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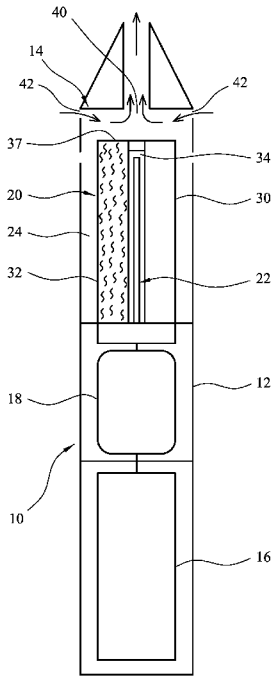

FIG. 1

(57) Abstract: A cartridge for an aerosol-generating system, the cartridge comprising: a first chamber having a first chamber housing and a second chamber separate to the first chamber and having a second chamber housing, wherein the first chamber contains an aerosol-forming substrate in the form of a gel, and wherein the second chamber contains a source of a compound for inhalation, wherein the first and second chamber housings are separate or separable from one another. Providing a two chamber cartridge assembly with separable chambers has advantages in the range of aerosols for user inhalation that can be delivered.

AEROSOL-GENERATING SYSTEM COMPRISING A CARTRIDGE CONTAINING A GEL

The present invention relates to an aerosol-generating system that heats an aerosol-forming substrate to generate an aerosol. In particular, the invention relates to an aerosol generating system that heats a gel to form an aerosol.

Aerosol-generating systems, such as e-cigarettes, that operate by heating a liquid formulation to generate an aerosol for inhalation by users are widely used. Typically they comprise device portion and a cartridge. In some systems, the device portion contains a power supply and control electronics and the cartridge contains a liquid reservoir holding the liquid formulation, a heater for vapourising the liquid formulation, and a wick that transports the liquid from the liquid reservoir to the heater. While this type of system has become popular, it does have disadvantages. One disadvantage is the potential for leakage of the liquid from the liquid reservoir both during transport and storage, and when the cartridge is connected to the device portion. The use of a wick to transport the liquid from the reservoir to the heater may add complexity to the system.

In a first aspect of the invention, there is provided an aerosol-generating cartridge for an aerosol-generating system, the aerosol-generating cartridge comprising:

a first chamber and a second chamber separate to the first chamber, wherein the first chamber contains an aerosol-forming substrate in the form of a gel, and wherein the second chamber contains source of a compound for inhalation.

The source of a compound for inhalation may comprise one or both of a source of nicotine and a flavour source.

Advantageously the gel is solid at room temperature. "Solid" in this context means that the gel has a stable size and shape and does not flow. The first and second chambers may contain different compositions. Both the first and second chambers may contain a gel. The second chamber may contain a solid material. Advantageously, neither the first chamber nor the second chamber contains a material which is not solid at room temperature.

In this context, an aerosol-forming substrate is a material or mixture of materials capable of releasing volatile compounds that can form an aerosol. The provision of the aerosol-forming substrate in the form of a gel may be advantageous for storage and transport, or during use. By providing the aerosol-forming substrate in a gel, the risk of leakage from the device may be reduced. Replenishing of the device with aerosol forming substrate when depleted or exhausted may also be improved, for example by reducing the risk of leakage or spillage.

The aerosol-forming substrate may comprise an aerosol-former. As used herein, the term "aerosol-former" refers to any suitable known compound or mixture of compounds that, in use, facilitates formation of a dense and stable aerosol. An aerosol-former is substantially resistant to thermal degradation at the operating temperature of the cartridge. Suitable

aerosol-formers are known in the art and include, but are not limited to: polyhydric alcohols, such as triethylene glycol, 1,3-butanediol and glycerine; esters of polyhydric alcohols, such as glycerol mono-, di- or triacetate; and aliphatic esters of mono-, di- or polycarboxylic acids, such as dimethyl dodecanedioate and dimethyl tetradecanedioate. Preferred aerosol formers are polyhydric alcohols or mixtures thereof, such as triethylene glycol, 1,3-butanediol and, most preferred, glycerine or polyethylene glycol.

A gel formulation or composition that is suited to releasing aerosol-former at a particular temperature may not be ideally suited for retaining and then releasing other compounds. By providing separate chambers, one containing the aerosol-former and one or more others containing the other compounds, for example nicotine or flavour source compounds, improved retention and release for both can be realised.

The first chamber may contain additional materials or components in addition to the gel.

As used herein, the term "aerosol-generating cartridge" refers to an article comprising an aerosol-forming substrate that is intended to be heated rather than combusted in order to release volatile compounds that can form an aerosol. When the resulting aerosol is to contain nicotine, it is advantageous for the source of nicotine to be contained in a gel. The source of nicotine may be included in one or both of the first and second chambers. The nicotine may be included in a gel with an aerosol-former in the first chamber or may be included in a second gel in the second chamber or may be included in gels in both chambers. Reducing the risk of leakage of nicotine-containing material from the system by retaining the nicotine in the gel at room temperature is therefore desirable. In alternative arrangements, the source of nicotine may be housed in the second chamber, for example in a liquid or solid material.

Flavour compounds may be contained in the second chamber in a gel. Alternatively or in addition, flavour compounds may be provided in another form. For example, the second chamber may contain a solid tobacco material that releases flavour compounds when heated. The second chamber may contain, for example, one or more of: powder, granules, pellets, shreds, spaghettis, strips or sheets containing one or more of: herb leaf, tobacco leaf, fragments of tobacco ribs, reconstituted tobacco, homogenised tobacco, extruded tobacco and expanded tobacco. The solid tobacco material in the second chamber may be in loose form. The tobacco may be contained in a gel or liquid. The second chamber may contain additional tobacco or non-tobacco volatile flavour compounds, to be released upon heating.

The first or second chamber may contain capsules that, for example, include volatile flavour compounds and such capsules may release their content, for example by melting during heating.

Advantageously, the gel comprises a thermoreversible gel. This means that the gel will become fluid when heated to a melting temperature and will set into a gel again at a gelation temperature. The gelation temperature is preferably at or above room temperature

and atmospheric pressure. Room temperature in this context means 25 degrees Celsius. Atmospheric pressure means a pressure of 1 atmosphere. The melting temperature is preferably higher than the gelation temperature. Preferably the melting temperature of the gel is above 50 degrees Celsius, or 60 degrees Celsius or 70 degrees Celsius and more preferably above 80 degrees Celsius. The melting temperature in this context means the temperature at which the gel is no longer solid and begins to flow. Preferably, the gel comprises agar or agarose or sodium alginate. The gel may comprise Gellan gum. The gel may comprise a mixture of materials. The gel may comprise water.

The gel may be provided as a single block or may be provided as a plurality of gel elements, for example beads or capsules. The use of beads or capsules may allow for simple refilling of the first (or second) chamber by the end user. The use of capsules or beads may also allow a user to see when a cartridge has already been used because gel will not form the same capsules or beads on gelation after heating and subsequent cooling.

When agar is used as the gelling agent, the gel preferably comprises between 0.5 and 5% by weight (and more preferably between 0.8 and1% by weight) agar. The gel may further comprise between 0.1 and 2% by weight nicotine. The gel may further comprise between 30% and 90% by weight (and more preferably between 70 and 90% by weight) glycerin. A remainder of the gel may comprise water and any flavourings.

When Gellan gum is used as the gelling agent, the gel preferably comprises between 0.5 and 5% by weight Gellan gum. The gel may further comprise between 0.1 and 2% by weight nicotine. The gel may further comprise between 30% and 99.4% by weight gylcerin. A remainder of the gel may comprise water and any flavourings.

In one embodiment, the gel comprises 2% by weight nicotine, 70% by weight glycerol, 27% by weight water and 1% by weight agar. In another embodiment, the gel comprises 65% by weight glycerol, 20% by weight water, 14.3% by weight tobacco and 0.7% by weight agar.

Advantageously, the cartridge does not comprise a transport element or mechanism for transporting the aerosol-former to a heat source or heater. The contents of the first or second chambers are advantageously heated *in situ* to generate a desired aerosol. In this context *in situ* means in the same position within the first and second chambers that the contents are held prior to use. There is no requirement for a capillary wick or pump. Advantageously, neither the first chamber nor the second chamber comprises a non-volatile structure for holding or retaining a liquid or gel in proximity to the heater.

The first and second chambers may be positioned side by side or one within the other or may be arranged in series such that an airflow can pass first through or past one chamber and then through or past the other.

The cartridge may comprise a slot between the first and second chambers. The slot may be configured to receive a heating element. The heating element may be received in the slot for example when the cartridge is installed in an aerosol-forming device. The

provision of a slot into which a heating element is received may provide for efficient heating by facilitating that heat energy from the heating element is passed directly to the first and second chambers rather than for example heating other elements of the system or the ambient air. Advantageously the slot is a blind slot. "Blind" in this context means closed at one end. The provision of a blind slot allows the heating element to be shielded from the vapour or aerosol generated by the system and can help to prevent the build-up of condensates on the heater.

The cartridge may be referred to as a cartridge assembly and may comprise chambers that can be separately inserted into, or connected to, and removed from, other elements of the aerosol-generating system. The cartridge assembly may comprise components in addition to the first and second chambers. The cartridge may comprise a housing. The housing of the cartridge may be formed from one or more materials. Suitable materials include, but are not limited to, metal, aluminium, polymer, polyether ether ketone (PEEK), polyimides, such as Kapton®, polyethylene terephthalate (PET), polyethylene (PE), polypropylene (PP), polystyrene (PS), fluorinated ethylene propylene (FEP), polytetrafluoroethylene (PTFE), epoxy resins, polyurethane resins and vinyl resins.

The housing of the cartridge may be formed from one or more thermally conductive materials. The interior of the first chamber or the second chamber may be coated or treated to comprise one or more thermally conductive materials. Use of one or more thermally conductive materials to form the cartridge or coat the interior of the first chamber and the second chamber can advantageously increase heat transfer from the heater to the content of the chamber, for example the gel. Suitable thermally conductive materials include, but are not limited to, metals such as, for example, aluminium, chromium, copper, gold, iron, nickel and silver, alloys, such as brass and steel and ceramics, or combinations thereof. Advantageously, at least one wall of the housing has a thermal conductivity greater than 10 Watts per metre per Kelvin at room temperature. In a preferred embodiment, the housing comprises a least one wall formed from aluminium.

In embodiments in which the cartridge is configured to be heated inductively, the housing of the cartridge may comprise a susceptor, for example a susceptor layer. The susceptor layer may for example form a wall of the housing or may be a coating applied to the interior or exterior of the housing. A susceptor may be located within the first or second chambers. For example, the gel may comprise a susceptor material.

Cartridges for use in aerosol-generating systems according to the present invention may be formed by any suitable method. Suitable methods include, but are not limited to, deep drawing, injection moulding, blistering, blow forming and extrusion.

The cartridge may comprise a mouthpiece configured to allow a user to puff on the mouthpiece to draw aerosol into their mouth or lungs. Where the cartridge comprises a mouthpiece, the mouthpiece may comprise a filter. The filter may have a low particulate

filtration efficiency or very low particulate filtration efficiency. Alternatively, the mouthpiece may comprise a hollow tube. The mouthpiece may comprise an airflow modifier, for example a restrictor.

The cartridge may be provided within a mouthpiece tube. The mouthpiece tube may comprise an aerosol-forming chamber. The mouthpiece tube may comprise an airflow restrictor. The mouthpiece tube may comprise a filter. The mouthpiece tube may comprise a cardboard housing. The mouthpiece tube may comprise one or more vapour impermeable elements within the cardboard tube. The mouthpiece tube may have a diameter similar to a conventional cigarette, for example around 7mm. The mouthpiece tube may have a mouth end configured to be placed in a user's mouth for inhalation of aerosol therethrough. The cartridge may be held in the mouthpiece tube for example at an opposite end to the mouth end.

One or both of the first and second chambers may be blind chambers. Blind in this context means closed at one end. Advantageously, there is only one exit aperture from the chamber. The cartridge housing may comprise at least one liquid and vapour impermeable external wall defining a blind chamber. Advantageously, both the first and second chambers are blind chambers. The use of blind chambers may reduce the risk of leakage. One or both of the chambers may be sealed by one or more frangible barriers.

The one or more frangible barriers may be formed from any suitable material. For example, the one or more frangible barriers may be formed from a foil or film, for example comprising metal. Where the cartridge comprises one or more frangible barriers sealing one or both of the first chamber and the second chamber, the device body preferably further comprises a piercing member configured to rupture the one or more frangible barriers.

Alternatively or in addition, one or both of the first chamber and the second chamber may be sealed by one or more removable barriers. For example, one or both of the first chamber and the second chamber may be sealed by one or more peel-off seals.

The one or more removable barriers may be formed from any suitable material. For example, the one or more removable barriers may be formed from a foil or film, for example comprising a metal.

One or both of the first and second chambers may be sealed by a vapour permeable element, for example a membrane or mesh configured to allow the escape of vapour from the first or second chamber through the membrane or mesh. Alternatively one or both of the first and second chambers may be sealed by a pressure activated valve that allows for the release of vapour through the valve when a pressure difference across the valve exceeds a threshold pressure difference.

The first chamber and the second chamber may be fixed together but separable from one another. The first and second chambers may be provided separately and fixed together by a user using a suitable mechanical interlock, such as a snap fitting or a screw fitting.

Alternatively, the first and second chambers may be held together using a separate retaining or fixing element. Alternatively, the first and second chambers may remain separate during use.

By providing the first and second chambers separately, a "mix and match" type set of choices may be made available to a user. The contents of the first chamber may provide a particular dosage of a target compound for delivery to a user, such as nicotine or a particular density of aerosol, and a range of options may be made available to the user. The contents of the second chamber may primarily provide flavour compounds, and a range of options for the second chamber may be available to the user. The user can choose one chamber from the range of first chambers and one chamber from the range of second chambers and may fit them together to form a complete cartridge.

Even when the first and second chambers are provided together and permanently fixed to one another, the same mix and match approach may be taken by a manufacturer to provide a range of different cartridge assemblies.

The first and second chambers may be of the same size and shape as one another or they may have a different size or shape to one another. The size and shape of the first and second chamber may be chosen to suit their contents, and to provide for a particular heating rate in use.

It is also possible to have more than two chambers. It may be desirable to have three or more chambers in the cartridge assembly, with at least two of the chambers having different contents.

The cartridge may have any suitable shape.

Preferably, the cartridge is substantially cylindrical.

The cartridge may have any suitable size.

The cartridge may have a length of, for example, between about 5 mm and about 30 mm. In certain embodiments the cartridge may have a length of about 12 mm.

The cartridge may have a diameter of, for example, between about 4 mm and about 10 mm. In certain embodiments the cartridge may have a diameter of about 7 mm.

An aerosol-generating system may be provided comprising an aerosol-generating device and a cartridge according to any of the embodiments described above. Preferably the aerosol-generating device is an electrically operated aerosol-generating device. Preferably, the aerosol-generating system is configured to generate an aerosol for inhalation by a user. The aerosol-generating system may be a handheld system and may comprise a mouthpiece on which a user sucks or draws in use.

In one embodiment there is provided an aerosol-generating system comprising a cartridge comprising two separate chambers, one chamber containing an aerosol-forming substrate in the form of a gel, and the other containing a source of a compound for inhalation, and an aerosol-generating device comprising a power supply for an electrical heater, the

cartridge being configured to removably connect to or be removably received in the aerosol-generating device. Separate chambers may be connected to and removed from the aerosol-generating device separately. In some embodiments, the cartridge is held within a mouthpiece tube, and the mouthpiece tube is removably received in the aerosol-generating device.

The source of a compound for inhalation may comprise one or both of a source of nicotine and a flavour source.

The electrical heater may be configured to heat the cartridge to generate a vapour within the cartridge from the aerosol-forming substrate. The device body may comprise an electrical power supply and the electrical heater. Alternatively, the cartridge may comprise all or a portion of the electrical heater.

The aerosol-generating device of the aerosol-generating system may comprise: a housing having a cavity for receiving the cartridge. The aerosol-generating device may comprise electronic circuitry configured to control the supply of power from a power supply to an electric heating element of the electrical heater.

The electric heating element may comprise one or more heating elements.

In preferred embodiments, the electrically operated aerosol-generating device comprises an electric heating element and a housing having a cavity, wherein the heated cartridge is received in the cavity. The heating element may conveniently be shaped as a needle, pin, rod, or blade that may be inserted into a slot or slots defined by the cartridge assembly.

The electric heating element may comprise one or more external heating elements, one or more internal heating elements, or one or more external heating elements and one or more internal heating elements. In this context, external means outside of the cavity and internal means inside of the cavity for receiving the cartridge.

The one or more external heating elements may comprise an array of external heating elements arranged around the inner surface of the cavity. In certain examples, the external heating elements extend along the longitudinal direction of the cavity. With this arrangement, the heating elements may extend along the same direction in which the cartridge is inserted into and removed from the cavity. This may reduce interference between the heating elements and the cartridge relative to devices in which the heating elements are not aligned with the length of the cavity. In some embodiments, the external heating elements extend along the length direction of the cavity and are spaced apart in the circumferential direction. Where the heating element comprises one or more internal heating elements, the one or more internal heating elements may comprise any suitable number of heating elements. For example, the heating element may comprise a single internal heating element. The single internal heating element may extend along the longitudinal direction of the cavity.

The electric heating element may comprise an electrically resistive material. Suitable electrically resistive materials include but are not limited to: semiconductors such as doped ceramics, electrically "conductive" ceramics (such as, for example, molybdenum disilicide), carbon, graphite, metals, metal alloys and composite materials made of a ceramic material and a metallic material. Such composite materials may comprise doped or undoped ceramics. Examples of suitable doped ceramics include doped silicon carbides. Examples of suitable metals include titanium, zirconium, tantalum and metals from the platinum group. Examples of suitable metal alloys include stainless steel, Constantan, nickel-, cobalt-, chromium-, aluminium- titanium- zirconium-, hafnium-, niobium-, molybdenum-, tantalum-, tungsten-, tin-, gallium-, manganese- and iron-containing alloys, and super-alloys based on nickel, iron, cobalt, stainless steel, Timetal®, iron-aluminium based alloys and iron-manganese-aluminium based alloys. Timetal® is a registered trade mark of Titanium Metals Corporation, 1999 Broadway Suite 4300, Denver Colorado. In composite materials, the electrically resistive material may optionally be embedded in, encapsulated or coated with an insulating material or vice-versa, depending on the kinetics of energy transfer and the external physicochemical properties required. The heating element may comprise a metallic etched foil insulated between two layers of an inert material. In that case, the inert material may comprise Kapton®, all-polyimide or mica foil. Kapton® is a registered trade mark of E.I. du Pont de Nemours and Company, 1007 Market Street, Wilmington, Delaware 19898, United States of America.

The electric heating element may be formed using a metal having a defined relationship between temperature and resistivity. In such embodiments, the metal may be formed as a track between two layers of suitable insulating materials. An electric heating element formed in this manner may be used both as a heater and a temperature sensor.

Where the electric heating element comprises a susceptor, the aerosol-generating device preferably comprises an inductor arranged to generate a fluctuating electromagnetic field within the cavity and an electrical power supply connected to the inductor. The inductor may comprise one or more coils that generate a fluctuating electromagnetic field. The coil or coils may surround the cavity.

Preferably the device is capable of generating a fluctuating electromagnetic field of between 1 and 30 MHz, for example, between 2 and 10 MHz, for example between 5 and 7 MHz. Preferably the device is capable of generating a fluctuating electromagnetic field having a field strength (H-field) of between 1 and 5 kA/m, for example between 2 and 3 kA/m, for example about 2.5 kA/m.

The aerosol-generating system and the aerosol-generating device according to the present invention may comprise a single heater. This advantageously provides for a simple device construction. The single heater may be configured as an external heater that in use is positioned externally to the cavity. Alternatively, the single heater may be configured as

an internal heater that in use is positioned internally to the cavity and received in a slot in the cartridge. Preferably, the single heater is configured as an internal heater.

Where the single heater is configured as an internal heater, the aerosol-generating device may advantageously comprise guide means to facilitate proper alignment of the internal heater with the cartridge.

Preferably, the single heater is an electric heating element comprising an electrically resistive material. The electric heating element may comprise a non-elastic material, for example a ceramic sintered material, such as glass, alumina (Al203) and silicon nitride (Si3N4), or printed circuit board or silicon rubber. Alternatively, the electric heating element may comprise an elastic, metallic material, for example an iron alloy or a nickel-chromium alloy.

The single heater may have any shape suitable to heat both chambers of the cartridge. The electrical heater may be positioned between the first and second chambers when the cartridge is connected to or received in the device body. In preferred embodiments, the single heater is an elongate internal electric heating element. In particularly preferred embodiments, the single heater is an elongate internal electric heating element having a width that is greater than the thickness thereof so that the elongate internal electric heating element is in the form of a heater blade.

Preferably, the heater does not project from the aerosol-generating device.

The aerosol generating system may comprise more than one heater to allow for different or selective heating of the first and second chambers. It may be desirable to heat the first chamber to a different temperature to the second chamber, for example.

The aerosol-generating system and the aerosol-generating device according to the present invention may further comprise one or more temperature sensors configured to sense the temperature of at least one of the electrical heater. In such embodiments, the controller may be configured to control a supply of power to the electrical heater based on the sensed temperature.

Any suitable electronic circuitry may be used in order to control the supply of power to the electric heating element. The electronic circuitry may be a simple switch. Alternatively the electronic circuitry may comprise one or more microprocessors or microcontrollers. The electronic circuitry may be programmable.

The power supply may be a DC voltage source. In preferred embodiments, the power supply is a battery. For example, the power supply 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 or a Lithium-Polymer battery. The power supply may alternatively be another form of charge storage device such as a capacitor. The power supply may require recharging and may have a capacity that allows for the storage of enough energy for use of the aerosol-generating device with one or more aerosol-generating cartridges.

Preferably, the aerosol-generating device comprises a body portion containing the power supply and a mouthpiece portion configured for engagement with the body portion. The body portion may be configured to receive the cartridge or cartridge assembly in a cavity of the body portion. By providing a reusable mouthpiece, separate to the cartridge, the construction of the cartridge can be simple and inexpensive.

Preferably, the cavity of the aerosol-generating device is substantially cylindrical.

As used herein with reference to the present invention, the terms "cylinder" and "cylindrical" refer to a substantially right circular cylinder with a pair of opposed substantially planar end faces.

Preferably, the cavity of the aerosol-generating device has a diameter substantially equal to or slightly greater than the diameter of the cartridge.

Advantageously, the system does not comprise a transport mechanism for transporting the aerosol-former to the heater. The contents of the cartridge are advantageously heated *in situ* to generate a desired aerosol. In this context *in situ* means in the same position within the first and second chambers that the contents are held prior to use. There is no requirement for a capillary wick or pump.

Where the cartridge comprises one or more frangible barriers sealing one or both of the first chamber and the second chamber, the aerosol-generating device preferably further comprises a piercing member configured to rupture the one or more frangible barriers.

Preferably, the aerosol-generating device is a portable or handheld aerosol-generating device that is comfortable for a user to hold between the fingers of a single hand.

The aerosol-generating device may be substantially cylindrical in shape. The aerosol-generating device may have a length of between approximately 70 millimetres and approximately 120 millimetres.

The invention will now be further described with reference to the accompanying drawings which further illustrate embodiments according to the present invention and in which:

Figure 1 is a schematic illustration of an aerosol-generating system in accordance with a first embodiment of the invention;

Figure 2a is a perspective view of a mouthpiece portion in accordance with a first embodiment of the invention;

Figure 2b is a bottom perspective view of a cartridge housing in accordance with a first embodiment of the invention;

Figure 2c is a top perspective view of the cartridge assembly of Figure 2b;

Figure 2d shows one of the chambers of the cartridge assembly of Figure 2b;

Figure 3 illustrates an embodiment in which a mouthpiece portion pierces a frangible seal on a cartridge in accordance with the invention;

Figure 4 is a schematic illustration of an aerosol-generating system in accordance with a further embodiment of the invention;

Figure 5 is a schematic illustration of an aerosol-generating system in accordance with a another embodiment of the invention;

Figure 6a is a schematic illustration of a cartridge assembly held within a mouthpiece tube in accordance with a further embodiment of the invention;

Figure 6b is an exploded view of the elements within the mouthpiece tube of Figure 6a; and

Figure 7 is an illustration of the airflow through the mouthpiece tube of Figure 6a.

Figure 1 is a schematic illustration of an aerosol-generating system in accordance with a first embodiment of the invention. The system comprises an aerosol-generating device 10 and a replaceable cartridge 20. The aerosol-generating device comprises a device body 12 and a mouthpiece portion 14.

The device body 12 comprises a power supply, which is a lithium ion battery 16 and electronic control circuitry 18. The device body also includes heater 22, which is in the form a blade that projects into a cavity 24 in the housing of the device body. The heater is an electric heater comprising an electrically resistive track on a ceramic substrate material. The control circuitry is configured to control the supply of power from the battery 16 to the electric heater 22.

The mouthpiece portion 14 engages the device body using a simple push fitting, although any type of connection, such as a snap fitting or screw fitting may be used. The mouthpiece portion in this embodiment is simply a tapered hollow tube, without any filter elements, and is shown in more detail in Figure 2a. However, it is possible to include one or more filter elements in the mouthpiece portion. The mouthpiece portion comprises air inlet holes 42 and encloses an aerosol-forming chamber 40 (shown in Figure 1) in which vapour can condense in an airflow prior to entering a user's mouth.

The cartridge 20 comprises a housing defining two blind chambers. The two chambers 30, 32 are open at a mouthpiece end. A membrane 37 (shown in Figure 1) seals the open end of the chambers. A removable seal may be provided over the membrane that a user peels off before use. A blind slot 34 is provided between the two chambers for the heater 22 to be received in. The blind slot 34 is closed at the mouthpiece end. A first chamber 30 holds a first gel, containing nicotine and aerosol-former, and the second chamber 32 holds a second gel, containing shredded tobacco leaves.

Figure 2b is a bottom perspective view of the cartridge assembly housing. Figure 2c is a perspective view of the cartridge assembly housing. The cartridge 20 has a generally cylindrical shape. The first and second chambers 33, 35 are separate and of equal size and shape, and held together at an interface 36. The first and second chambers 33, 35 are held together by a retaining ring 39. Both chamber housings engage the retaining ring 39. Other

means of holding the chambers together are possible, such as a separate clip or bracket, or the provision of interlocking or snap fitting features on each of the chambers. The blind slot 34 is formed between the chambers when they are held together. A channel 38 is provided in a wall of one chamber 35 to engage a corresponding rib in the cavity 24. This ensures that the cartridge assembly can only be inserted into the cavity 24 in one orientation, in which the heater blade is received in the slot 34.

Figure 2d shows the housing of one of the chambers shown in Figures 2b and 2c showing the shape of the blind slot 34. The shape of the slot matches the blade shape of the heater.

The first gel in the first chamber 30 comprises one or two aerosol formers such as glycerin and polyethylene glycol. The relative concentration of the aerosol formers can be adapted to the particular requirements of the system. In this embodiment the gel in the first chamber 30 comprises (by weight): 2% nicotine, 70% glycerin, 27% water, 1% agar.

The gelling agent is preferably agar. It has the property of melting at temperatures above 85°C and turning back to gel at around 40°C. This property makes it suitable for hot environments. The gel will not melt at 50°C, which is useful if the system is left in a hot automobile in the sun, for example. A phase transition to liquid at around 85°C means that the gel only needs to be heated to a relatively low-temperature to induce aerosolization, allowing low energy consumption. It may be beneficial to use only agarose, which is one of the components of agar, instead of agar.

The second gel in the second chamber 32 comprises (by weight): 65% glycerin, 20% water, 14.3% solid powdered tobacco, 0.7% agar

Further or different flavors, such as menthol, can be added either in water or in propylene glycol or glycerin prior to the formation of the either of the gels.

The amount of gel provided in each cartridge can also be chosen to suit particular needs. Each cartridge may contain enough gel to provide a single dose or usage session for a user or may contain sufficient gel for several or many doses or usage sessions.

In operation, the system is configured to operate in a continuous heating mode. This means that the heater 22 heats the cartridge throughout an operating session rather than in response to sensed user puffs. The user turns the system on using a simple switch (not shown) and the heater heats the cartridge. A temperature sensor may be included in the system so that a user can be provided with an indication of when an operating temperature has been reached, at which aerosol is generated. The gels become liquid upon heating above 85°C. Aerosol containing nicotine and glycerin is generated at temperatures between 180°C to 250°C. During operation, the heater operates at approximately 250°C.The heater may operate for a fixed time period after activation, say 6 minutes, or may operate until a user switches the system off. The operating time may depend on the amount of gel contained within the cartridge.

The cartridge housing is formed of aluminium, which is a good thermal conductor. The heater is never in contact with the gel or any generated vapour or aerosol. It is held in the blind slot 34 and so is isolated from the generated aerosol. This ensures that there is no build-up of condensates on the heater, which might lead to the generation of undesirable compounds in operation.

Figure 3 illustrates an embodiment in which each of the chambers of the cartridge are sealed by a frangible sealing element. The mouthpiece portion is used to pierce the sealing elements to allow vapour generated in the chambers to escape from the two chambers.

Figure 3a illustrates the insertion of the cartridge 20 into the device 12. As in Figure 1, the cartridge comprises first and second chambers 30, 32 and a blind slot 34 between the chambers. The chambers are sealed by sealing elements 50.

Figure 3b shows the cartridge inserted into the device, with the heater 22 received in the slot 34 between the chambers. A mouthpiece portion 14 is then connected to the device body portion 12. Figure 3b illustrates the direction of insertion of the mouthpiece portion. The mouthpiece portion is provided with piercing elements 52 which acts to pierce the frangible sealing elements and provide an escape passage 54 for vapour generated in the first and second chambers.

Figure 3c shows the mouthpiece portion 14 in a fully inserted position, with the piercing elements 52 extending into the first and second chambers and allowing vapour to escape from the first and second chambers 30, 32, into an aerosol-forming chamber in the mouthpiece portion. The vapour cools and is entrained in an airflow in the mouthpiece portion to form an aerosol, before being inhaled by the user. As in the embodiment of Figure 1, the mouthpiece portion may be provided with air inlets. Alternatively or in addition, an airflow path into the mouthpiece portion may be provided through the device. Alternatively or in addition, an airflow path may be provided through the first and second chambers.

Figure 4 is a schematic illustration of an aerosol-generating system in accordance with a further embodiment of the invention. In the embodiment of Figure 4, the heater 122 is on the outside of the cavity of the device portion in which the cartridge assembly is received rather than extending into a slot formed in the cartridge assembly. The device body 112 comprises a power supply, which is a lithium ion battery 116 and electronic control circuitry 118. The device body also includes a heater 122, which extends around a cavity 124 in the housing of the device body. The heater is an electric heater comprising an electrically resistive track provided on a flexible substrate. Specifically, the heating element comprises a metallic etched foil forming a track, held between two layers of Kapton®. By providing a heater comprising electrically resistive tracks on a flexible substrate, the heater may be easier to manufacture and form into the required shape to conform to the cavity. The control

circuitry is configured to control the supply power from the battery 116 to the electric heater 122.

The cartridge of Figure 4 is similar to the cartridge shown in Figure 1.The composition of the gels in the two chambers of the cartridge may be the same as in the embodiment of Figure 1. The cartridge housing is also formed from aluminium. However, in the embodiment of Figure 4 an open ended slot 134 is provided rather than a blind slot. The open ended slot 134 provides an airflow path from an air inlet 142 in the device body to the aerosol-forming chamber 140 in the mouthpiece portion 114. A cartridge piercing arrangement similar to that shown in Figure 3 may be used to open the cartridge using the mouthpiece portion 114, with suitable adaptations made for the different airflow path. The two chambers may be separate and held together as in the embodiment of Figure 1, or may remain separate from one another throughout their use.

In operation, the system is configured to operate in a continuous heating mode as in the embodiment of Figure 1. This means that the heater 122 heats the cartridge throughout an operating session rather than in response to sensed user puffs. The user turns the system on using a simple switch (not shown) and the heater heats the cartridge. A temperature sensor may be included in the system so that a user can be provided with an indication of when an operating temperature has been reached. The gels become liquid upon heating above 85°C. Aerosol containing nicotine and glycerin is generated at temperatures between 180°C to 250°C. During operation, the heater operates at approximately 250°C. The heater may operate for a fixed time period after activation, say 6 minutes, or may operate until a user switches the system off.

Figure 5 is a schematic illustration of an aerosol-generating system in accordance with a still further embodiment of the invention. The embodiment of Figure 5 operated by using induction heating rather than by using resistive heating. Instead of using a resistive heater either around or inside the cavity in which the cartridge is received, the device body comprises an inductor coil surrounding the cavity and a susceptor is provided in the cavity, in this example as part of the cartridge.

The device body 212 comprises a power supply, which is a lithium ion battery 216 and electronic control circuitry 218. The device body also includes an induction coil 224, which extends around a cavity in the housing of the device body. The device body also comprises electronic circuitry 220 to generate an AC signal which is provided to the induction coil 224.

The mouthpiece portion 214 is similar to the mouthpiece portion shown in Figure 1 and encloses an aerosol-forming chamber 240. In this example air inlets 242 are provided at the junction of the mouthpiece portion and the device body.

The cartridge of Figure 4 is similar to the cartridge shown in Figure 1.The composition of the gels in the two chambers of the cartridge may be the same as in the embodiment of

Figure 1. However, rather than having a blind cavity for receiving a heater, the adjacent walls of the two chambers comprise a susceptor material 222 that heats up in the alternating magnetic field, such as a layer of iron. The susceptor material in this example is provided as part of the cartridge rather than part of the device body, but it is possible for the susceptor material to be provided as part of the device body or both in the cartridge and the device body. The entire cartridge housing may be formed from a susceptor material, or a susceptor material may be provided as a coating on one of more surfaces of the cartridge. It is also possible to provide susceptor material within the first and second chambers, suspended in the gel or other material contained there.

A sealing element is provided to seal the first and second chambers in the same manner as described with reference to Figure 1. A cartridge piercing arrangement similar to that shown in Figure 3 may be used to open the cartridge using the mouthpiece portion 114, with suitable adaptations made for the different airflow path. Alternatively, a simple peelable seal may be used and a vapour permeable membrane provided across the open end of the first and second chambers 230, 232.

In operation, the system is configured to operate in a continuous heating mode as in the embodiment of Figure 1. This means that when a user switches the device on, the device supplies an AC signal to the induction coil in order to generate an alternating magnetic field in the cavity. This induces current flow in the susceptor resulting in a heating of the susceptor. If a ferromagnetic material is used as the susceptor, hysteresis losses may also contribute to the heating. The induction coil may be described as an induction heater in this context. By controlling the magnitude and frequency of the AC signal, the temperature within the first and second chambers can be controlled. A temperature sensor may be provided within the cavity and a feedback control loop used. Again the induction heater may operate for a fixed time period after activation, say 6 minutes, or may operate until a user switches the system off.

Figure 6a is a schematic illustration of a further embodiment of the invention. In the embodiment of Figure 6a, the cartridge 330 is held within a mouthpiece tube 300. A flow restrictor 350 and lining tubes 340, 360, 370 are also held within the mouthpiece tube. The components held within the mouthpiece tube 330 are shown in an exploded view in Figure 6b.

The cartridge 330 is similar to the cartridge shown in Figure 2c and comprises separate chamber housings. However, the cartridge 330 has no membrane or sealing element but includes airflow channels 335 formed in the walls of the cartridge and air inlets 334 at the top of the airflow channels to allow air into the open ends of the first and second chambers.

The mouthpiece tube is formed from cardboard and has a diameter of 6.6mm and a length of 45 mm. Lining tubes 340 are formed from polyetheretherketone (PEEK) and are

provided to prevent the cardboard mouthpiece tube from absorbing moisture from within the mouthpiece tube. The lining tubes can be made very thin, in this embodiment having a thickness of 0.3mm. A restrictor 350 is provided to restrict the airflow to ensure mixing of air with vapour from the cartridge and ensure the generation of an aerosol within the space following the restrictor, in lining tube 360.

Figure 7 illustrates the airflow within the mouthpiece tube of Figure 6a during operation. The mouthpiece tube is shown within the cavity 24 of a device 12 of the type shown in Figure 1, but without a mouthpiece 14. Figure 7 illustrates only the end of the device that receives the mouthpiece tube. The battery and control circuitry is not shown. The device includes device air inlets 355 that allow air into an internal air flow passage 365 formed in the device around the periphery of the cavity 24. A spacer element 352 is positioned in a base of the cavity to allow air to flow from the internal airflow passage 365 into the cavity 24 and then into the airflow channels 335 in the cartridge 330 and through the air inlets 334 into the interior of the mouthpiece tube.

The cartridge shown in Figures 6a and 6b may be heated by heater of the type shown in Figure 1 or a type shown in Figures 4 or 5. In operation, the system is configured to operate in a continuous heating mode as in Figure 1. This means that the heater heats the cartridge throughout an operating session rather than in response to sensed user puffs. The user turns the system on using a simple switch (not shown) and the heater heats the cartridge. The gels in the first and second chambers become liquid upon heating and vapour containing nicotine and glycerin is generated at temperatures between 180°C to 250°C.

When the system is at the operating temperature, the user sucks on a mouth end of the mouthpiece tube to draw air through the mouthpiece tube. Air is drawn into a distal end of the mouthpiece tube, opposite the mouthpiece end from the internal passage 365. The air travels up the airflow channels 335 and through air inlets 334 into space 345. The air mixes in space 345 with vapour from the first and second chambers. The mixed air and vapour then passes through the restrictor 350, after which it cools to continue to form an aerosol before being drawn into a user's mouth. After operation, the mouthpiece tube, including the cartridge, can be withdrawn from the device and disposed of. Mouthpiece tubes of this type may be sold in packs to provide for multiple operations of the system.

The embodiments described have each been described as configured to operate a continuous heating scheme, in which the heater is activated for a predetermined time period during which a user may take several puffs. However, the systems described may be configured to operate in different ways. For example, power may be provided to the heater or induction coil for only the duration of each user puff, based on signals from an airflow sensor within the system. Alternatively, or in addition, power to the heater or induction coil may be switched on and off in response to user actuation of a button or switch.

The figures show particular embodiments of the invention. But it should be clear that changes may be made to the described embodiments within the scope of the invention. In particular, different arrangements for airflow through the system may be provided and different heating arrangements can be envisaged, such as non-electrical heaters.

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Claims

1. A cartridge for an aerosol-generating system, the cartridge comprising:
a first chamber having a first chamber housing and a second chamber separate to the first chamber and having a second chamber housing, wherein the first chamber contains an aerosol-forming substrate in the form of a gel, and wherein the second chamber contains a source of a compound for inhalation,
wherein the first and second chamber housings are separate or separable from one another.

2. A cartridge according to claim 1, wherein the first and second chamber housing are connected to one another by a mechanical interlock or by a fastening element.

3. A cartridge according to claim 1 or 2, wherein the gel comprises a thermoreversible gel.

4. A cartridge according to any preceding claim, wherein the gel comprises agar or agarose or Gellan gum, or sodium alginate.

5. A cartridge according to any preceding claim, wherein the source of a compound for inhalation comprises a source of nicotine or a flavour source.

6. A cartridge according to any preceding claim, wherein the second chamber contains a second gel, the second gel comprising the source of a compound for inhalation.

7. A cartridge according to any preceding claim, wherein the first chamber contains a source of nicotine.

8. A cartridge according to any preceding claim, wherein the second chamber contains a solid tobacco material.

9. A cartridge according to any preceding claim, wherein the cartridge comprises a slot between the first and second chambers.

10. A cartridge according to claim 9, wherein the slot is a blind slot.

11. A cartridge according to any preceding claim, wherein the first and second chambers contain different compositions.

12. A cartridge according to any preceding claim, wherein the first and second chambers are blind chambers.

13. A cartridge according to any preceding claim, wherein the housing comprises a susceptor layer.

14. An aerosol-generating system comprising cartridge according to any preceding claim and a device body comprising a power supply for an electrical heater, the cartridge being configured to removably connect to or be removably received in the device body.

15. An aerosol-generating system according to claim 14, wherein the electrical heater is configured to heat the cartridge to generate a vapour within the cartridge assembly from the aerosol-former but wherein the heater does not directly contact the aerosol-forming substrate.

16. An aerosol-generating system according to claim 14 or 15, wherein the heater is configured to heat the aerosol-forming substrate within the first chamber housing.

17. An aerosol-generating system according to claim 14, 15 or 16, wherein the device body comprises the power supply and the electrical heater and wherein the electrical heater is positioned between the first and second chambers when the cartridge is connected to or received in the device body.

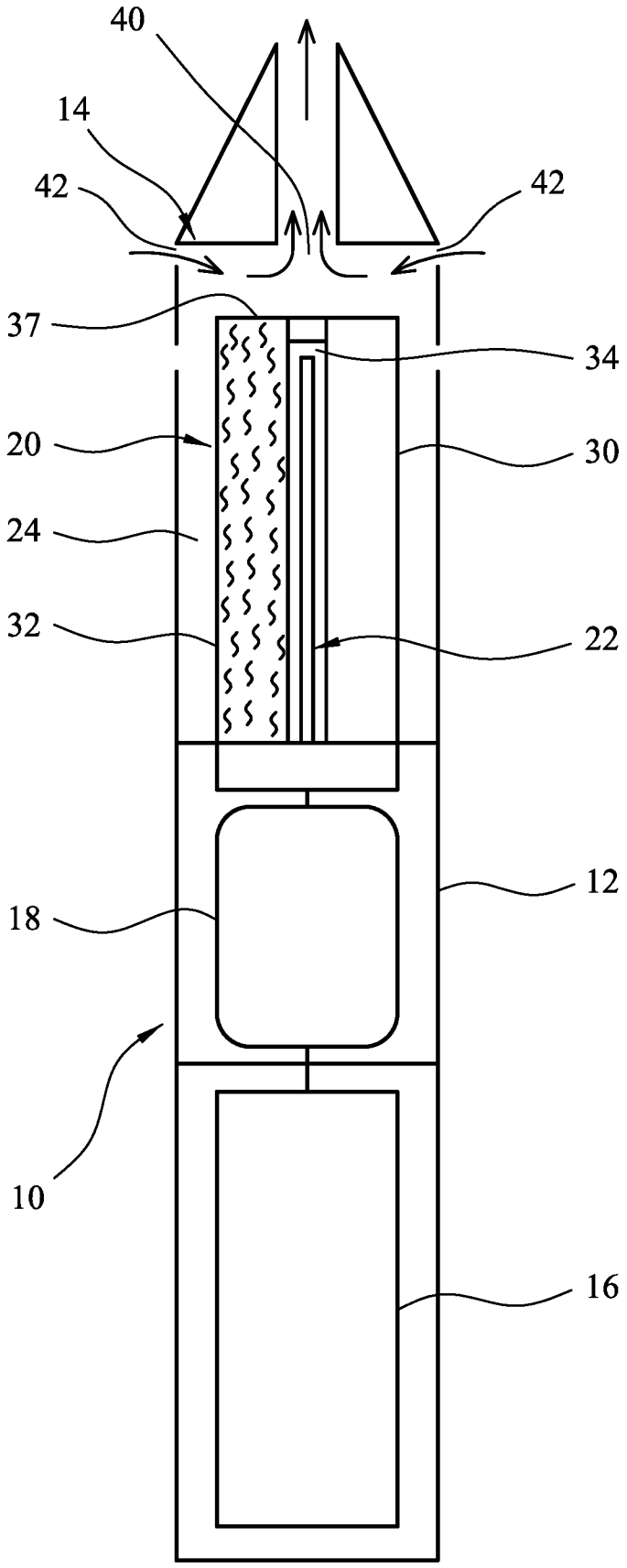
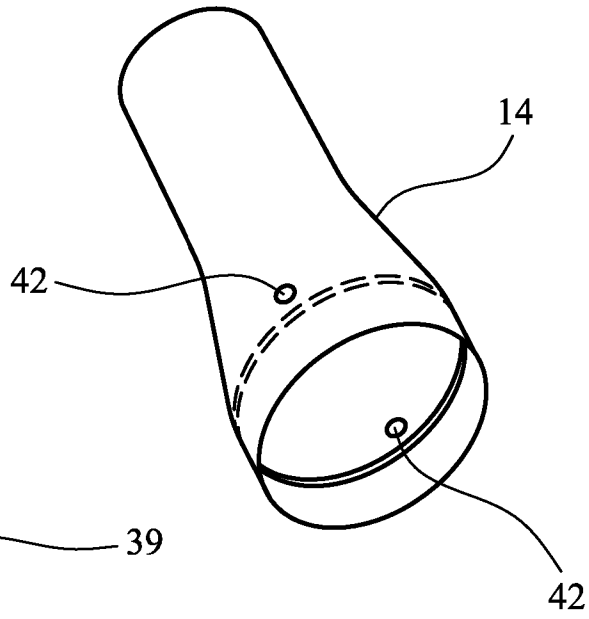


FIG. 1

FIG. 2a



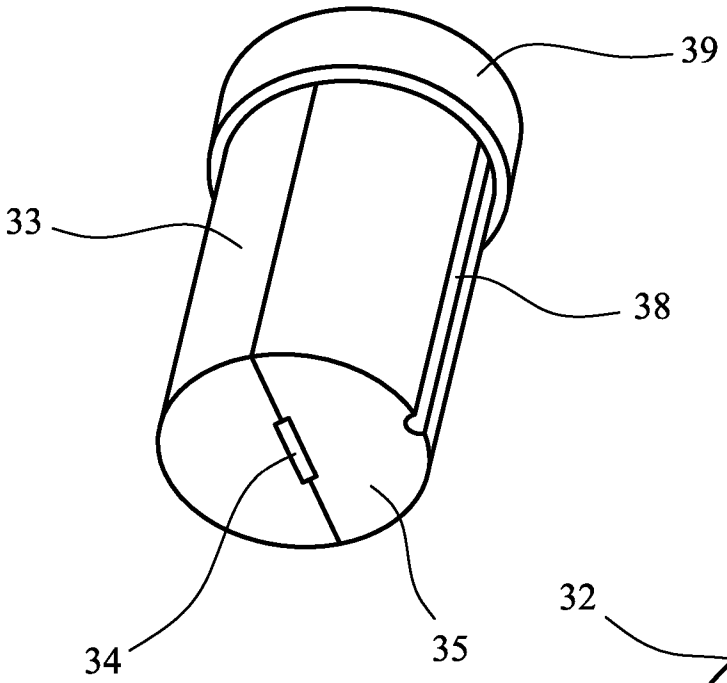


FIG. 2b

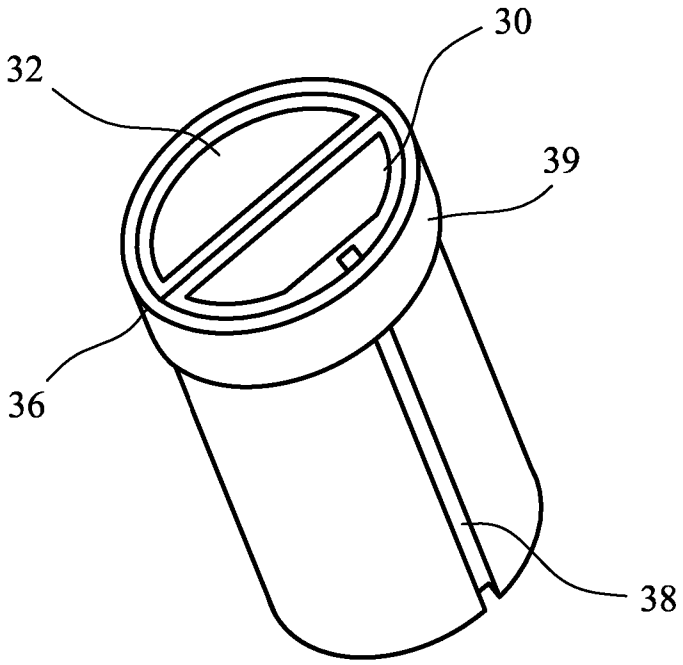


FIG. 2c

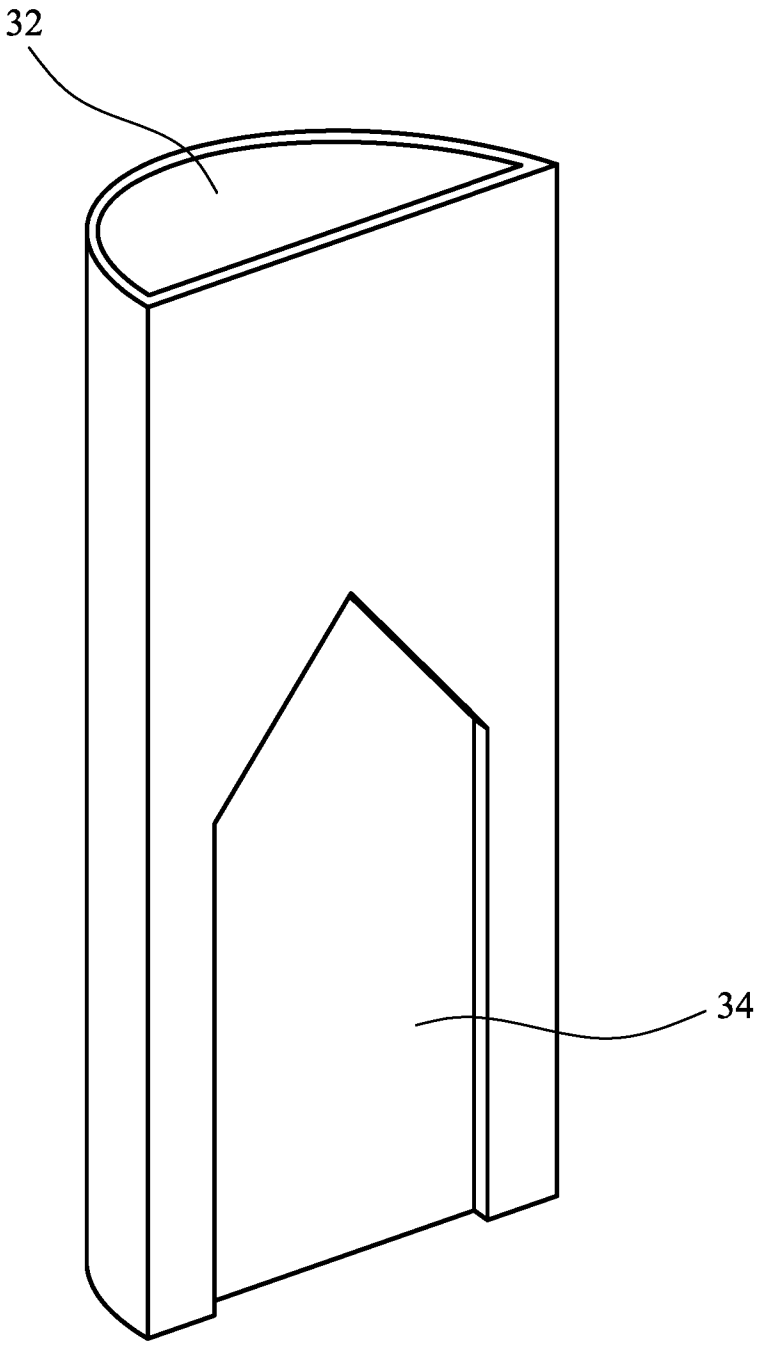


FIG. 2d

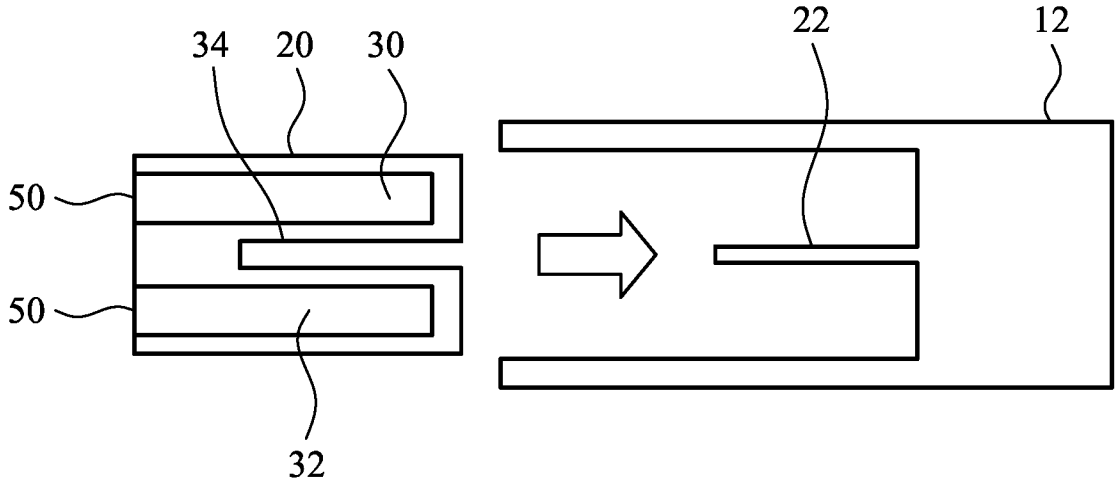


FIG. 3a

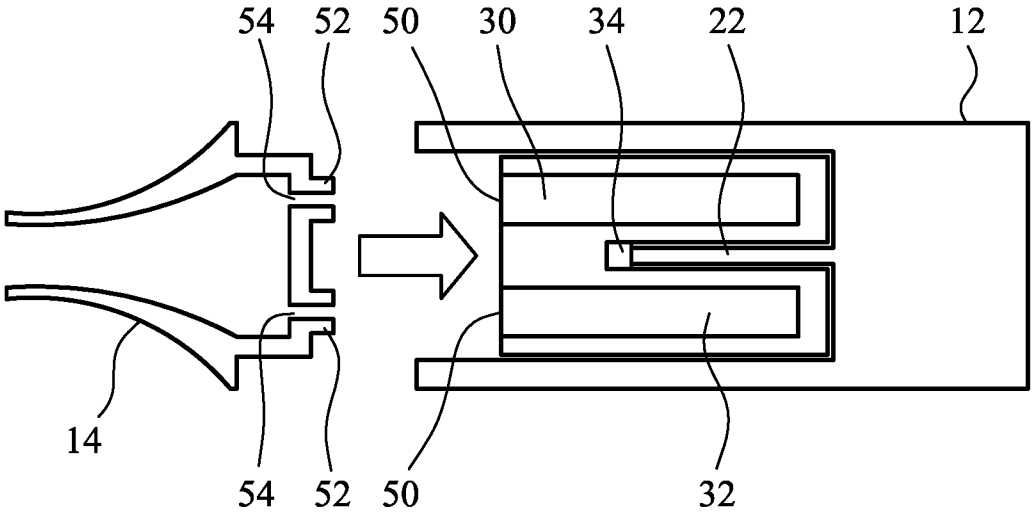


FIG. 3b

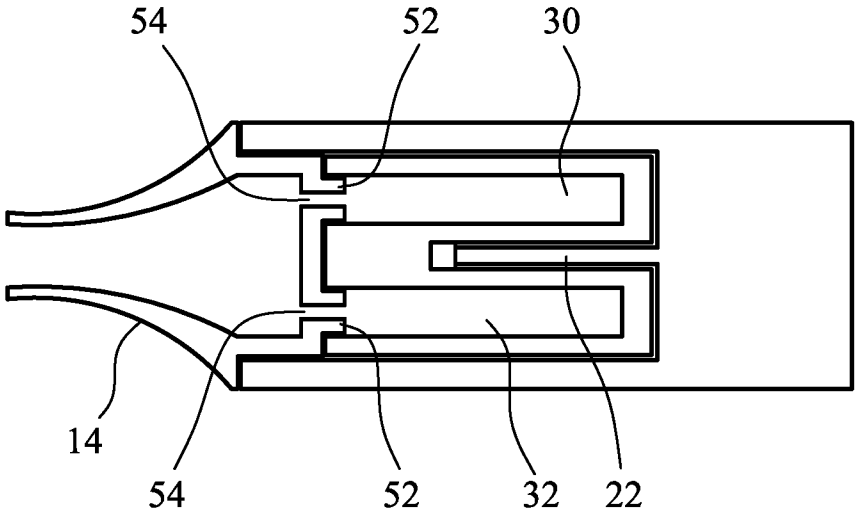


FIG. 3c

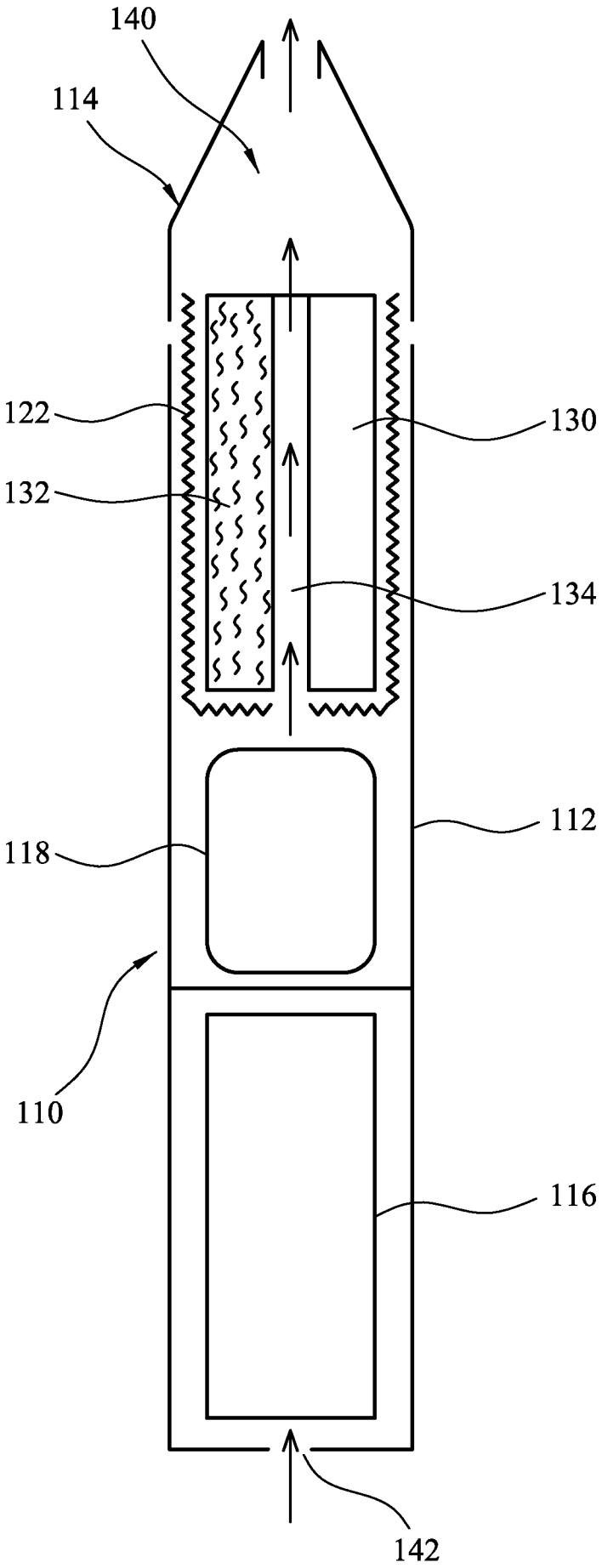


FIG. 4

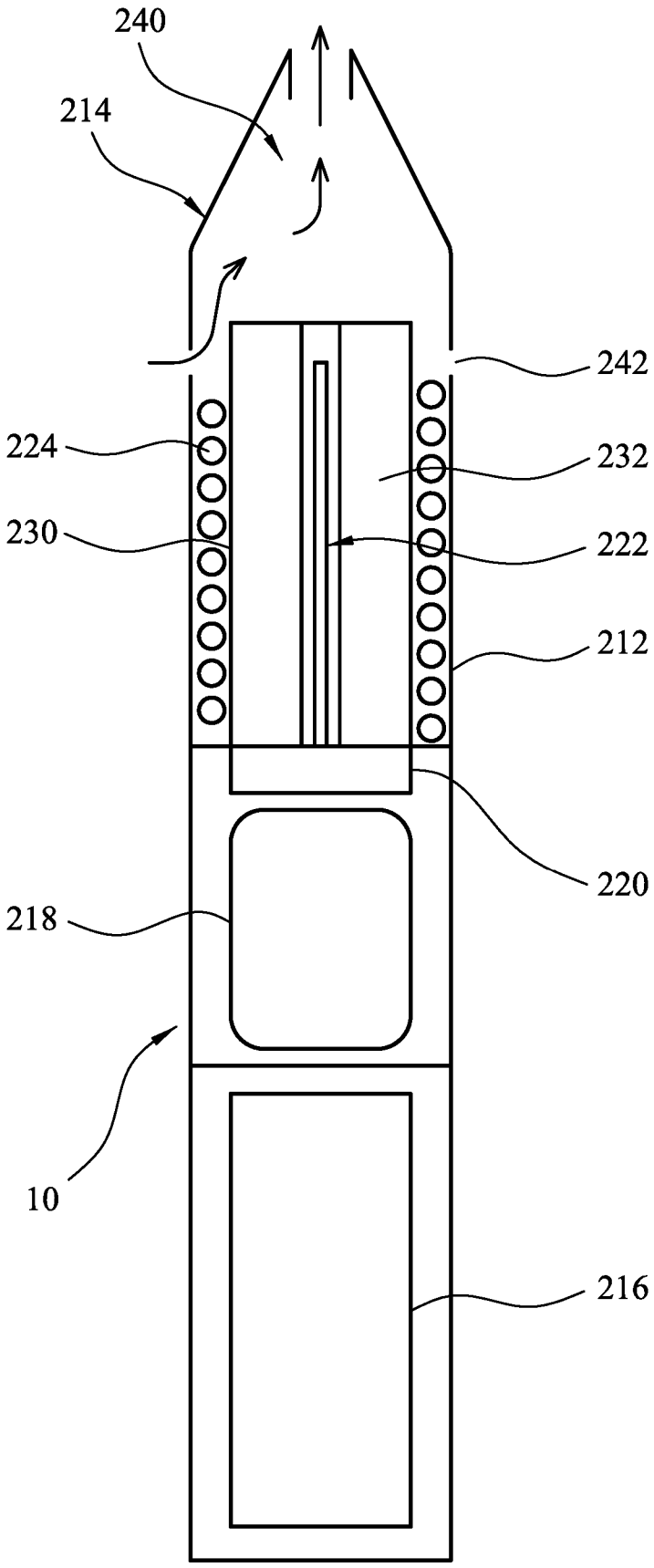


FIG. 5

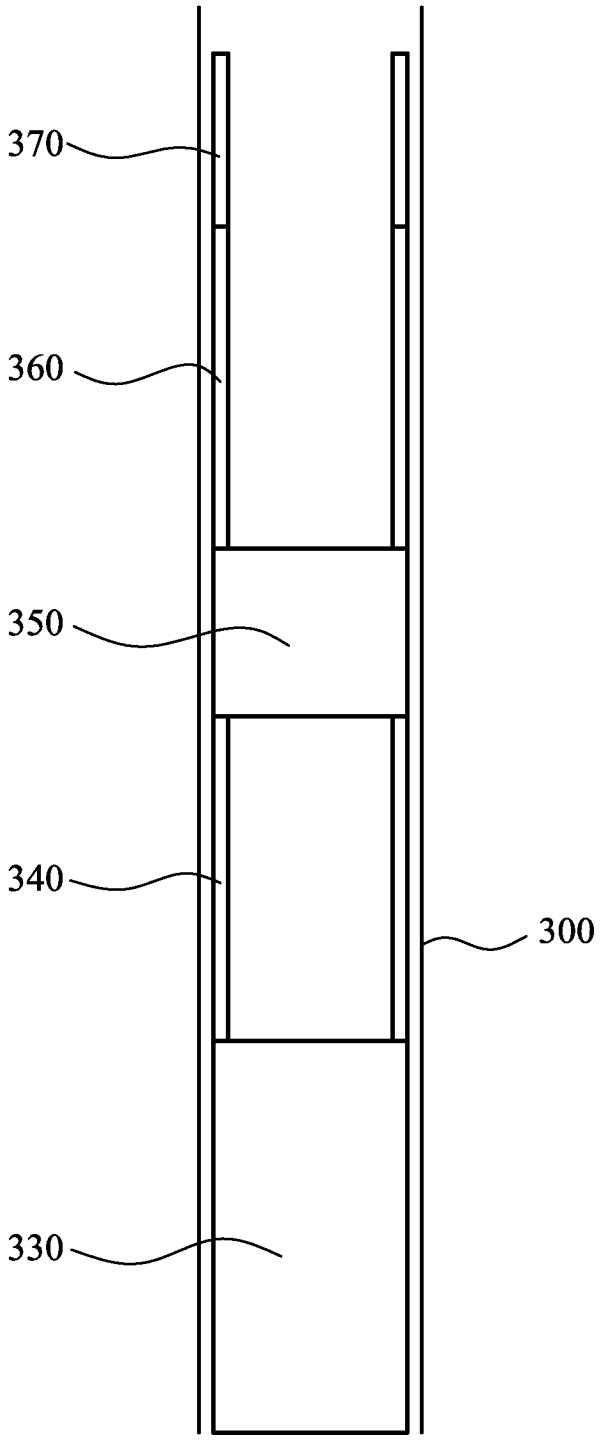


FIG. 6a

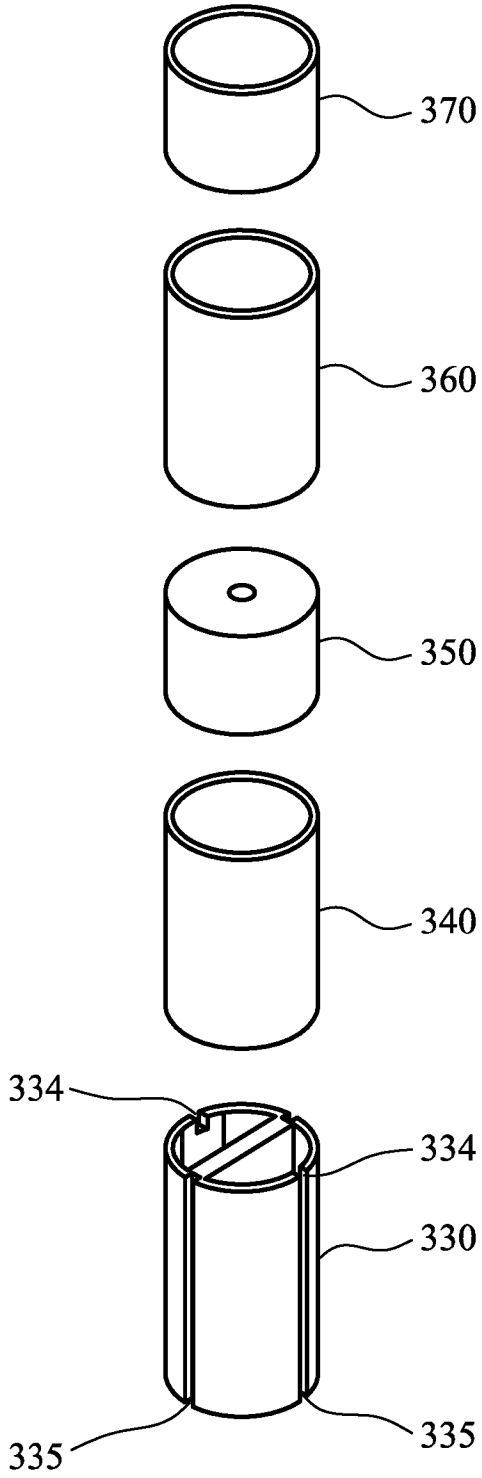


FIG. 6b

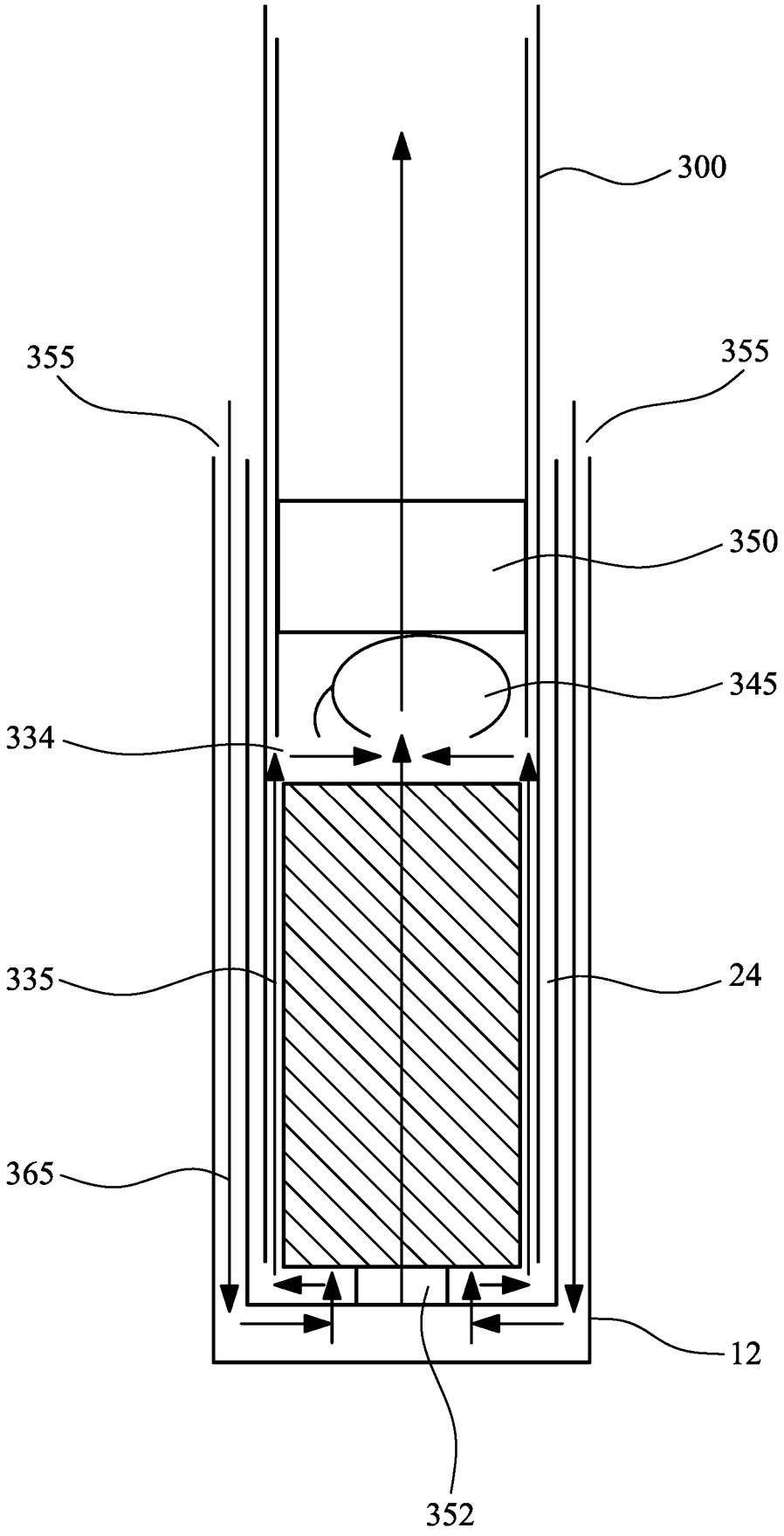


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/067449

A. CLASSIFICATION OF SUBJECT MATTER
INV. A24B15/16 A24F47/00
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A24B A24F

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2016/046362 Al (PHILIP MORRIS PRODUCTS SA [CH]) 31 March 2016 (2016-03-31) page 13, line 14 - line 19; claim 9; figure 2	1-7, 9-15, 17
Y	US 2014/366898 Al (M0NSEES JAMES [US] ET AL) 18 December 2014 (2014-12-18) paragraphs [0002], [0003], [0095]; claims 1, 65, 67	1-7, 9-15, 17
A	US 2016/143360 Al (SANCHEZ LUIS A [US] ET AL) 26 May 2016 (2016-05-26) figures 1-19	1-17
A	W0 2015/038981 A2 (NICODART INC [US]; BR0DY ARTHUR LAWRENCE [US]) 19 March 2015 (2015-03-19) paragraph [0199] - paragraph [0212]; figure 6A	1-17

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"L" documentwhich may throw doubts on priority claim(s) orwhich is cited to establish the publication date of another citation or other special reason (as specified)

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 September 2017	09/10/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Villanyi Kelemen, K

2

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2017/067449

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