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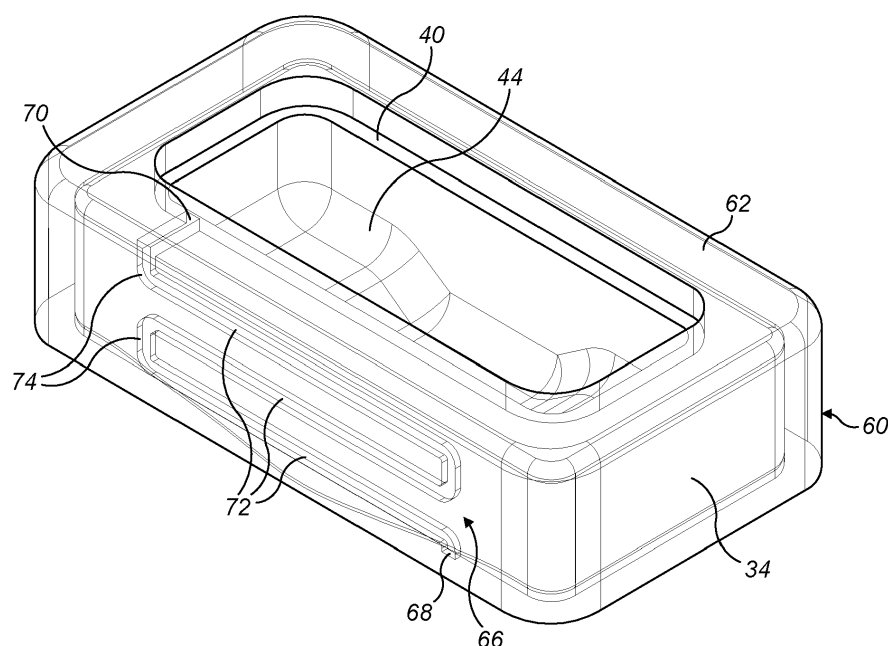
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(54) **AEROSOL GENERATING SYSTEMS AND CARTRIDGES FOR USE IN AEROSOL GENERATING SYSTEMS**

(57) A cartridge 14 for an aerosol generating system comprises a reservoir 30 having a reservoir chamber 32 for containing a liquid aerosol generating substrate, a vaporisation region 36, a porous ceramic fluid transfer medium 34 operable to absorb liquid from the reservoir chamber 32 and transfer the absorbed liquid to the vaporisation region 36, and a seal located between the reservoir 30 and the fluid transfer medium. The seal

60, 60a, 60b has a first surface abutting the reservoir 30 and a second surface abutting the porous ceramic fluid transfer medium 34. The seal 60, 60a, 60b comprises a resilient material, and a pressure release structure 66, 66a, 66b is formed in the resilient material. An aerosol generating system including the cartridge 14 is also described.

**FIG. 3**

Description

Technical Field

[0001] The present invention relates generally to aerosol generating systems. The invention relates particularly, but not exclusively, to cartridges for aerosol generating systems that comprise a base part and a separable cartridge.

Technical Background

[0002] Aerosol generating systems, also commonly termed electronic cigarettes, are an alternative to conventional cigarettes. Instead of generating a combustion smoke, they vaporise a liquid aerosol generating substrate which can be inhaled by a user. The liquid typically comprises an aerosol-forming substance, such as glycerine or propylene glycol, that creates the vapour when heated. Other common substances in the liquid are nicotine and various flavourings.

[0003] An aerosol generating system is a hand-held inhaler system, typically comprising a mouthpiece section, a reservoir configured to hold liquid aerosol generating substrate in a reservoir chamber, and a power supply unit. Vaporisation is achieved in a vaporisation region, such as a vaporisation chamber, by a vaporiser or heater unit which typically comprises a heating element in the form of a heating coil and a fluid transfer medium such as a wick. Vaporisation occurs when the heating element heats the liquid in the fluid transfer medium until the liquid is transformed into vapour.

[0004] 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. It should, however, be noted that the terms "aerosol" and "vapour" may be used interchangeably in this specification, particularly with regard to the form of the inhalable medium that is generated for inhalation by a user.

[0005] Conventional cigarette smoke comprises nicotine as well as a multitude of other chemical compounds generated as the products of partial combustion and/or pyrolysis of the plant material. Electronic cigarettes on the other hand deliver primarily an aerosolised version of an initial starting e-liquid composition comprising nicotine and various food safe substances such as propylene glycol and glycerine, etc., but are also efficient in delivering a desired nicotine dose to the user. Electronic cigarettes need to deliver a satisfying amount of vapour for an optimum user experience whilst at the same time maximising energy efficiency.

[0006] WO 2017/179043 discloses an aerosol generating system comprising a disposable cartridge and a reusable base part. The cartridge has a simplified struc-

ture which is achieved by keeping the main heating element in the reusable base part, while the cartridge is provided with a heat transfer unit. The heat transfer unit is configured to transfer heat from the heating element to the proximity of liquid in the cartridge to produce a vapour for inhalation by a user.

[0007] During use of an aerosol generating system, as liquid in the fluid transfer medium is vaporised, the pressure in the reservoir drops. This is because liquid is pulled into the fluid transfer medium by capillary forces in order to re-saturate the fluid transfer medium as liquid already held in the fluid transfer medium is heated and vaporised. The pressure difference between the reservoir chamber and the ambient atmosphere outside the reservoir can become large unless air is permitted to propagate to the reservoir chamber in order to equalise the pressure. Failure to permit air ingress to the reservoir chamber can prevent the fluid transfer medium from re-saturating correctly. For this reason, aerosol generation systems sometimes include a pressure balance system that is operable to provide a pressure equalisation air path between the reservoir chamber and air at ambient pressure. Such a pressure balance system allows for gas (and in particular, air) transfer into the reservoir as liquid is consumed in the vaporisation process.

[0008] However, since such pressure balance systems permit air ingress to the reservoir chamber, they can also permit fluid to escape from the reservoir chamber. This can undesirably result in leakage from the reservoir chamber, resulting in the need to provide additional structure in the system to combat or contain the leakage. Such additional structure can add to the complexity of the system, and hence increase the cost and complexity of manufacture.

[0009] It is desirable to provide a cartridge including an alternative pressure balance system that is less prone to leakage, and/or which has a simplified construction.

Summary

[0010] According to a first aspect of the present invention, we provide a cartridge for an aerosol generating system, the cartridge comprising:

- a reservoir having a reservoir chamber for containing a liquid aerosol generating substrate;
- a vaporisation region;
- a porous ceramic fluid transfer medium operable to absorb liquid from the reservoir chamber and transfer the absorbed liquid to the vaporisation region; and
- a seal located between the reservoir and the fluid transfer medium, the seal having a first surface abutting the reservoir and a second surface abutting the porous ceramic fluid transfer medium; wherein the seal comprises a resilient material, and a pressure release structure is formed in the resilient material.

[0011] Conventional pressure balance systems are typically provided in a wall of the reservoir, or as an additional component in fluid communication with the reservoir, such as a mounting fixture for the fluid transfer medium. This adds complexity to the construction of a cartridge, and so adds to the expense of production. Furthermore, leakage from the reservoir can occur via the pressure balance system, as it provides a fluid path between the reservoir chamber and the exterior of the reservoir. Again, this can result in the need for additional complexity in the form of leakage prevention systems, such as ribs external to the reservoir for collecting the leaked liquid.

[0012] By providing a pressure release structure in a resilient (i.e. deformable and/or elastic) seal, air can be provided with a pressure equalisation path for ingress to the reservoir chamber that has flexible dimensions. The pressure release structure is thus operable to permit air ingress to the reservoir chamber from a location external to the reservoir via a path which can deform if necessary. Such a structure may be less prone to leakage than prior pressure release systems, as it may be formed having smaller dimensions than an equivalent structure formed in a rigid material. Locating the pressure release structure in a resilient seal may further allow for a simplified construction as compared to other pressure balance systems, as a flexible component may be easier to manufacture and/or require lower manufacturing tolerances.

[0013] The pressure release structure may comprise a pressure release channel formed in the first surface of the resilient seal. Air may be guided through the pressure release channel to the reservoir chamber between the resilient seal and the reservoir.

[0014] The pressure release structure may comprise a pressure release channel formed in the second surface of the resilient seal. Air may be guided through the pressure release channel to the reservoir chamber between the resilient seal and the porous ceramic fluid transfer medium. In this case, any fluid that escapes from the reservoir chamber via the pressure release channel may be absorbed into the porous ceramic of the fluid transfer medium directly from the pressure release channel. This may reduce the risk of leakage from the reservoir via the pressure release channel.

[0015] In one example, the cartridge further comprises a vapour transfer channel operable to fluidly connect an inlet with an outlet, with the vaporisation region being in communication with, and preferably located in, the vapour transfer channel between the inlet and the outlet.

[0016] The pressure release structure may comprise a gas inlet located in the vapour transfer channel and a gas outlet in fluid communication with the reservoir chamber. Thus, in the unlikely event that any fluid does happen to escape from the reservoir chamber, such escaped fluid may be deposited into the vapour transfer channel. This may reduce the risk of such fluid coming into contact with other parts of the cartridge, such as electrical connections.

[0017] The pressure release structure may comprise a pressure release channel extending between the reservoir chamber and the vapour transfer channel, preferably terminating adjacent the vaporisation region. Thus, in the unlikely event that any fluid does happen to escape from the reservoir chamber, such escaped fluid may be deposited into the vaporisation region, from which it may be vaporised together with fluid that has been wicked through the fluid transfer medium in a more conventional manner.

[0018] The pressure release channel may comprise a gas outlet in direct fluid communication with the reservoir chamber. Pressure within the reservoir may therefore be equalised by means of air ingress to the reservoir chamber via the gas outlet. The pressure release channel may alternatively terminate short of the reservoir chamber at a blind end. In this alternative, no open gas outlet is provided in direct fluid communication with the reservoir chamber, and instead a separating portion of resilient material is located between the blind end of the pressure release channel and an edge of the seal. Nevertheless, air may enter the reservoir from the pressure release channel if the pressure in the reservoir lowers sufficiently such that a differential pressure between the reservoir chamber and the exterior causes air to be drawn around the separating portion. The separating portion may have a largest dimension that is less than 2mm, or less than 1mm, or less than 0.5mm. By omitting an open gas outlet in the interior surface of the reservoir a direct fluid connection between the reservoir chamber and the exterior is also omitted, further reducing the likelihood of leakage.

[0019] A portion of the vapour transfer channel extending from the vaporisation region to the outlet may pass around a side of the reservoir. Thus, said portion of the vapour transfer channel is laterally offset from the reservoir, and does not pass through the reservoir. This avoids the need to provide a second seal to separate the reservoir chamber from the vapour transfer channel, further reducing complexity, thus enabling a reduced number of components and simplifying the manufacture process.

[0020] Where the pressure release structure is a pressure release channel, said pressure release channel may follow a tortuous path. An example of a channel having a tortuous path is a channel that has no straight path between an inlet of the channel and an outlet of the channel. Such a path typically has increased path length as compared with a straight path, and typically includes one or more bends. Each of these features may act to retard or resist the flow of liquid through the path. The tortuous path may be generally serpentine, and may comprise at least two, and preferably more than two, e.g. three or four, transverse path sections, where transverse refers to a direction that is generally perpendicular to a longitudinal axis of the cartridge. Such sections may further resist the flow of liquid by providing a physical barrier to flow in a longitudinal direction, where the longitudinal direction refers to a direction aligned with the longitudinal axis of the cartridge, which may dictate a

typical use orientation for the cartridge.

[0021] Where the pressure release structure is a pressure release channel, said pressure release channel may have a hydraulic diameter of 2mm or less, or 1mm or less, where the hydraulic diameter is defined as $D_h = 4A/P$, where A is the cross sectional area of the channel and P is the wetted perimeter of the channel. The pressure release channel may have a hydraulic diameter in the range 1mm-0.1mm, or 1mm-0.2mm, or 1mm-0.5mm. Providing hydraulic diameter in this range may assist in confining fluid leaked from the reservoir chamber within the pressure release channel by means of surface tension.

[0022] The pressure release channel may have a substantially U-shaped cross-section. Such a cross-section is simple to mold or cast, improving ease of manufacture.

[0023] The pressure release structure may further comprise a valve that is deformable between a closed state, in which fluid egress from the reservoir chamber is restricted, and an open state, in which gas ingress to the reservoir chamber is permitted. The valve may be deformable in response to a deflection force, the deflection force preferably resulting from a threshold pressure difference between a first side of the valve and a second side of the valve. A valve of this type may be conveniently formed of the resilient material of the seal, and may be operable further inhibit leakage of fluid from the reservoir.

[0024] Where the pressure release structure is a pressure release channel, the valve may be located at or adjacent to a reservoir end of the pressure release channel. For example, the valve may be located at or adjacent to the gas outlet of the pressure release channel. Providing the valve in this location may keep the bulk of the pressure release channel clear of fluid, further facilitating air ingress.

[0025] The valve may be a one-way valve, such as a duck-bill valve or other non-return valve comprising a deformable feature that is biased against deformation in one direction. In addition to a deformable feature, the one-way valve may comprise an obstruction, wherein the obstruction is operable to permit deformation of the deformable feature in a first direction and to restrict deformation of the deformable feature in a second direction different to the first. The obstruction may reduce the likelihood of fluid leaking through the one-way valve, by providing resistance to the opening of the valve in the second direction.

[0026] The deformable feature may be moveable, e.g. pivotable, about a side wall of the pressure release channel, and the obstruction may be located in the pressure release channel at a location selected to restrict movement, e.g. rotation, of the deformable feature in the second direction. For example, the deformable feature may comprise a barrier having a hinge-like connection to the side wall of the pressure release channel, and the obstruction may comprise a protrusion located on an opposing side wall of the pressure release channel.

[0027] The fluid transfer medium may be operable to close an opening in the reservoir such that at least a

portion of an interior surface of the fluid transfer medium is in direct contact with a liquid held within the reservoir chamber. Such an arrangement further simplifies construction by avoiding the need for an end wall closing the reservoir, and associated seal.

[0028] The seal is preferably formed entirely from the resilient material. The resilient material is preferably silicone.

[0029] The seal preferably surrounds an exterior surface of the fluid transfer medium.

[0030] According to a second aspect of the invention, we provide an aerosol generating system comprising:

a cartridge for an aerosol generating system, the cartridge comprising:

a reservoir having a reservoir chamber for containing a liquid aerosol generating substrate;
a vaporisation region;
a porous ceramic fluid transfer medium operable to absorb liquid from the reservoir chamber and transfer the absorbed liquid to the vaporisation region; and
a seal located between the reservoir and the fluid transfer medium, the seal having a first surface abutting the reservoir and a second surface abutting the porous ceramic fluid transfer medium;
wherein the seal comprises a resilient material, and a pressure release structure is formed in the resilient material; and

wherein the aerosol generating system further comprises a base part configured to removably connect to the cartridge.

[0031] The cartridge may comprise any of the features set out above in relation to the first aspect of the invention, in any combination.

[0032] The base part may comprise a heater operable to supply heat to the vaporisation region when the cartridge is thermically connected to the cartridge. Such an arrangement simplifies the structure of the cartridge and allows reuse of the heater with multiple cartridges.

[0033] The cartridge may further comprise a thermal interface membrane operable to transfer heat from the heater in the base part to the vaporisation region when the cartridge is thermically connected to the base part. Such a thermal interface membrane provides a cartridge having a sealed construction which reduces the risk of leakage.

[0034] It is to be appreciated that the cartridge and the base part may further include any one or more components conventionally included in an aerosol generating system, such as the system described below in connection with Figure 1.

[0035] For example, the cartridge may further comprise a cartridge housing having a proximal end config-

ured as a mouthpiece end, which is in fluid communication with the vaporisation region via the or a vapour transfer channel, and a distal end operable to removably connect with the base part. The mouthpiece end may be configured for providing the vaporised liquid to the user.

[0036] The reservoir may be provided in the cartridge housing with the vapour transfer channel extending from an inlet at the base and one side of the cartridge, along the distal end of the cartridge to the vaporisation region and up one side of the cartridge to an outlet located centrally at the mouthpiece end.

[0037] The cartridge housing may be made of one or more of the following materials: aluminium, polyether ether ketone (PEEK), polyimides, such as Kapton®, polyethylene terephthalate (PET), polyethylene (PE), high-density polyethylene (HDPE), polypropylene (PP), polystyrene (PS), fluorinated ethylene propylene (FEP), polytetrafluoroethylene (PTFE), polyoxymethylene (POM), polybutylene terephthalate (PBT), Acrylonitrile butadiene styrene (ABS), Polycarbonates (PC), epoxy resins, polyurethane resins and vinyl resins.

[0038] As noted above, the fluid transfer medium comprises a porous ceramic fluid transfer medium, which may be positioned adjacent to an opening of the reservoir chamber and arranged to hold and transfer aerosol generating liquid from the reservoir chamber to the vaporisation region by capillary action. The porous ceramic fluid transfer medium may be substantially rigid and inflexible. The pore size of the porous ceramic may be in the range 10-80 μm , for example 20-60 μm .

[0039] The base part of the system may include a power supply unit, e.g. a battery, which may be connected to the heater. In operation, upon activating the aerosol generating system, the power supply unit electrically heats the heater of the base part, which then provides its heat by conduction to the fluid transfer medium in the cartridge (optionally via a thermal interface membrane) resulting in vaporisation of the liquid absorbed therein. As this process is continuous, liquid from the reservoir chamber is continuously absorbed by the fluid transfer medium. Vapour created during the above process is transferred from the vaporisation region via the vapour transfer channel so that it can be inhaled via the outlet by a user. Once the liquid in the reservoir chamber is used up, the cartridge may be disconnected from the base part and a new cartridge fitted, enabling the reuse of the base part.

[0040] The heater of the base part may comprise a protruding heater extending from the base part so that, in use, the heater extends into a recess of the cartridge.

[0041] The power supply unit, e.g. battery, may be a DC voltage source. For example, the power supply unit may be a Nickel-metal hydride battery, a Nickel cadmium battery, or a Lithium based battery, for example a Lithium-Cobalt, a Lithium-Iron-Phosphate, a Lithium-Ion or a Lithium-Polymer battery.

[0042] The base part may further comprise a controller associated with electrical components of the aerosol

generating system, including the battery and heater.

[0043] The aerosol generating system may comprise an electronic cigarette. As used herein, the term "electronic cigarette" may include an electronic cigarette configured to deliver an aerosol to a user, including an aerosol for inhalation/vaping. An aerosol for inhalation/vaping may refer to an aerosol with particle sizes of 0.01 to 20 μm . The particle size may be between approximately 0.015 μm and 20 μm . The electronic cigarette may be portable.

Brief Description of the Drawings

[0044] The invention will now be described, by way of example only, with reference to the accompanying drawings, in which like features are denoted with the same reference numerals.

Figure 1 is a partial cross-sectional view of an aerosol generating system comprising a base part (only partly visible) and a cartridge;

Figure 2 shows a side view of a porous ceramic fluid transfer medium suitable for use in the aerosol generating system of Figure 1, together with a seal;

Figure 3 shows a perspective view of the porous ceramic fluid transfer medium and seal of Figure 2, with the seal shown in phantom;

Figure 4 shows a bottom perspective view of the seal of Figures 2 and 3, absent the porous ceramic fluid transfer medium;

Figure 5 shows a perspective view of a porous ceramic fluid transfer medium suitable for use in the aerosol generating system of Figure 1, together with an alternative seal; and

Figure 6 shows a bottom perspective view of another alternative seal, including a close up of a valve portion of the seal.

Detailed Description

[0045] Figure 1 shows one example of an aerosol generating system 10, which can be used as a substitute for a conventional cigarette. The aerosol generating system 10 comprises a base part 12 and a cartridge 14 (also referred to in the art as a "capsule" or "pod") thermically connectable to the base part 12. The base part 12 is thus the main body part of the aerosol generating system and is preferably re-usable.

[0046] The base part 12 comprises a housing 16 accommodating therein a power supply unit (not shown), such as a battery, a heater 20 and a controller (not shown). The power supply is operatively connected to the heater 20. In the example shown, the heater 20 is in the form of a rigid protruding heater 20 that protrudes out of a first end of the base part 12 for partial receipt within the cartridge 14. The battery is configured for providing the heater 20 with the necessary power for its operation, via suitable electrical contacts, allowing it to become

heated to a required temperature. The heater 20, in the example shown, comprises a ceramic heater. However, it will be appreciated that any suitable type of heater may be selected as required by the implementation. The controller is operable to control the operations of the aerosol generation system 10 using power supplied by the battery.

[0047] The first end of the housing 16 of the base part 12 has one or more interface features configured for matching one or more corresponding interface features located on the cartridge 14 so as to mechanically couple the cartridge 14 to the base part.

[0048] Referring still to Figure 1, the cartridge 14 comprises a cartridge housing 22 having a proximal end 24 and a distal end 26. The proximal end 24 may constitute a mouthpiece end configured for being introduced directly into a user's mouth. In some examples, a mouthpiece may be fitted to the proximal end 24. The distal end 26 of the housing 22 comprises a base 28 into which the heater 20 protrudes when the cartridge 14 is connected to the base unit 12. In particular, an aperture 29 in the base 28 defines a recess into which at least a portion of the heater 20 protrudes when connected.

[0049] The cartridge 14 further comprises a reservoir 30 defining a reservoir chamber 32 configured for containing therein a liquid to be vaporised. The liquid may comprise an aerosol-forming substance such as propylene glycol and/or glycerol and may contain other substances such as nicotine and acids. The liquid may also comprise flavourings such as e.g. tobacco, menthol or fruit flavour. The reservoir 30 extends between the proximal end 24 towards the distal end 26 and is spaced from the distal end 26.

[0050] The cartridge 14 is further provided with a fluid transfer medium in the form of a porous ceramic fluid transfer medium 34, also referred to herein as a porous ceramic wick, in fluid communication with the reservoir chamber 32. The porous ceramic fluid transfer medium 34 is inflexible, in that it is rigid and does not deform in response to pressure changes within the reservoir chamber 32. The porous ceramic fluid transfer medium 34 is operable to absorb liquid aerosol generating substrate from the reservoir and deliver said liquid aerosol generating substrate to a vaporisation region 36. As used herein, the term "vaporisation region" 36 refers to the region in which liquid is vaporised and may alternatively be termed a vaporisation chamber or area. Typically, the vaporisation region is an area within and/or adjacent to the porous ceramic wick 34 in which liquid is heated to a sufficiently high temperature to achieve vaporisation / aerosolization.

[0051] A vapour transfer channel 31 extends from one or more inlets 33 to an outlet 35 located centrally in the proximal end 24 of the cartridge. The air inlet 33 communicates with an inlet channel 31a, which leads to the vaporisation chamber 36. An outlet channel 31b leads from the vaporisation chamber 36 to the air outlet 35. Because the vaporisation chamber 36 is located near the

distal end 26, the outlet channel 31b conducts air over the majority of the length of the cartridge 14 from the distal end 26 to the proximal end 24. The outlet channel 31b is offset laterally from a longitudinal axis of the housing 22 and extends around the reservoir chamber 32 between a wall of the cartridge housing 22 and one side of the reservoir 30. Because the outlet channel 31b is offset laterally and does not pass through the reservoir 30, it is not necessary to provide a seal or gasket to seal the reservoir around the channel 31b.

[0052] In use, air follows a continuous airflow path extending from the air inlet 33 at the distal end 26, successively through the inlet channel 31a, the vaporisation chamber 36 and the outlet channel 31b, to the air outlet 35 at the proximal end 24. Vaporised liquid is entrained in air within the vapour transfer channel 31 as said air flows past the porous ceramic fluid transfer medium 34, for example during a user's inhalation.

[0053] It will be appreciated that many configurations for the vapour transfer channel are possible. For example, the cartridge inlet(s) 33 may be in direct communication with the external atmosphere or, as in the example shown, the inlet(s) 33 may be fluidly connected to an external air inlet 33a located in the base part 12 of the system via a fluidly sealable joint 37.

[0054] Upon connection of the interfaces between the cartridge 14 and the base part 12 of the device, the heater 20 protrudes into the vapour transfer channel 31 immediately below the porous ceramic wick 34, thereby enabling heating of liquid in the wick until the liquid is transformed into vapour when the heater is activated.

[0055] A thermal interface membrane 50 is provided between the heater 20 and the porous ceramic wick 34. The membrane 50 is a thin membrane such as a metal foil that is configured to ensure rapid and even heating of the vaporisation region 36 in an accurate and defined geometry, reducing the amount of lateral thermal spreading (i.e. thermal losses). The thermal interface membrane 50 is flexible, and so is able to deform, and so at least partially conform, to the shape of the heater 20 when a connection is made between the cartridge 14 and the base part 12. Heat from the heater 20 in the base part is thus transferred to the fluid transfer medium 34 through the thermal interface membrane 50 by conduction, convection and/or radiation (but primarily via conduction) when the cartridge is thermally connected to the base part 12 in order to effect vaporisation of the aerosol generating liquid held in the fluid transfer medium.

[0056] Referring now to Figures 2, 3 and 4, a porous ceramic fluid transfer medium 34 is shown, together with a seal 60. The porous ceramic fluid transfer medium 34 and seal 60 are shown separately from a cartridge 14 for clarity, but it will be appreciated that the porous ceramic fluid transfer medium 34 and seal 60 may be used in a cartridge 14, such as the cartridge shown in Figure 1, which comprises a reservoir 30 having a reservoir chamber 32 for containing a liquid aerosol generating substrate, and a vaporisation region 36. In use, the fluid

transfer medium 34 is operable to absorb liquid from the reservoir chamber 32 and transfer the absorbed liquid to the vaporisation region 36, and the seal 60 is located between the reservoir 30 and the fluid transfer medium 34 and operable to provide a fluid-tight seal between the two. To this end, the seal 60 has a first surface 62 abutting the reservoir and a second surface 64 abutting the porous ceramic fluid transfer medium 34. The first surface 62 may alternatively be thought of an external surface of the seal 60, and the second surface 64 may alternatively be thought of as an internal surface.

[0057] The seal 60 comprises, and in the example shown is entirely formed of, a resilient material. A pressure release structure 66 is formed in the resilient material.

[0058] The pressure release structure 66 is configured to permit air ingress to the reservoir chamber 32 from a location external to the reservoir. In particular, the pressure release structure 66 comprises a gas inlet 68, which is located in the vapour transfer channel 31 when the seal 60 is correctly installed in a cartridge 14 between the reservoir 30 and the fluid transfer medium 34. The pressure release structure 66 also comprises a gas outlet 70, which is in fluid communication with the reservoir chamber 32 when the seal is correctly installed in the cartridge 14 between the reservoir 30 and the fluid transfer medium 34. In the example shown in Figures 1-4, the gas outlet 70 is in direct fluid communication with the reservoir chamber 32, such that it opens directly into the reservoir chamber 32, thus providing an unobstructed air path into the reservoir chamber from the gas inlet 68 at the opposite end of the pressure release structure.

[0059] The pressure release structure 66 thus defines a channel extending between the reservoir chamber 32 and the vapour transfer channel 31. Ambient air may enter the reservoir chamber 32 via the pressure release channel 66 in order to balance the pressure within the reservoir as liquid is drawn out of the reservoir and into the fluid transfer medium during use.

[0060] Because the pressure release structure 66 provides a route for air ingress to the reservoir, it is possible that fluid from the reservoir chamber 32 may escape from the reservoir via the pressure release structure 66. In the example shown, the pressure release structure 66 comprises a pressure release channel, and is formed in the second (internal) surface 64 of the seal 60. The pressure release channel has a generally U- or C-shaped cross-section, and thus defines an open groove in the internal surface of the seal. In this way, the pressure release channel is closed on one side by the porous ceramic of the fluid transfer medium, when the seal 60 is located over an external surface 40 of the fluid transfer medium. In this way, any fluid that enters the pressure release channel is encouraged into direct contact with the porous ceramic of the fluid transfer medium 34. Thus, leaked fluid may be absorbed into the fluid transfer medium directly from the pressure release channel.

[0061] In the unlikely event that fluid does happen to

escape from the gas inlet 68 of the pressure release channel, such escaped fluid is deposited into the vapour transfer channel 31 from the gas inlet 68. In the example shown, the gas inlet 68 is located adjacent the vaporisation region 36, from which escaped fluid may be vaporised together with fluid that has been wicked through the fluid transfer medium in a more conventional manner.

[0062] To further inhibit leakage from the reservoir 30, the pressure release channel 66 follows a tortuous path, in that the channel 66 provides no straight path between the gas inlet 68 and the gas outlet 70. In particular, the tortuous path is generally serpentine, and comprises at least two, and in this case three, transverse path sections 72, which are connected via a series of bends 74. Such a tortuous path further resists the flow of liquid by providing a physical barrier to flow in a longitudinal direction, as well as by increasing the overall length of path the fluid must travel in order to escape.

[0063] The pressure release channel 66 has a hydraulic diameter that is selected to assist in confining fluid leaked from the reservoir chamber within the pressure release channel by means of surface tension. As used herein, the hydraulic diameter is defined as $D_h = 4A/P$, where A is the cross-sectional area of the channel and P is the wetted perimeter of the channel. For example, in the case of a channel having a circular cross-section, the hydraulic diameter may be written as $D_h = 4\pi R^2/2\pi R = 2R$. In contrast, for a channel having a rectangular cross-section of width a and depth b , the hydraulic diameter may be written as $D_h = 4ab/2(a+b) = 2ab/(a+b)$. In the example shown in Figures 3 and 4, the pressure release channel is generally U-shaped, and has a broadly rectangular cross section. The U-shaped pressure release channel has a hydraulic diameter of approximately 1mm. It will be appreciated that the design of the channel is dependent on the seal geometry and e-liquid properties. However, in general the hydraulic diameter may be 2mm or less, for example in the range 1mm-0.1mm, or 1mm-0.2mm.

[0064] The seal 60 surrounds at least a portion of the exterior surface 40 of the fluid transfer medium, and in the example shown covers the side surfaces of the fluid transfer medium and a major portion of the top surface of the fluid transfer medium, so as to provide a resilient connection between the fluid transfer medium and the reservoir. The seal may be formed from any suitable resilient sealing material, such as silicone.

[0065] When installed in a cartridge, such as the cartridge shown in Figure 1, the fluid transfer medium 34 is operable to close an opening 42 in the reservoir 30, in particular at a distal end of the reservoir 30. Thus, at least a portion of an interior surface 44 of the porous ceramic fluid transfer medium 34 is in direct contact with a liquid held within the reservoir chamber. Liquid from the reservoir may thus be absorbed into the fluid transfer medium through the inner surface 44, and wicked towards the vaporisation region.

[0066] During use of the aerosol generating system

shown in Figure 1, liquid in the fluid transfer medium 34 is heated by the heater 20. The heated liquid is vaporised in the vaporisation region 36, and the resulting vapour is removed from the vaporisation region by air drawn through the vapor transfer channel 31 by a user of the system. The vaporisation of liquid within the porous ceramic causes pressure in the reservoir chamber 32 to drop. This is because new liquid is pulled into the fluid transfer medium 34 due to capillary forces in order to re-saturate the fluid transfer medium 34 as the liquid already held in the fluid transfer medium is heated and vaporised.

[0067] The pressure difference between the reservoir chamber 32 and the ambient atmosphere outside the reservoir chamber 32 can become large unless air is permitted to propagate to the reservoir chamber 32 in order to equalise the pressure. Failure to permit air ingress to the reservoir chamber 32 can prevent the fluid transfer medium 34 from re-saturating correctly.

[0068] In aerosol generating systems having flexible fluid transfer media, such as cotton wicks, the wick itself is typically a soft fibrous structure which can deform, and hence can create gaps that enable air to travel to the reservoir and thereby equalise the pressure. This is not possible in aerosol generating systems that utilise porous ceramic wicks however, since such wicks are hard inflexible structures which do not deform during operation. Depending on the pore size and structure of the porosity inside a ceramic wick, the pressure difference between the reservoir and the outside may need to become large (e.g. up to 20Pa) before it is strong enough to cause air to propagate to the reservoir through the ceramic (which may typically have a minimum wall thickness in the range 1.5mm-2mm) in order to equalize the pressure and re-saturate the wick. This can lead to dry puffing and inconsistent delivery, which is why most commercial products with a ceramic wick include a pressure balance system in the form of a small channel in the reservoir or wick fixture that acts to permit pressure equalisation.

[0069] However, such channels also lead to leakage, meaning such cartridges are typically also provided with additional features to address the problem of leakage, such as numerous ribs in a "dead" space outside the reservoir, intended to hold the leaked liquid.

[0070] In contrast, a seal 60 of the type described herein includes a pressure release channel 66 provided in the resilient material of the seal itself. Since resilient material can deform, such a pressure release channel may be made having a smaller resting (i.e. undeformed) hydraulic diameter than a channel formed in a hard plastics material. Furthermore, such a seal need not be made to precise dimensions, because of its ability to deform, and so manufacturing tolerances may be lower. Such a seal may additionally be easier to install than a pressure balance system formed in a housing or mounting of the reservoir, which is typically formed of a hard plastics material. Pressure within the reservoir may thus be equalised via a pressure release structure of the type described herein in a simplified manner as com-

pared with prior systems.

[0071] Figures 5 and 6 show two alternative seals 60a, 60b. Where appropriate, like reference numerals are used to refer to like features, and so for brevity features common to the seal 60 shown in Figures 1-4 will not be described again in detail.

[0072] The alternative seal 60a shown in Figure 5 includes a pressure release structure in the form of a pressure release channel 66a. The pressure release channel is formed in the external surface 62 of the seal. When installed in a cartridge 14, the pressure release channel 66a provides a route for gas to enter the reservoir chamber 32 from a location that is external to the reservoir chamber 32. In particular, the pressure release channel includes a gas inlet 68 which, similar to that described above in connection with Figures 1-4, is located in the vapour transfer channel 31, as well as a gas outlet 70 in fluid communication with the reservoir chamber. Gas may thus enter the reservoir chamber in order to balance pressure within the reservoir chamber by traveling through the pressure balance channel 66a between the seal and a wall or housing 76 of the reservoir 30.

[0073] Like the pressure release channel 66 shown in Figures 2-4, the pressure release channel 66a shown in Figure 5 follows a tortuous path, and has a hydraulic diameter selected to assist in confining leaked fluid to the channel using surface tension.

[0074] Referring now to Figure 7, a further alternative seal 60b is shown. The seal 60b includes a pressure release structure in the form of an internal pressure release channel 66b, similar to that shown in Figures 1-4. The pressure release channel 66b differs from the channel 66 described above with respect to Figures 1-4 however, in that it further includes a valve 80 located at or adjacent to the gas outlet 70 of the pressure release channel. The valve 80 is deformable between a closed state (shown in Figure 6), in which fluid egress from the reservoir chamber 32 is restricted, and an open state (not shown), in which gas ingress to the reservoir chamber 32 is permitted.

[0075] The valve 80 is deformable in response to a deflection force resulting from a threshold pressure difference between a first, reservoir, side 82 of the valve and a second, inlet, side 84 of the valve. That is, when the pressure difference between the inlet side 84 of the valve and the outlet side 82 of the valve becomes sufficiently high that the threshold pressure difference is exceeded, the valve 80 is operable to deform from the closed state to the open state, in order to permit air to pass through the valve into the reservoir chamber 32. The valve structure thus uses the elasticity of the rubber-like material of the seal by incorporating a thin structural feature operable to deform due to the pressure difference. Preferably the valve structure inside the channel stays closed (initial state) under the steady state and associated forces (capillary force of the liquid inside the reservoir and gravity) and opens after vaporization when the pressure difference increases and overcomes the deflection force

or stress of the valve structure (e.g. bending stiffness of the valve structure).

[0076] The valve 80 shown in Figure 6 is a one-way valve. It will be appreciated that multiple types of one-way valve are available; however, in the example shown the valve 80 includes a deformable feature 86 and an obstruction 88. The deformable feature 86 is provided as a barrier that is attached at one edge to a side wall of the pressure release channel, so as to be pivotally moveable within the pressure release channel 66b about the attached edge. The obstruction 88 is operable to permit deformation, and in particular pivotal movement, of the deformable feature 86 in a first direction, but to restrict deformation of the deformable feature 86 in a second direction different to the first. In particular, the obstruction 88 is provided as a protrusion located on an opposing side wall 90 of the pressure release channel 66b, which is located adjacent the inlet side 84 of the valve 80, so as to restrict pivotal movement towards the inlet side but to permit pivotal movement towards the reservoir side. The obstruction has a curved profile, such that in the event of an excessively high pressure within the reservoir the valve may be forced open in the second direction to permit fluid to escape to reduce the excess pressure. The free end of the deformable feature also has a curved profile, facilitating ease of movement. Such a valve 80 further reduces the risk of fluid leakage from the reservoir, and can be conveniently formed in the resilient material of the seal during manufacture as a single piece.

[0077] It will be appreciated that a valve 80 could be located at a different point along the channel if preferred, for example at or adjacent the gas inlet, or at an intermediate point between the gas inlet and the gas outlet. It will further be appreciated that a valve 80 could be included in an external pressure release channel, such as that shown in Figure 5.

[0078] In an alternative embodiment, the gas outlet 70 may be located short of the reservoir chamber 32 at a blind end. In such an alternative, no open gas outlet is provided in direct fluid communication with the reservoir chamber, and instead a separating portion of resilient material is located between the blind end of the pressure release channel and the interior surface 64 of the seal. Nevertheless, air may enter the reservoir chamber 32 from the pressure release channel if the pressure in the reservoir lowers sufficiently such that a differential pressure between the reservoir chamber and the exterior causes air to be drawn around the separating portion of the seal, for example by deformation of the seal permitting air to pass between the seal and the adjacent surface. In the case of an internal channel, the adjacent surface may be the porous ceramic of the fluid transfer medium, whereas for an external channel the adjacent surface may be the reservoir housing. Such an arrangement requires a smaller pressure differential than if the air were required to be drawn through the full depth of the ceramic wick, and is made possible by the resilient nature of the seal. The separating portion thus may serve as a

valve. The separating portion may have a largest dimension that is in the range 0.1mm-2mm.

[0079] Although exemplary embodiments have been described in the preceding paragraphs, it should be understood that various modifications may be made to the examples described herein without departing from the scope of the appended claims. For example, more or fewer pressure release channels could be provided if required, and/or pressure release channels could be provided at different locations to those shown. Similarly, the pressure release channels could have different cross-sectional shapes to those shown. Thus, the breadth and scope of the claims should not be limited to the above-described exemplary embodiments.

[0080] 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 (14) for an aerosol generating system, the cartridge (14) comprising:
 - a reservoir (30) having a reservoir chamber (32) for containing a liquid aerosol generating substrate;
 - a vaporisation region (36);
 - a porous ceramic fluid transfer medium (34) operable to absorb liquid from the reservoir chamber (32) and transfer the absorbed liquid to the vaporisation region (36); and
 - a seal (60, 60a, 60b) located between the reservoir (30) and the fluid transfer medium (34), the seal having a first surface (62) abutting the reservoir and a second surface (64) abutting the porous ceramic fluid transfer medium; wherein the seal (60, 60a, 60b) comprises a resilient material, and a pressure release structure (66, 66a, 66b) is formed in the resilient material.
2. The cartridge of claim 1, wherein the pressure release structure (66, 66a, 66b) comprises a pressure release channel formed in the first surface (62) of the seal.
3. The cartridge of claim 1, wherein the pressure release structure (66, 66a, 66b) comprises a pressure release channel formed in the second surface (64) of the seal.
4. The cartridge of any preceding claim, wherein the cartridge further comprises a vapour transfer channel (31) operable to fluidly connect an inlet (33) with an outlet (35), the vaporisation region (36) being located in the vapour transfer channel (31) between

- the inlet (33) and the outlet (35), wherein the pressure release structure (66, 66a, 66b) comprises a gas inlet (68) located in the vapour transfer channel (31) and a gas outlet (70) in fluid communication with the reservoir chamber (32).
5. The cartridge of any claim 4, wherein a portion of the vapour transfer channel (31) extending from the vaporisation region (36) to the outlet (35) passes around a side of the reservoir (30), and is laterally offset from the reservoir. 10
 6. The cartridge of any preceding claim, wherein the pressure release structure (66, 66a, 66b) is a pressure release channel having a tortuous path. 15
 7. The cartridge of any preceding claim, wherein the pressure release structure (66, 66a, 66b) is a pressure release channel having a hydraulic diameter in the range 0.1mm-1mm. 20
 8. The cartridge of any preceding claim, wherein the pressure release structure (66, 66a, 66b) further comprises a valve (80) that is deformable between a closed state, in which fluid egress from the reservoir chamber is restricted, and an open state, in which gas ingress to the reservoir chamber is permitted. 25
 9. The cartridge of claim 8, wherein the pressure release structure (66, 66a, 66b) is a pressure release channel, and wherein the valve (80) is located at or adjacent to a reservoir end of the pressure release channel. 30
 10. The cartridge of claim 8 or claim 9, wherein the valve (80) is a one-way valve comprising a deformable feature (86) and an obstruction (88), wherein the obstruction is operable to permit deformation of the deformable feature in a first direction and to restrict deformation of the deformable feature in a second direction different to the first. 35 40
 11. The cartridge of claim 10, wherein the deformable feature is pivotable about a side wall of the pressure release structure, and the obstruction is located in the pressure release channel at a location selected to restrict rotation of the deformable feature in the second direction. 45 50
 12. The cartridge of any preceding claim, wherein the fluid transfer medium (34) is operable to close an opening (42) in the reservoir (30) such that at least a portion of an interior surface (44) of the fluid transfer medium is in direct contact with a liquid held within the reservoir chamber (32). 55
 13. The cartridge of any preceding claim, wherein the

seal (60, 60a, 60b) is formed entirely from the resilient material.

14. The cartridge of any preceding claim, wherein the seal (60, 60a, 60b) surrounds an exterior surface (40) of the fluid transfer medium (34).

15. An aerosol generating system comprising the cartridge (14) of any one of claims 1-14 and a base part (12) configured to removably connect to the cartridge (14).

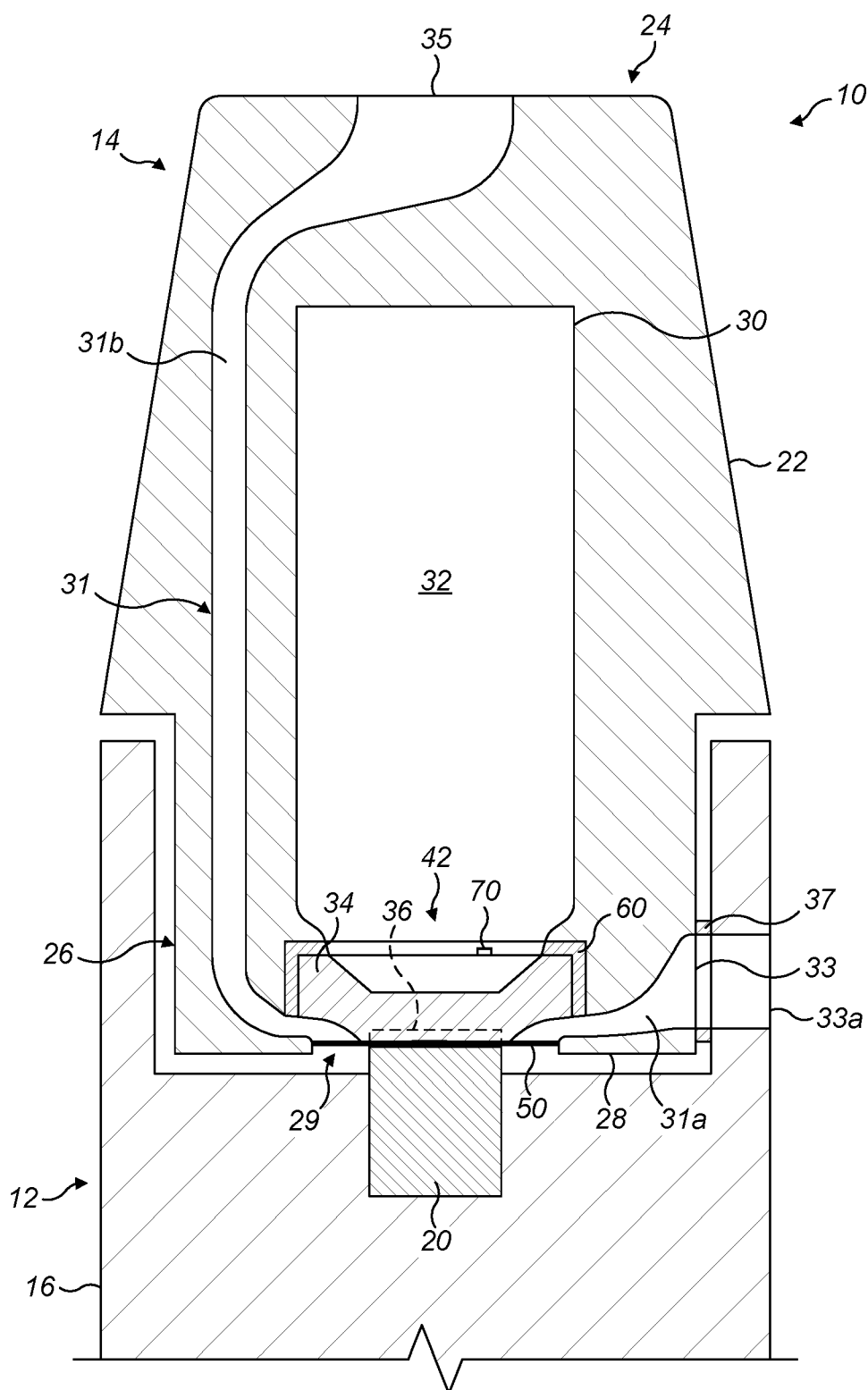


FIG. 1

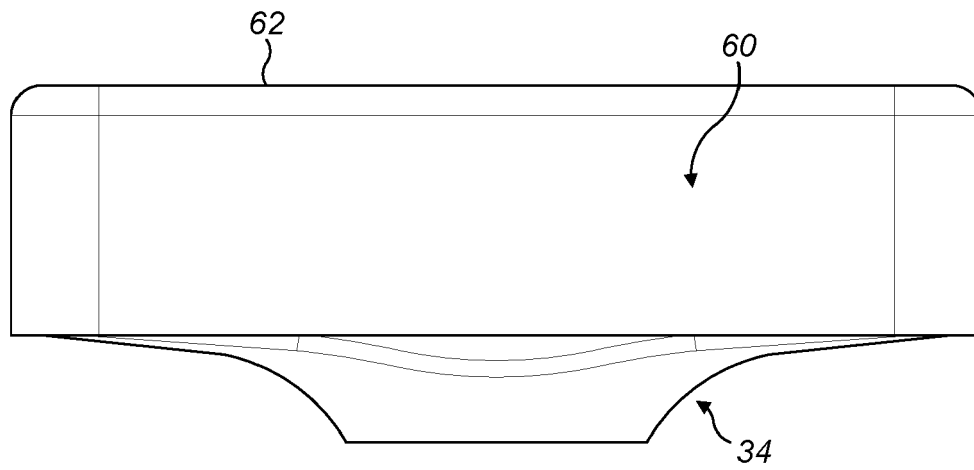


FIG. 2

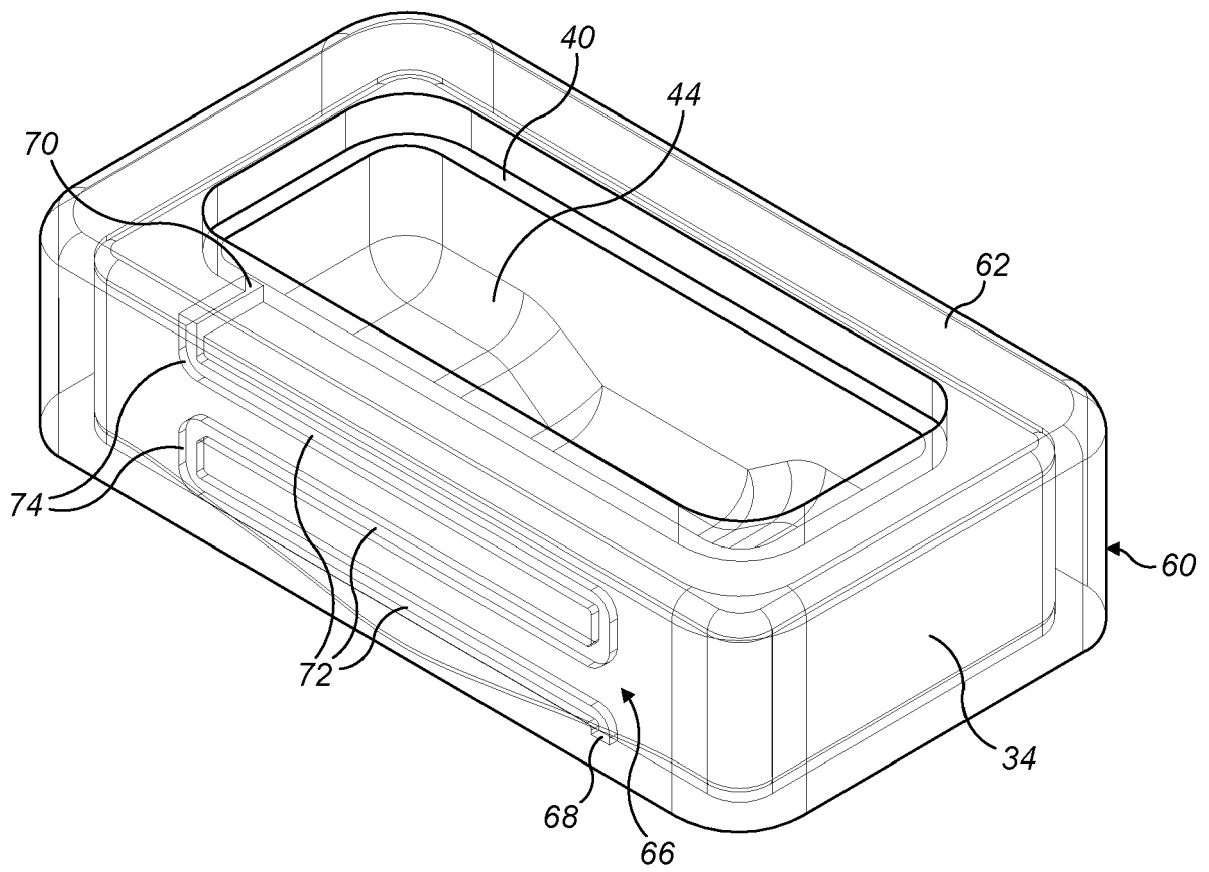


FIG. 3

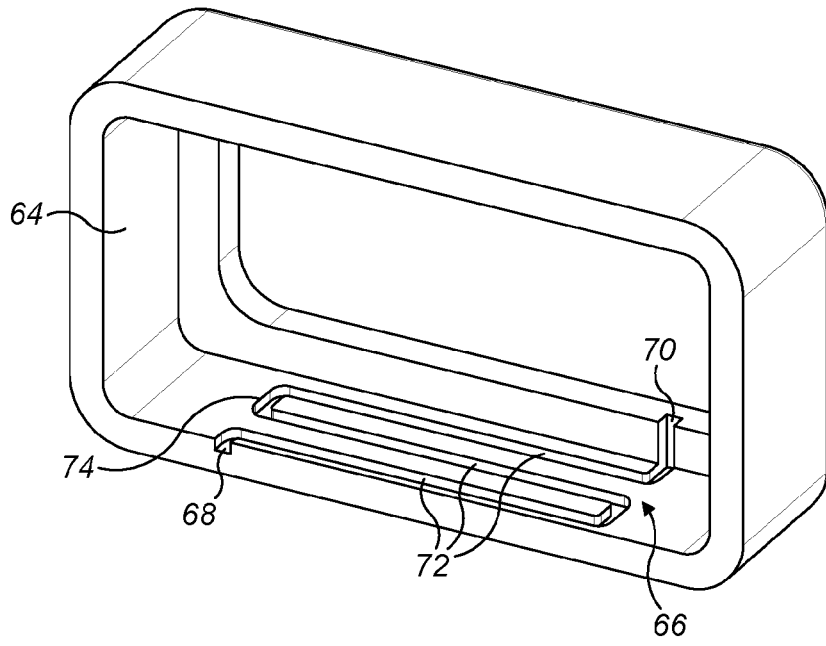


FIG. 4

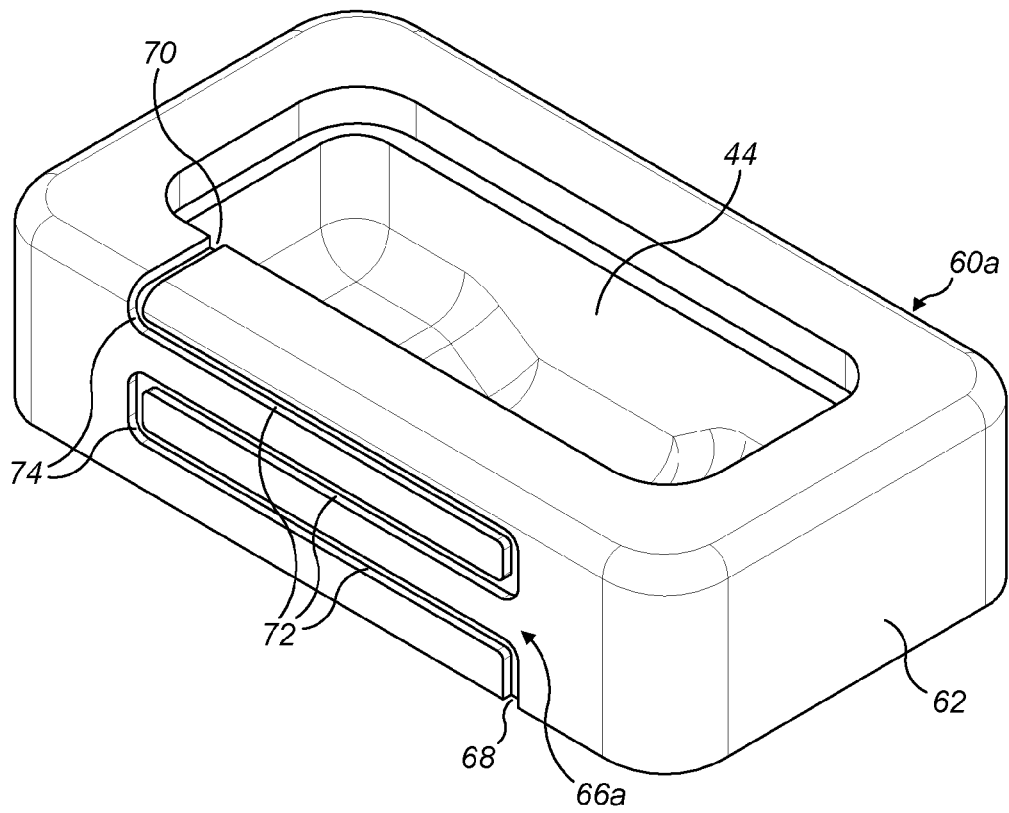
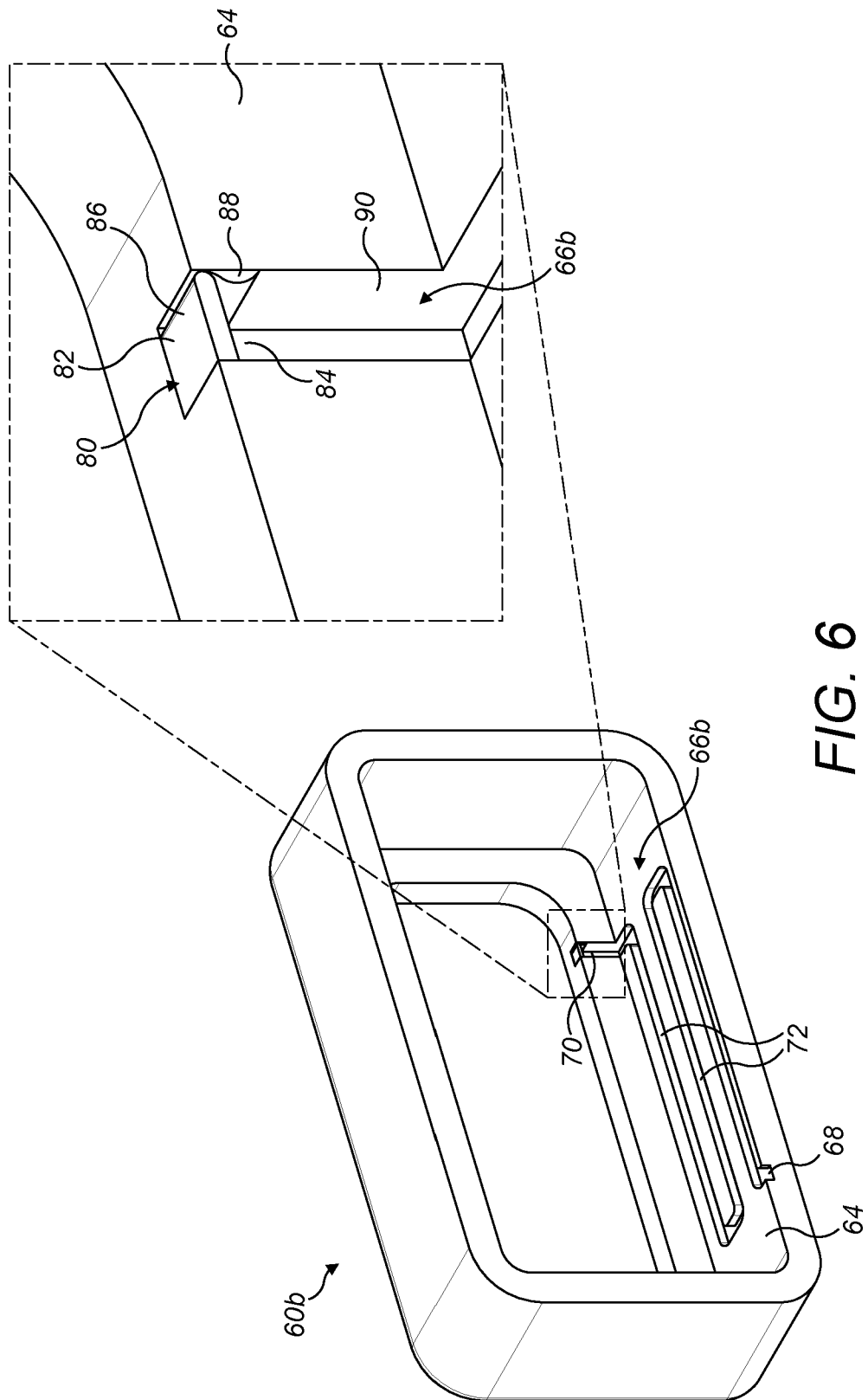


FIG. 5





EUROPEAN SEARCH REPORT

Application Number

EP 23 20 0850

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X	US 2022/409832 A1 (LI GUANGHUI [CN] ET AL) 29 December 2022 (2022-12-29)	1-7, 12-15	INV. A24F40/42
A	* figures 1-8, 11 * * paragraph [0028] - paragraph [0029] * * paragraph [0034] - paragraph [0036] * * paragraph [0039] * * paragraph [0043] - paragraph [0057] * * paragraph [0065] - paragraph [0066] * -----	8-11	A24F40/485 ADD. A24F40/10
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Y	* figures *	9-11	
A	* paragraph [0029] * * paragraph [0031] - paragraph [0032] * * paragraph [0040] - paragraph [0041] * * paragraph [0043] - paragraph [0044] * * paragraph [0046] - paragraph [0047] * -----	2-7	
Y	WO 2022/111358 A1 (SHENZHEN FIRST UNION TECH CO [CN]) 2 June 2022 (2022-06-02)	9-11	
A	* figures 6-7 * * page 10 * -----	1-8, 12-15	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		4 March 2024	Kirchmayr, Katrin
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