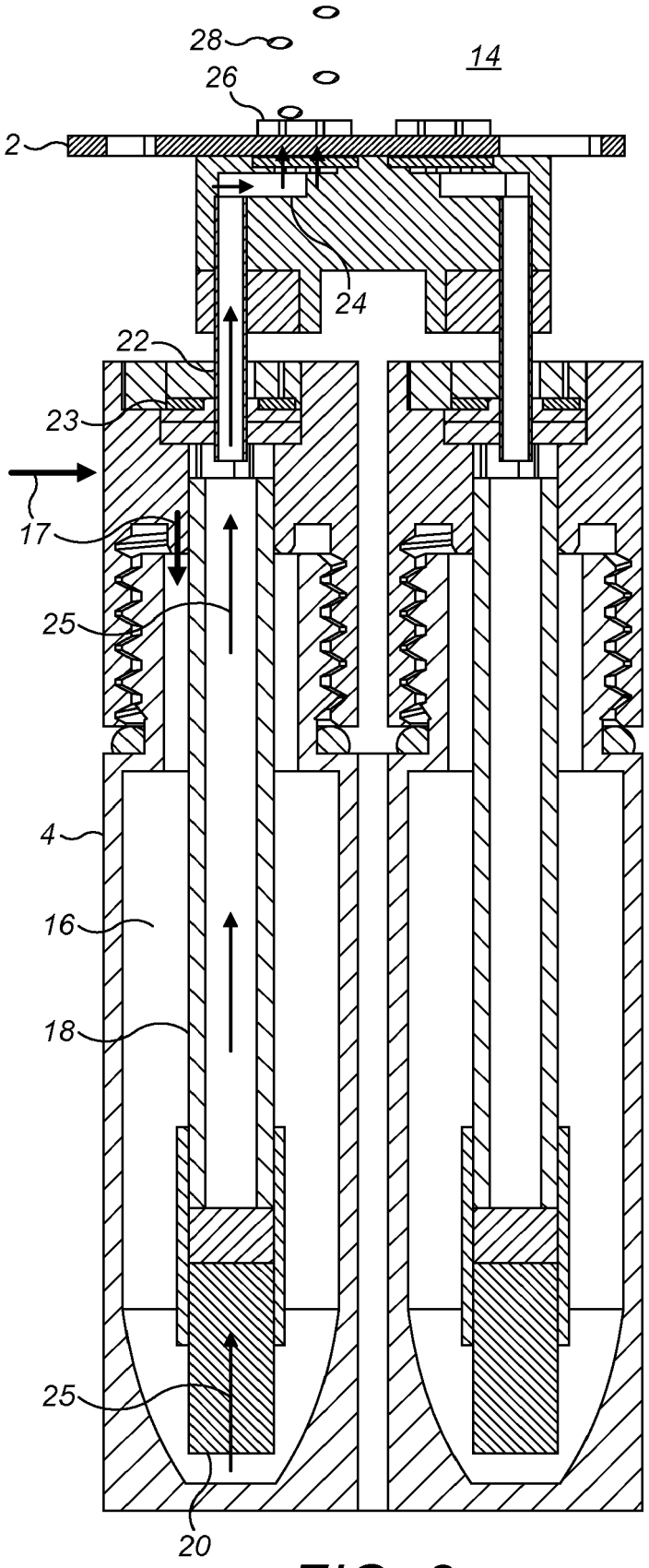

FIG. 2

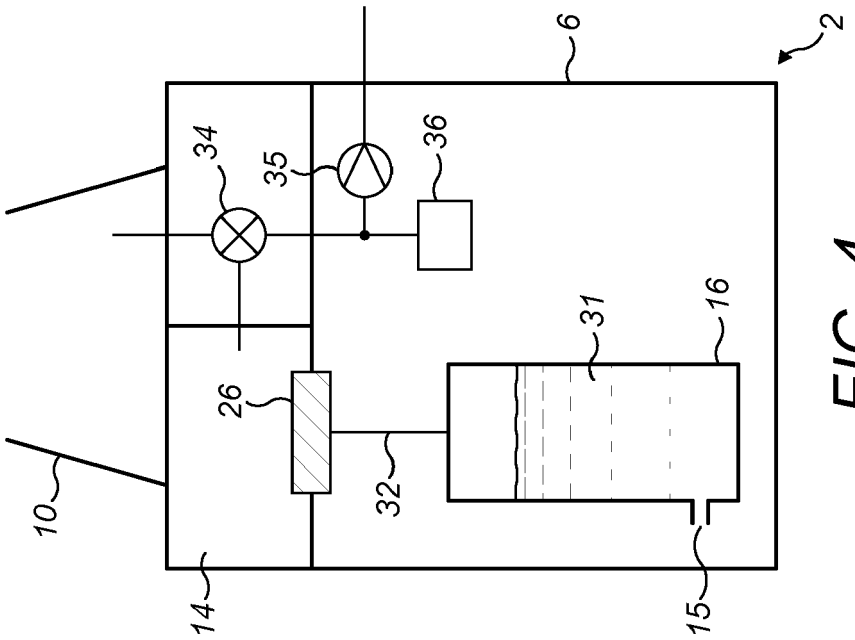

FIG. 4

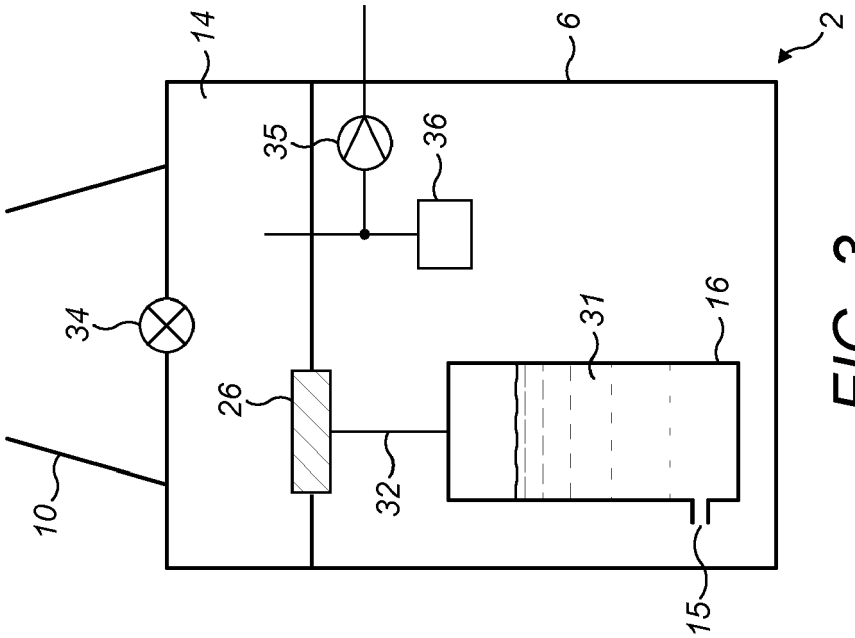

FIG. 3

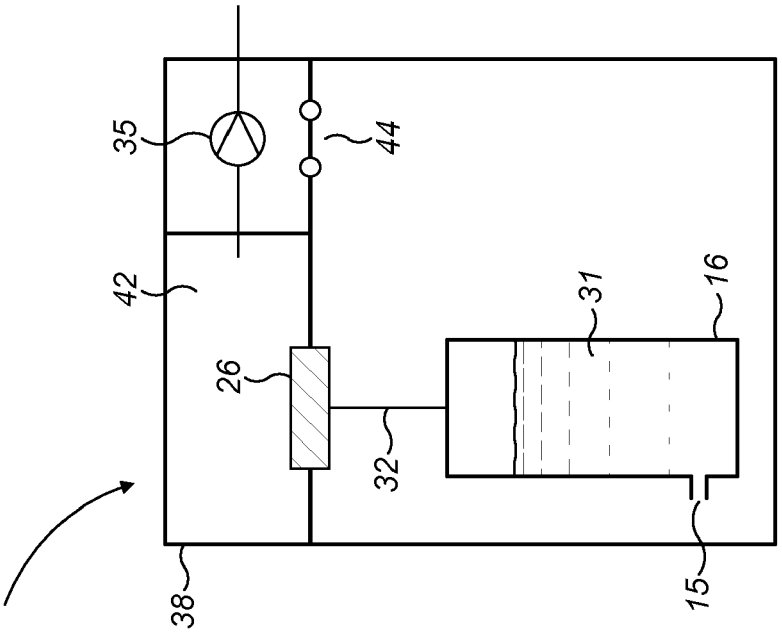

FIG. 5b

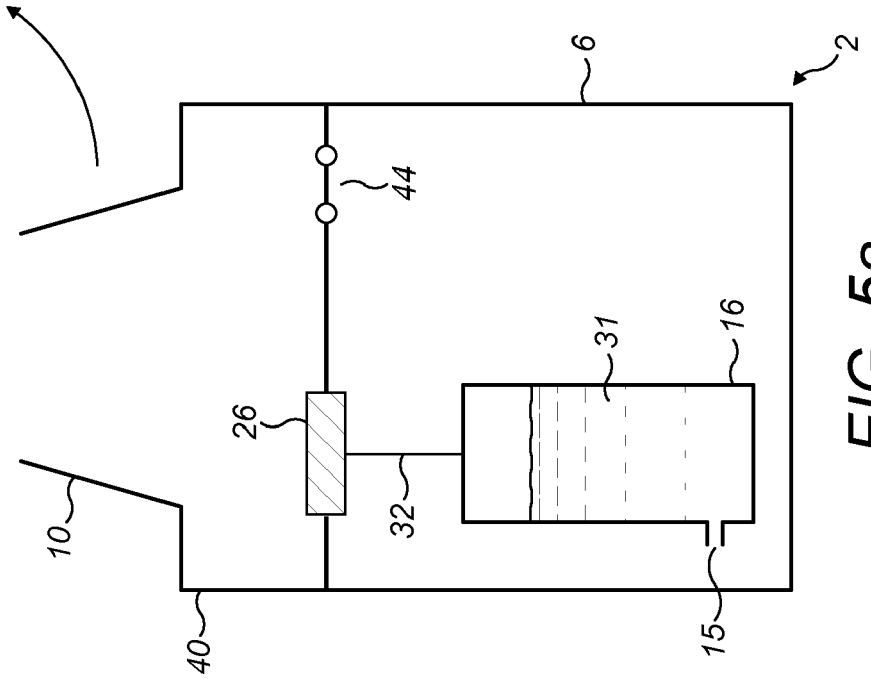

FIG. 5a

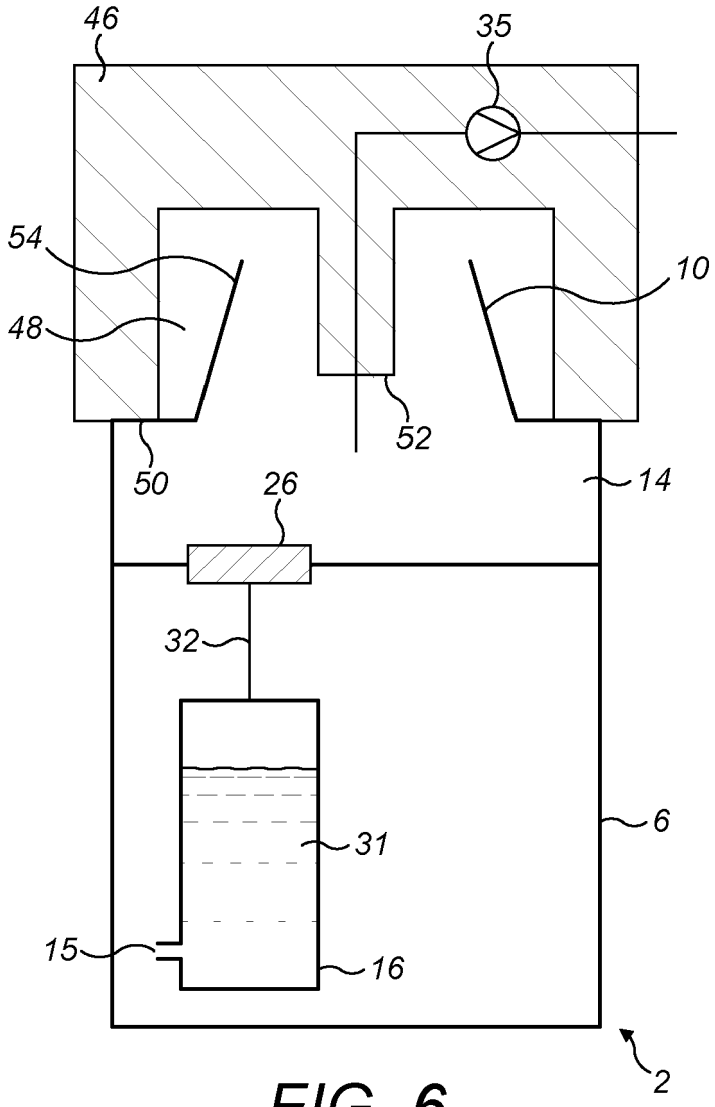

FIG. 6

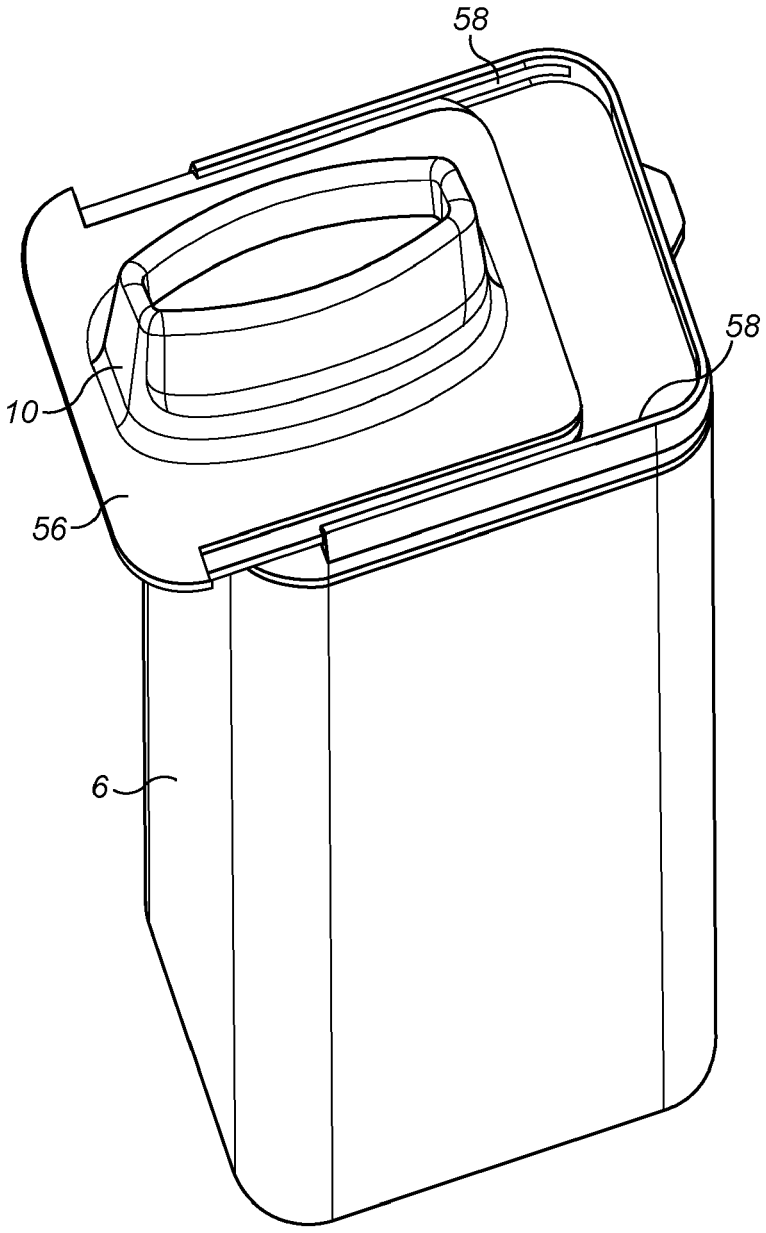

FIG. 7

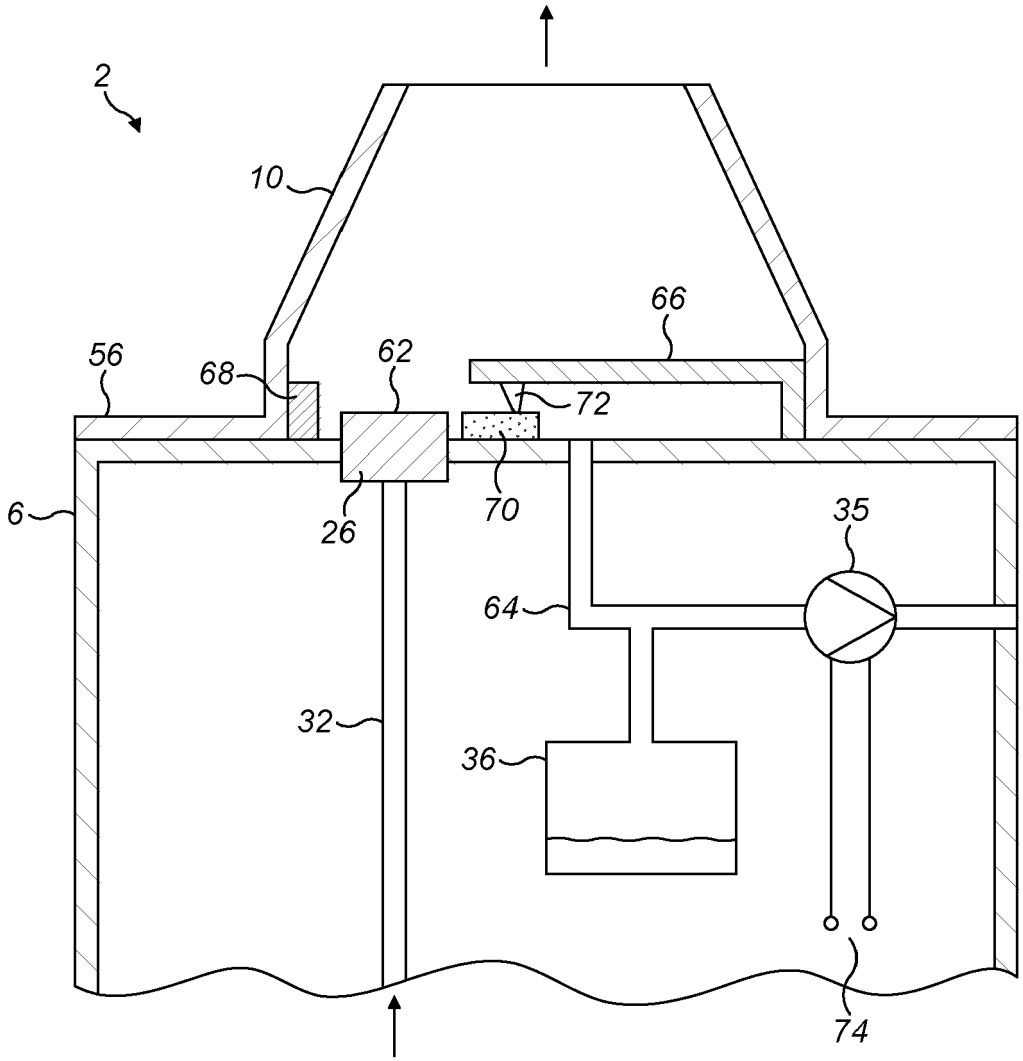

FIG. 8a

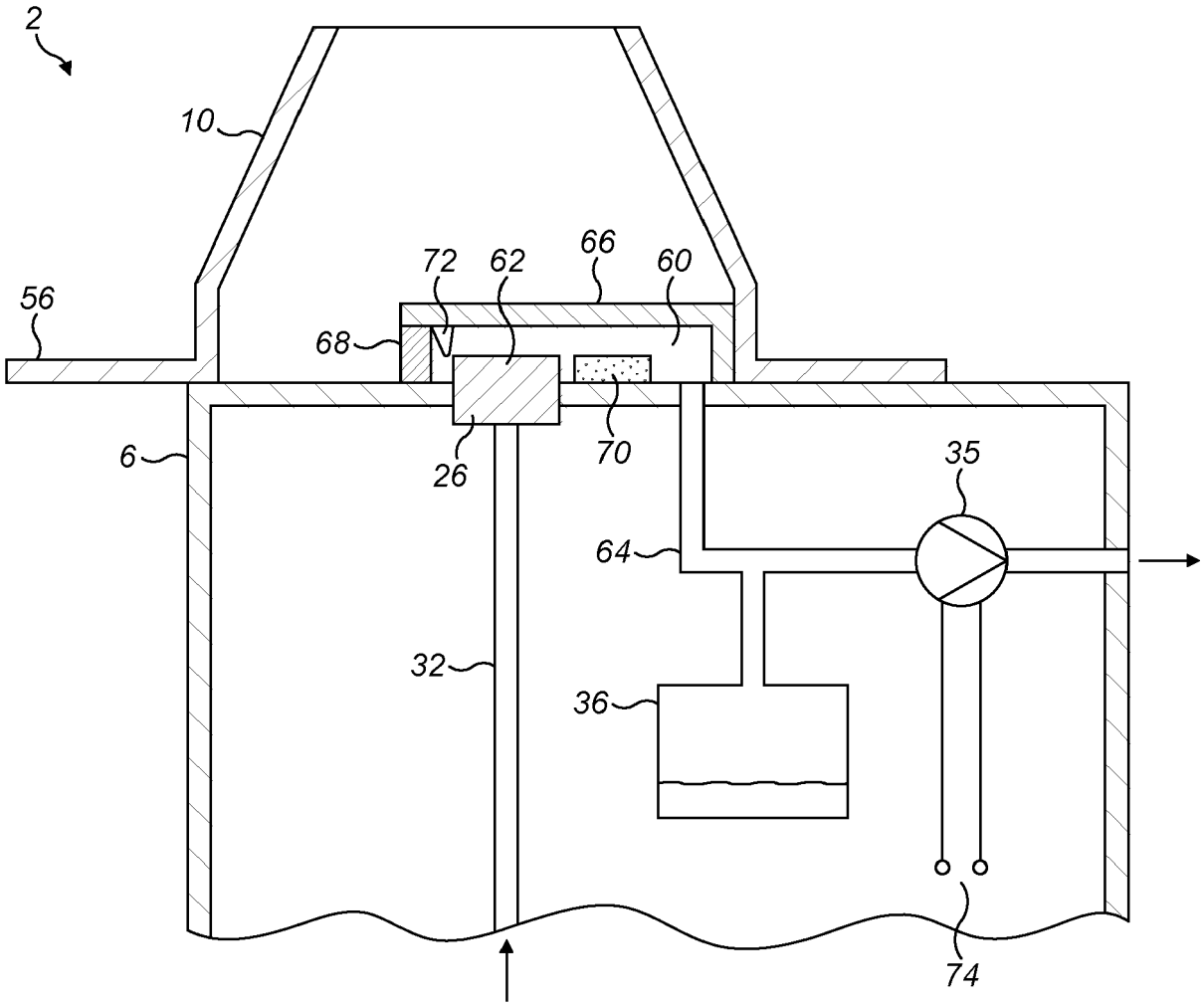

FIG. 8b

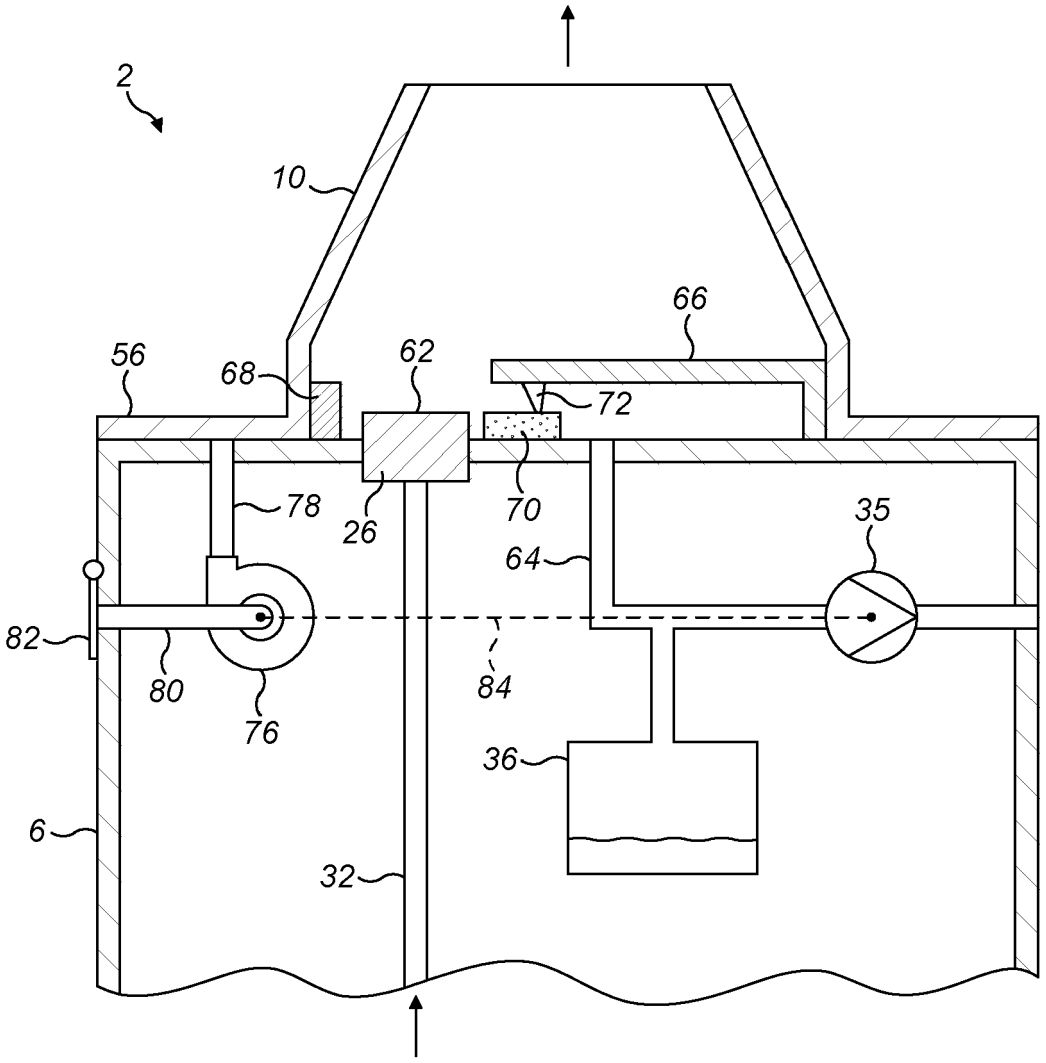

FIG. 9a

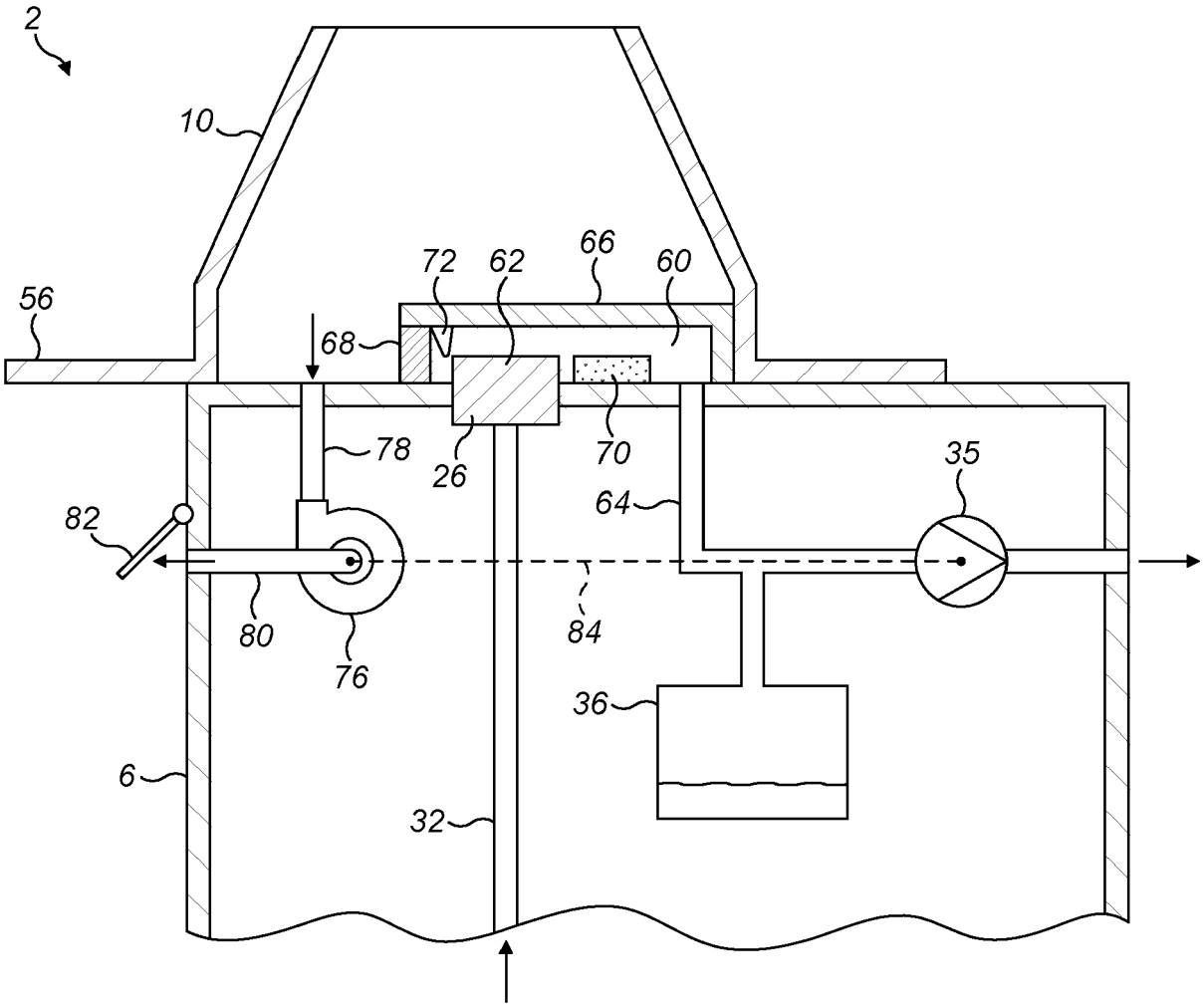

FIG. 9b

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EUROPEAN SEARCH REPORT

Application Number
EP 21 20 7443

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2021/052013 A1 (MABEE BRIAN D [US] ET AL) 25 February 2021 (2021-02-25) * paragraphs [0059] - [0149]; figures 1-23 * -----	1-15	INV. A24F40/48

TECHNICAL FIELDS SEARCHED (IPC)

A24F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 May 2022	de la Loma, Andrés

CATEGORY OF CITED DOCUMENTS

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02-05-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2021052013 A1	25-02-2021	AU 2020337254 A1	03-02-2022
		CA 3146971 A1	04-03-2021
		US 2021052013 A1	25-02-2021
		WO 2021041108 A1	04-03-2021

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