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(54) **AEROSOL GENERATING SYSTEMS**

(57) A cartridge (4) for an aerosol generating device (2) comprises a liquid storage passage (20) having an inlet (22) open to atmosphere and an outlet (24) for supplying aerosol generating liquid (18) to the aerosol generating device (2), the liquid storage passage (20) being configured to retain aerosol generating liquid (18) by capillary action. The liquid storage passage (20) is preferably a long and narrow passage, which may comprise a plurality of fluidly connected passage sections (30) configured in a serpentine arrangement. The cartridge (4) may comprise a plurality of said liquid storage passages (20) arranged in respective tiers (40). The cartridge (4) is suitable for supplying the aerosol generating liquid (18) to liquid jet heads (28) in the device (2).

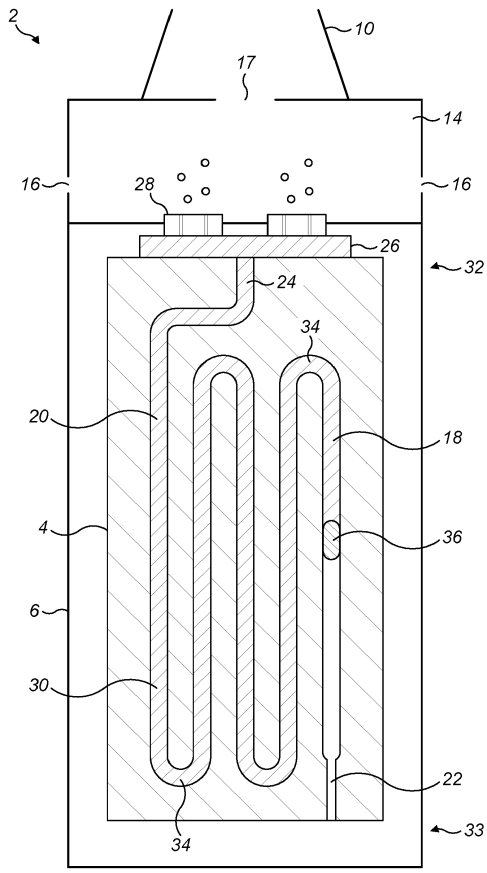

FIG. 2

EP 4 179 897 A1

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 reuse 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 liquid.

[0006] If the reservoir of aerosol generating liquid is a simple tank, then the supply of liquid may be sensitive to the orientation of the aerosol generating device. Specifically, liquid may be unable to enter the fluid flow path from the reservoir if the device is used in an orientation such that the liquid in the reservoir does not cover an outlet leading to the fluid flow path.

[0007] As aerosol generating liquid is drawn from the reservoir, the volume of the liquid removed needs to be replaced by an equivalent volume of air at substantially atmospheric pressure, otherwise the removal of liquid will tend to cause the pressure in the reservoir to drop and resist the transport of the liquid along the fluid flow path. Accordingly, a small "pinhole" aperture is typically provided to admit air into the reservoir. However, the provision of such an aperture creates a risk that liquid may leak out from the reservoir and cause damage to the surroundings or to internal components of the aerosol generating system, as well as wastage of the liquid.

[0008] 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. Unless the context clearly requires otherwise, throughout the description and the claims, the words "comprise", "comprising", and the like, are to be construed in an inclusive as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to".

[0009] When terms denoting orientation such as "upper", "lower", "top" and "bottom" are used in this specification, they are intended (unless the context requires otherwise) to refer to the orientation of the device as shown in the drawing under discussion, or during normal use. It is understood that cartridges and devices according to the invention may be manufactured, transported, stored and used in any orientation, while remaining within the scope of the appended claims.

Summary of the Disclosure

[0010] According to a first aspect of the present disclosure, there is provided a cartridge for an aerosol generating device, the cartridge comprising a liquid store for storing an aerosol generating liquid, the liquid store consisting of a liquid storage passage having an inlet open to atmosphere and an outlet for supplying aerosol generating liquid to the aerosol generating device, the liquid storage passage being configured to retain aerosol generating liquid by capillary action.

[0011] Because the liquid storage passage retains the aerosol generating liquid by capillary action, there is a reduced risk that the liquid may leak from the liquid storage passage, for example under the force of gravity or as a result of mechanical shocks to the cartridge. When the cartridge is coupled to an aerosol generating device, some types of device may exert their own capillary forces that tend to draw liquid from the outlet of the cartridge but the capillary action of the liquid storage passage according to the present invention is able to balance the capillary forces from the device, such that liquid only flows from the storage passage when a supply of liquid is required during use of the device.

[0012] Preferably, the cross section of the liquid storage passage is substantially uniform along the length of the liquid storage passage. This keeps the capillary action that retains the aerosol generating liquid in the liquid storage passage at a substantially constant level, no matter how much of the liquid remains in the liquid storage passage. This is because the supply of a given volume of liquid from the liquid storage passage always results in the same the change in the area of surface contact between the liquid and the walls of the liquid storage passage.

[0013] The length of the liquid storage passage is preferably at least 50 times the maximum dimension of the uniform cross section. Thus, the liquid storage passage is in the form of a long, narrow tube (narrow in proportion to its length) which, for any given volume of liquid in the storage passage, results in a large area of surface contact between the liquid and the walls and contributes to a high level of capillary action to retain the liquid in the storage passage.

[0014] The liquid storage passage may comprise a plurality of passage sections fluidly connected to form a continuous liquid storage passage between the inlet and the outlet. Because the liquid storage passage is preferably a long, narrow tube, it is not practical for it to be formed as a single, straight passage section within the confines of a cartridge to be received in a handheld aerosol generating device. Therefore the passage is configured to have a convoluted form capable of packing a long passage into an overall envelope of modest dimensions. This could be done in various ways, including a coiled or continuously curving passage, but a plurality of passage sections connected in series represents a preferred solution. The passage sections may be substantially straight, with connections between them that are angled or curved. The length of each passage section is preferably at least 10 times the maximum dimension of the uniform cross section. Therefore, the liquid storage passage does not change direction too frequently, which reduces the complexity of the structure and increases passage density and volumetric efficiency (i.e. the amount of fluid that can be contained in a given container).

[0015] In preferred embodiments of the invention, the cartridge comprises a first end and a second end together defining a longitudinal direction between the first end and the second end. Each passage section extends between the first end and the second end, substantially parallel to the longitudinal direction. Configuring the plurality of passage sections to extend substantially parallel to one another is an efficient way of packing them into the available volume of the cartridge. The passage sections are preferably connected alternately at opposite ends to form a continuous serpentine liquid storage passage. Thus, to travel along the liquid storage passage, liquid must flow alternately in opposite directions. This provides a benefit that external forces such as gravity or mechanical shocks, which act generally uniformly on the whole cartridge, are substantially cancelled out between successive passage sections when considered relative to the direction of flow along the passage. As a result, such forces have a greatly reduced tendency to urge the liquid to move towards the inlet or outlet of the liquid storage passage, which could result in leakage.

[0016] In some embodiments of the invention, the liquid storage passage may contain the aerosol generating liquid and a non-evaporating liquid between the aerosol generating liquid and the inlet. A drop or small volume of such a non-evaporating liquid can act as a barrier to prevent or reduce wastage of the aerosol generating liquid by evaporating into air that has been admitted via the inlet.

[0017] In some embodiments of the invention, the liquid store consists of a plurality of said liquid storage passages, each liquid storage passage having an inlet open to atmosphere and an outlet for supplying aerosol generating liquid to the aerosol generating device, and each liquid storage passage being configured to retain aerosol generating liquid by capillary action. Providing a plurality of the liquid storage passages may be more convenient than configuring a single liquid storage passage in a manner sufficiently convoluted to occupy a substantial proportion of the volume of the cartridge. Also, providing each liquid storage passage with its own outlet offers some redundancy, whereby if one of the passages becomes blocked or exhausted so that it can longer supply aerosol generating liquid to the device, the other passages can continue to do so. When the cartridge is connected to an aerosol generating device, the respective liquid storage passages may each be connected to a separate aerosol generating unit of the device. Alternatively, they may be connected to a common manifold, which in turn supplies the liquid to one or more aerosol generating units.

[0018] In some embodiments of the invention, the cartridge comprises a first surface, a second surface substantially parallel to the first surface, and a plurality of said tiers between the first and second surfaces, and one of said liquid storage passages is arranged in each tier. This provides a convenient way of manufacturing a cartridge that comprises a plurality of the liquid storage passages in an essentially modular fashion.

[0019] According to another aspect of the invention, an aerosol generating system comprises an aerosol generating device and a cartridge as previously described, the cartridge being releasably connectable to the aerosol generating device. Preferably, the aerosol generating device comprises an aerosol generating unit and the liquid outlet of the liquid storage passage is positioned adjacent to the aerosol generating unit to supply aerosol generating liquid to the aerosol generating unit.

[0020] According to another aspect of the invention, the aerosol generating unit of the aerosol generating device is a liquid jet head. A liquid jet head works in a similar way to inkjet 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.

[0021] 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.

Brief Description of the Drawings

[0022]

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

Figure 2 is a schematic diagram of a cartridge according to a first embodiment of the invention, installed in an aerosol generating device.

Figure 3 is a perspective view, partially transparent, showing the construction of a cartridge according to a second embodiment of the invention.

Figure 4 is a perspective view seen in section on line A-A of Figure 3.

Figure 5 is a perspective view, partially transparent, showing the construction of a cartridge according to a third embodiment of the invention.

Figure 6 is a section on line B-B of Figure 5.

Figure 7 is a section on line C-C of Figure 5.

Detailed Description of Embodiments

[0023] Embodiments of the present disclosure will now be described by way of example only and with reference to the accompanying drawings.

[0024] Figure 1 illustrates a handheld vapour generating system, comprising a vapour generating device 2 and a replaceable cartridge 4 that is removably received in the vapour 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 vapour generating liquid, which can be consumed by the device 2 to generate 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.

[0025] The configuration and operation of the system during normal use to generate an aerosol may be conventional; they are not the subject of the present invention and are not described in any detail here. The device 2 may heat the liquid from the cartridge 4 to form a vapour, which subsequently condenses to form an aerosol. Alternatively, the device may use liquid jet head technology to form the aerosol directly by injecting droplets of the liquid into air in a mixing chamber. 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 vapour generating device 2.

[0026] Figure 2 schematically shows a cartridge 4 according to the invention, installed in an aerosol generating device 2. Details of the device, such as a power supply and control electronics, are not illustrated. At the proximal end of the device 2 is a mixing chamber 14, which receives air from the atmosphere via one or more air inlets 16, and which is in fluid communication with the mouthpiece 10 so that a user can draw air through the mixing chamber by inhaling through the mouthpiece 10. Although the air inlets 16 and the aperture 17 between the mixing chamber 14 and the mouthpiece 10 are illustrated as simple openings, they may take other forms, including conduits, and may be provided with features such as baffles to reduce leakage of liquid from the device or filters to prevent particles being drawn into the device. Particularly in other embodiments of the invention (not illustrated) in which the aerosol is generated by condensation of vapour, a conduit between the mixing chamber and the mouthpiece may provide space for such condensation to take place. A heater (not shown) may be provided to cause vaporization of the liquid or simply to condition the air in the mixing chamber to bring the aerosol to a preferred temperature for inhalation by the user.

[0027] The cartridge 4 shown in Figure 2 stores the liquid 18 in a liquid storage passage 20. The passage 20 extends in a convoluted shape from an inlet 22 that is open to atmosphere to an outlet 24, from which the aerosol generating liquid 18 can be introduced into the mixing chamber 14 of the aerosol generating device 2. The air inlet 22 does not necessarily need to be exposed directly to the atmosphere at the exterior of the device 2. It is sufficient if, as shown, the air inlet opens to a space inside the housing 6 of the device, which is substantially equalized with ambient atmospheric pressure. When the cartridge 4 is received in an aerosol generating device 2, the outlet 24 of the liquid storage passage 20 is adjacent to and in fluid communication with an aerosol generating unit of the aerosol generating device 2. Coupling means (not illustrated) are provided to ensure that such fluid communication is established in an air- and liquid-tight manner.

[0028] The aerosol generating unit of the device 2 comprises one or more liquid transfer elements to control the rate at which the liquid 18 enters the mixing chamber 14. In the illustrated device 2, the liquid transfer elements are liquid jet heads 28. The aerosol generating unit further comprises a manifold 26 for distributing liquid 18 from the storage passage 20 to the respective jet heads 28. In alternative embodiments that have only a single liquid storage passage 20 coupled to a single jet head 28, the manifold 26 may be omitted. The liquid jet heads 28 expel droplets of the liquid 18 into the mixing chamber 14 to form an aerosol in the air that is drawn through the mixing chamber 14 by inhalation of the user. Control electronics in the device 2 may be coupled to airflow or pressure sensors (not illustrated) in the mixing chamber 14 or in the mouthpiece 10 such that the control electronics can determine when the user inhales and activate the jet heads 28 only at those times. A filter (for example stainless steel mesh filter, polymer filter, not illustrated) may be provided between the outlet 24 and the manifold 26 or between the manifold 26 and the liquid jet heads 28.

[0029] The liquid storage passage 20 is configured to retain the aerosol generating liquid 18 by capillary action. When the aerosol generating system is not in use to generate an aerosol, there is a risk that aerosol generating liquid 18 could leak from the liquid storage passage 20 via either the inlet 22 or the outlet 24. However, in accordance with the invention, the affinity between the liquid 18 and the internal walls of the liquid storage passage 20 is sufficient to retain the liquid 18 in the passage 20 against the force of gravity that might tend to cause leakage. The liquid jet heads 28 with which the liquid storage passage 20 is in fluid communication comprise narrow conduits that can exert their own capillary action tending to draw the liquid 18 out of the storage passage 20. However, the capillary action of the liquid storage passage 20 is able to balance that tendency and retain the liquid 18 when the system is not in use to generate an aerosol.

[0030] When the system is in use to generate an aerosol, the liquid jet heads 28 expel liquid 18 into the mixing chamber 14 and deplete the quantity of liquid 18 in the manifold 26, which causes a reduced pressure at the outlet 24. The difference between atmospheric pressure at the inlet 22 and reduced pressure at the outlet 24 is sufficient to overcome the capillary action that retains the liquid 18 in place so the pressure difference causes liquid to flow along the storage passage 20 and replenish the manifold 26.

[0031] The strength of the capillary force that retains the aerosol generating liquid 18 in the liquid storage passage 20 depends on various factors, including in particular: the affinity between the liquid 18 and the material of the passage walls, the viscosity of the liquid 18, and the cross section of the liquid storage passage 20. The liquid 18 must have a positive affinity for the material of the walls. For example, the aerosol generating liquid 18 is typically hydrophilic so the walls should be made from a compatible material that attracts such a liquid, for example polycarbonate, ABS plastic (Acrylonitrile butadiene styrene), polyethylene, more specifically PET . If the liquid storage passage 20 is too wide or if the viscosity of the liquid 18 is too low, liquid may continue to flow through the centre of the passage 20 despite the adhesion of its outer parts to the passage walls. An additive may be added to the aerosol generating liquid 18 to change its affinity for the passage walls and/or its viscosity. Any such additive must be safe for inhalation by the user and any change to viscosity must not detract from the reliable operation of the jet heads 28. Additionally, the capillary sections or tubes have diameters from 2 to 5mm, preferably from 3 to 4mm, more preferably 3mm. In this way the capillary tubes provide resistive forces to the gravity and to the opposite capillary force of the MEMS jet heads 28.

[0032] Preferably, the liquid storage passage 20 is formed as a long, narrow tube having a substantially uniform cross-section. In Figure 2 the cross-section is a circle but in other embodiments it may, for example, be a square or other rectangle. Preferably the greatest dimension of the cross-section is no more than twice the smallest dimension. For example, if the cross-section is a rectangle, it preferably has an aspect ratio no greater than 2:1.

[0033] Preferably, the total length of the liquid storage passage 20 is at least 50 times the maximum dimension of the uniform cross section. In order to fit the long fluid storage passage 20 within the confines of the cartridge 4, it is given a convoluted shape. In preferred embodiments of the invention, as seen in Figure 2, the fluid storage passage 20 comprises a plurality of passage sections 30 fluidly connected to form a continuous liquid storage passage 20 between the inlet 22 and the outlet 24. In this embodiment, the cartridge 4 comprises a first end 32 and a second end 33 together defining a longitudinal direction between the first end 32 and the second end 33. Each of the five passage sections 30 extends between the first end 32 and the second end 33, substantially parallel to the longitudinal direction. Successive passage sections 30 are connected alternately at opposite ends to form the continuous liquid storage passage 20. As used here, "connected" does not imply that the form of the passage must result from a physical process of connecting together sections that were originally separate (although that is not excluded from the scope of the invention). It simply means that the passage sections 30 are in fluid communication with one another via the connecting sections 34.

[0034] The length of each passage section 30 is preferably at least 10 times the maximum dimension of the uniform cross section. It will be understood that the number of passage sections 30 may be greater or fewer than five. By increasing the number of sections 30, it would be possible for a greater proportion of the volume of the cartridge 4 to be occupied by the liquid storage passage 20 so that a cartridge of a given size can store a greater volume of the liquid 18. It is convenient, but not essential, for successive passage sections 30 along the length of the liquid storage passage 20 to be positioned adjacent to one another within the cartridge.

[0035] Connecting substantially straight passage sections 30 by curved connecting sections 34 results in the liquid storage passage 20 having a serpentine form. This arrangement both contains a long, narrow liquid storage passage 20 within a compact space and provides the further advantage that it reduces the tendency for the liquid 18 to leak out of the liquid storage passage 20. The intended direction of flow forwards along the liquid storage passage 20 from the inlet 22 to the outlet 24 will carry the liquid 18 alternately towards the first end 32 and the second end 33 of the device 2 as successive passage sections 30 are traversed. Therefore the force of gravity, or any other mechanical force such as a sudden shock to the device 2, will act to urge the liquid 18 in alternate passage sections 30 to move respectively forwards and backwards along the passage 20. Most of the forces will cancel out so the net force that might cause the liquid 18 to leak from either the inlet 22 or the outlet 24 will be greatly reduced. For the same reason, and because of the capillary forces retaining the liquid 18 in position in the liquid storage passage 20, cartridges 4 according to the present invention may be used in different orientations, with a greatly reduced risk that the stored liquid 18 may flow away from the outlet 24 and interrupt the supply of aerosol generating liquid 18 to the device 2.

[0036] As seen in Figure 2, the cross-section of the inlet 22 and the outlet 24 may be smaller than the uniform cross-section over the majority of the length of the liquid storage passage 20. This also helps to avoid leakage of liquid 18 from the inlet 22 or the outlet 24. The smaller cross-section of the inlet 22 also helps to reduce possible evaporation of the liquid 18 to the atmosphere via the inlet 22. A further way of doing this is to provide a drop or a small volume of a non-evaporating liquid 36 in the liquid storage passage 20 between the aerosol generating liquid 18 and the inlet 22. The drop 36 acts as a barrier to prevent or reduce evaporation from the surface of the liquid 18 towards the upstream end of the passage 20. The non-evaporating liquid 36 does not itself evaporate, or at least does so slowly enough that the remaining liquid 36 can continue to act as a barrier during the expected life of the cartridge 4 until the liquid 18 is exhausted. One example of a suitable non-evaporating liquid is propylene glycol . As the aerosol generating liquid 18 is consumed, it moves forwards along the liquid storage passage 20 and its volume is replaced by air from the inlet 22. The drop of non-evaporating liquid 36 similarly moves forwards, remaining in contact with the surface of the aerosol generating liquid 18.

[0037] The liquid storage passage 20 shown in Figure 2 is formed as a passage within a solid block of the material of the cartridge, which may be done by a manufacturing process such as 3D printing. Figures 3 and 4 illustrate a different way of forming serpentine liquid storage passages 20 in a cartridge 4, which may be more suitable for mass production. The cartridge 4 comprises one or more generally rectangular layers or tiers 40. By way of example, three of the tiers 40 are shown in Figures 3 and 4. A liquid storage passage 20 is formed through the thickness of each tier 40, for example by moulding or machining, so as to be open to the upper and lower surfaces of the tier 40. The tier 40 is then sandwiched between a pair of solid rectangular plates 42, which close the top and bottom of the storage passage 20 to form a structure substantially similar to that in Figure 2, except that that the liquid storage passage 20 has a rectangular cross-section. The inlet 22 and outlet 24 of the liquid storage passage 20 are formed as bores in the ends of each tier 40. In this case, the inlet 22 and outlet 24 are at opposite ends of the tier 40 but that is not essential. If the liquid storage passage 20 comprises an even number of the longitudinal passage sections 30, then the inlet 22 and the outlet 24 will naturally be located at the same end of the tier 40.

[0038] As seen in Figures 3 and 4, a number of the tiers 40 and plates 42 may be stacked alternately in the cartridge 4, with plates 42 forming the top and bottom of the stack. (The uppermost plate 42 is transparent in the Figures to reveal the structure below.) The tiers 40 and plates 42 may be joined together in an air- and liquid-tight manner by any convenient means, for example by adhesives or by heat staking. In the embodiment of Figures 3 and 4, each tier 40 provides an independent liquid storage passage 20. When the cartridge 4 is received in an aerosol generating device, the outlets 24 of the respective passages 20 may each be coupled to a separate jet head 28. Alternatively, the outlets 24 may all be coupled to a common manifold 26, which supplies the liquid 18 to one or more jet heads 28.

[0039] In a variant of this embodiment, the liquid storage passage 20 could be formed in each tier 40 so as to be open to only the upper surface of the tier 40. Then no plate 42 would be needed to close the passage 20 at its lower surface or seal between the layers; and all of the plates 42 in the stack except for the uppermost one would be redundant. In other respects, the structure of the cartridge 4 of such an embodiment would be identical to that in Figures 3 and 4.

[0040] Whereas the embodiment of Figures 3 and 4 comprises a plurality of tiers 40 forming a corresponding plurality of liquid storage passages 20 that operate in parallel, Figures 5 to 7 illustrate an alternative embodiment in which the tiers 40 are connected in series to form a single, extra long liquid storage passage 20. To achieve this, the construction of the cartridge 4 is essentially the same as in the previous embodiment but there are some changes in detail. In the top tier 40, an inlet 22 is formed at the first end 32 in the same way as in Figure 3. At the second end 33, instead of emerging through an outlet 24, the liquid storage passage 20 continues through an aperture 44 in the plate 42 below to communicate with the passage 20 in the middle tier 40 (Figure 6). At the first end 32 of the middle tier 40, the liquid storage passage 20 continues through a further aperture 44 in the plate 42 below to communicate with the passage 20 in the bottom tier 40 (Figure 7). Then at the second end of the bottom tier 40, the liquid storage passage 40 is coupled to an outlet 24 (Figure 6). Thus the liquid storage passage 20 follows a single, convoluted path through all three tiers 40 of the cartridge 4.

[0041] Although exemplary embodiments have been described in the preceding paragraphs, it should be understood that various modifications may be made to those embodiments without departing from the scope of the appended claims. Thus, the breadth and scope of the claims should not be limited to the above-described exemplary embodiments.

[0042] Any combination of the above-described features in all possible variations thereof is encompassed by the present disclosure unless otherwise indicated herein or otherwise clearly contradicted by context.

Claims

1. A cartridge (4) for an aerosol generating device (2), the cartridge (4) comprising:
a liquid store for storing an aerosol generating liquid (18), the liquid store consisting of a liquid storage passage (20) having an inlet (22) open to atmosphere and an outlet (24) for supplying aerosol generating liquid (18) to the aerosol generating device (2), the liquid storage passage (20) being configured to retain aerosol generating liquid (18) by capillary action.

2. A cartridge (4) according to claim 1, wherein the cross section of the liquid storage passage (20) is substantially uniform along the length of the liquid storage passage (20).

3. A cartridge (4) according to claim 2, wherein the length of the liquid storage passage (20) is at least 50 times the maximum dimension of the uniform cross section.

4. A cartridge (4) according to claim 2 or claim 3, wherein the liquid storage passage (20) comprises a plurality of passage sections (30) fluidly connected to form a continuous liquid storage passage (20) between the inlet (22) and the outlet (24).

5. A cartridge (4) according to claim 4, wherein the cartridge (4) comprises a first end (32) and a second end (33) together defining a longitudinal direction between the first end (32) and the second end (33).

6. A cartridge (4) according to claim 5, wherein each passage section (30) extends between the first end (32) and the second end (33) substantially parallel to the longitudinal direction.

7. A cartridge (4) according to claim 6, wherein passage sections (30) are connected alternately at opposite ends to form a continuous serpentine liquid storage passage (20).

8. A cartridge (4) according to any of claims 4 to 7, wherein the length of each passage section (30) is at least 10 times the maximum dimension of the uniform cross section.

9. A cartridge (4) according to any of claims 2 to 8, wherein the maximum dimension of the uniform cross section is from 2 to 5mm, preferably from 3 to 4mm, more preferably 3mm.

10. A cartridge (4) according to any preceding claim, wherein the liquid storage passage (20) contains the aerosol generating liquid (18) and a non-evaporating liquid (36) between the aerosol generating liquid (18) and the inlet (22).

11. A cartridge (4) according to any preceding claim, wherein the liquid store consists of a plurality of said liquid storage passages (20), each liquid storage passage (20) having an inlet (22) open to atmosphere and an outlet (24) for supplying aerosol generating liquid (18) to the aerosol generating device (2), and each liquid storage passage (20) being configured to retain aerosol generating liquid (18) by capillary action.

12. A cartridge (4) according to claim 11, wherein the cartridge (4) comprises a first surface, a second surface substantially parallel to the first surface, and a plurality of tiers (40) between the first and second surfaces, and one of said liquid storage passages (20) is arranged in each tier (40).

13. An aerosol generating system comprising an aerosol generating device (2) and a cartridge (4) according to any preceding claim, the cartridge (4) being releasably connectable to the aerosol generating device (2).

14. An aerosol generating system according to claim 13, wherein the aerosol generating device (2) comprises an aerosol generating unit (26,28) and the outlet (24) of the liquid storage passage (20) is positioned adjacent to the aerosol generating unit (26,28) to supply aerosol generating liquid (18) to the aerosol generating unit (26,28).

15. An aerosol generating system according to claim 14, wherein the aerosol generating unit comprises a liquid jet head (28).

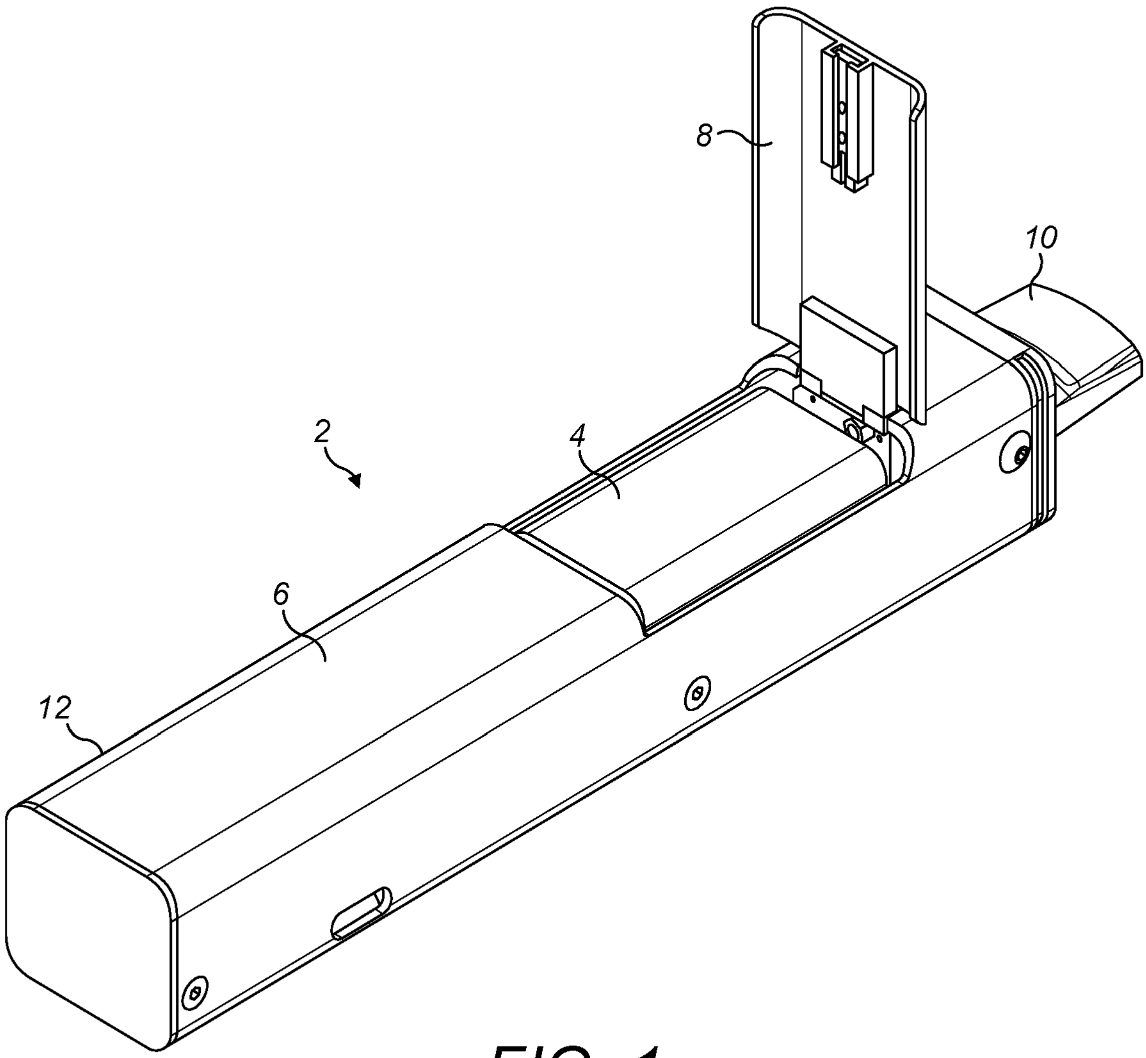

FIG. 1

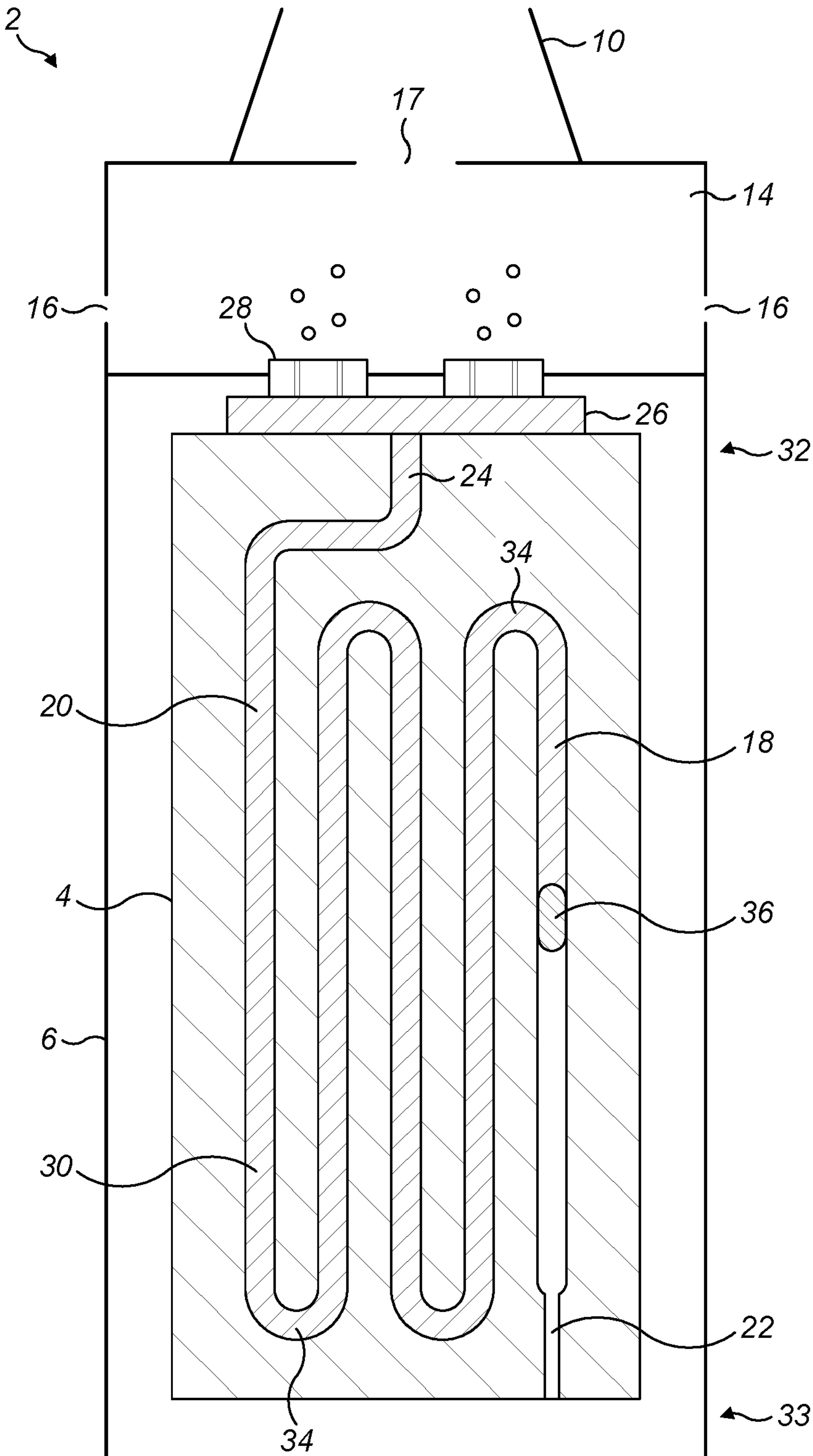

FIG. 2

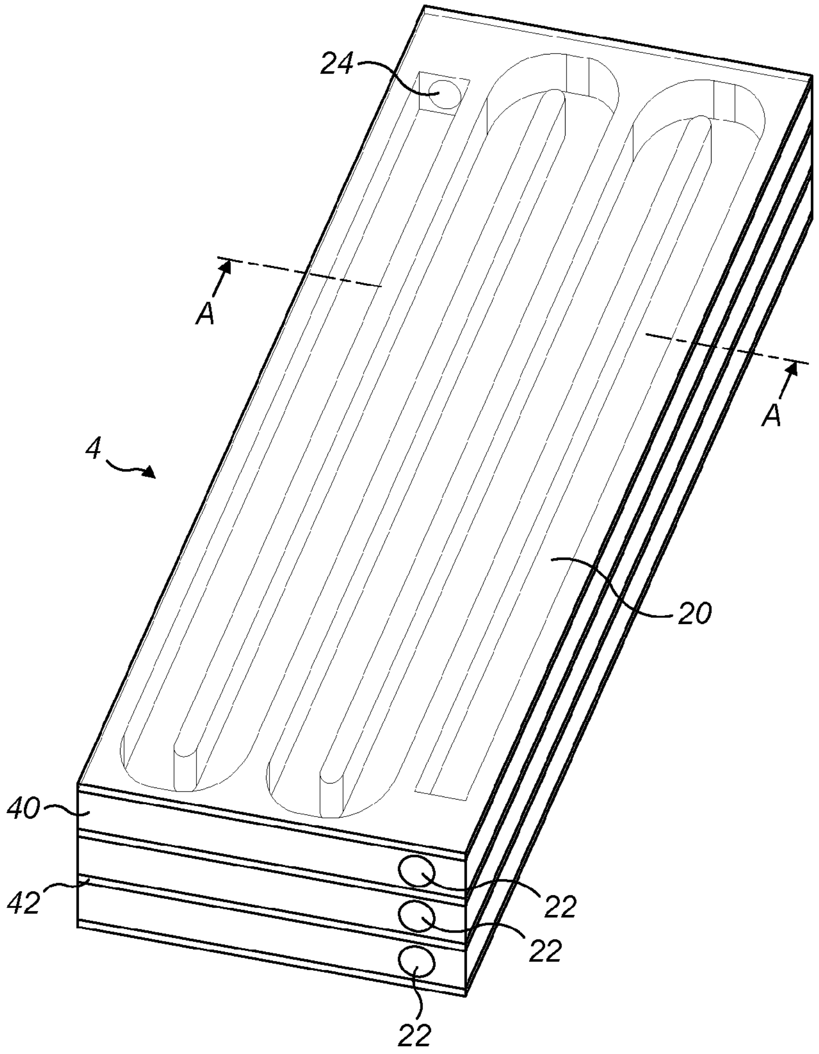

FIG. 3

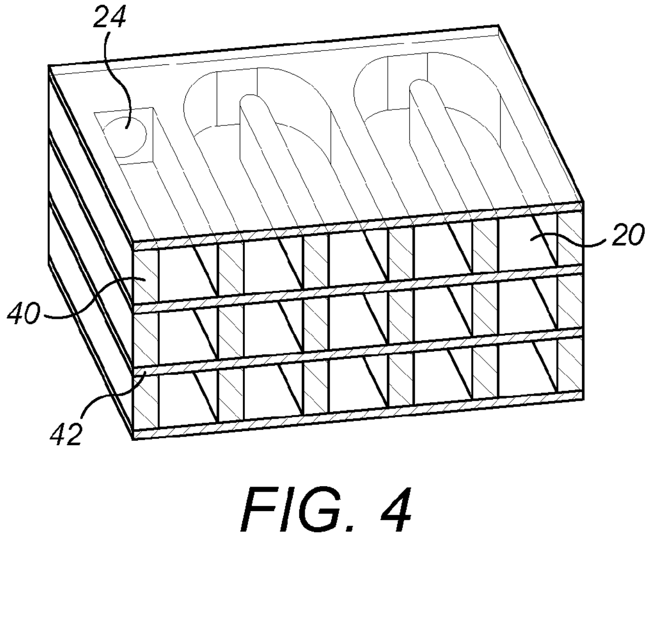

FIG. 4

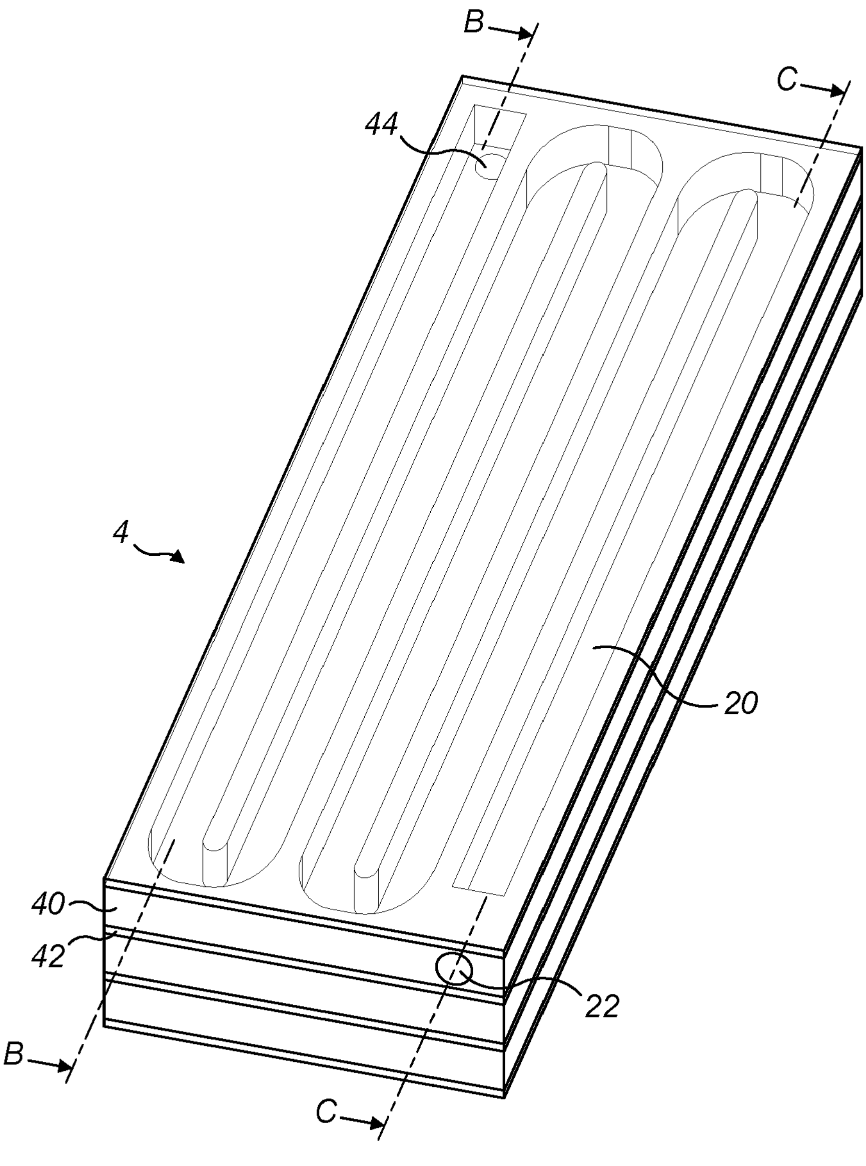

FIG. 5

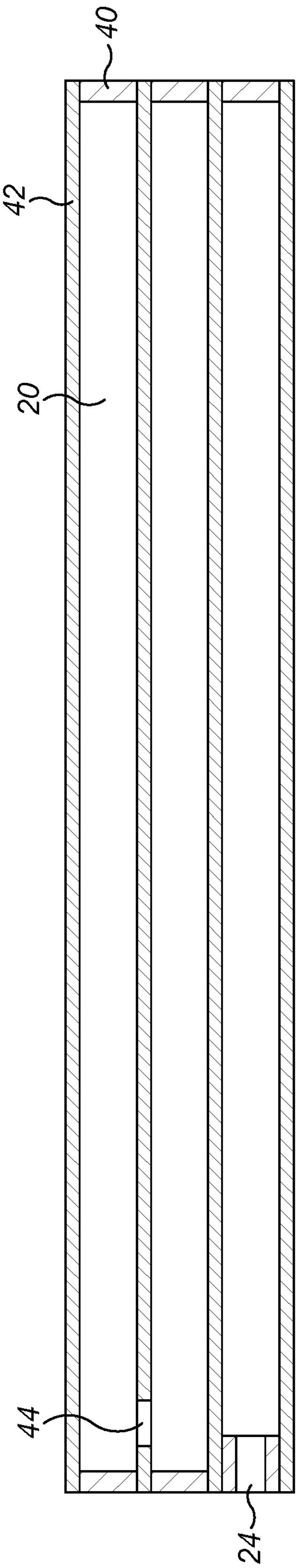

FIG. 6

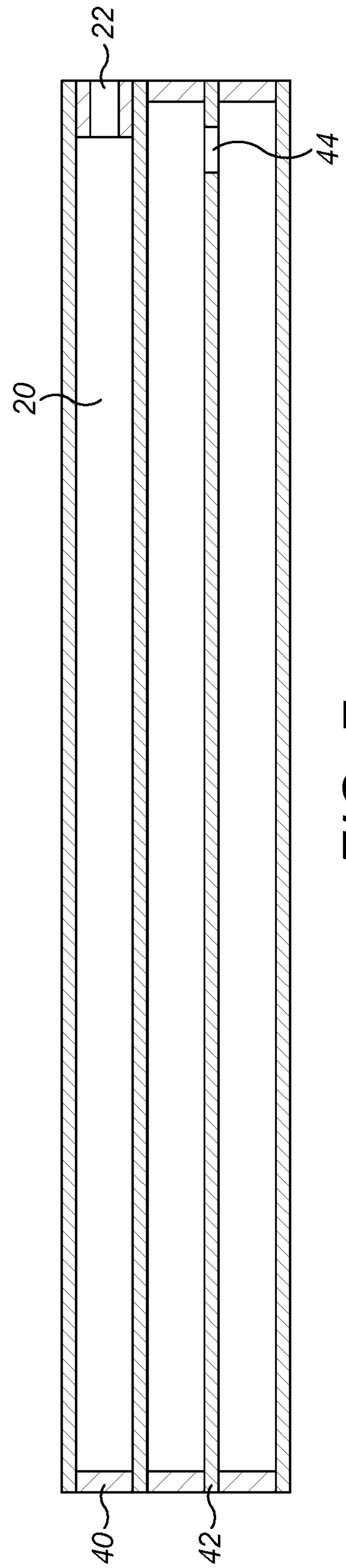

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 2021/186100 A1 (TRIEU HOC KHIEM [DE] ET AL) 24 June 2021 (2021-06-24) * paragraphs [0025], [0034], [0035], [0042], [0043], [0051], [0062], [0063], [0065], [0069], [0085] - [0092] *	1-9, 11-15 10	INV. A24F40/42
X	DE 10 2014 114133 A1 (AIE INVEST S A [LU]) 31 March 2016 (2016-03-31) * paragraphs [0036], [0037], [0041], [0044] *	1-3,8, 13,14	
			TECHNICAL FIELDS SEARCHED (IPC)
			A24F

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	10 May 2022	Coniglio, Carlo

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EP 21 20 7439

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10-05-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2021186100 A1	24-06-2021	CN 111163656 A	15-05-2020
		DE 102017123869 A1	18-04-2019
		EP 3694351 A1	19-08-2020
		JP 2020536564 A	17-12-2020
		KR 20200070270 A	17-06-2020
		US 2021186100 A1	24-06-2021
		WO 2019072971 A1	18-04-2019
DE 102014114133 A1	31-03-2016	NONE	

EPO FORM P0459

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