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## (54) AEROSOL DELIVERY APPARATUS

(57) An aerosol delivery apparatus (150c, 150d) configured for engagement with a base unit (120), the apparatus and base unit together forming an aerosol delivery system (110), the aerosol delivery apparatus (150c, 150d) comprising a first air passage (170a) having a first aerosol generator, and a second air passage (170b) separate from the first air passage (170a) having a second aerosol generator. The first aerosol generator comprises an air-permeable substrate (160) disposed in the first air passage (170a) and arranged to allow air being drawn through the first air passage (170a) to be drawn through the air-permeable substrate (160), the air-permeable substrate being loaded with a first source of nicotine for entrainment in heated air passing through the first air passage (170a). The second aerosol generator comprises a wick (262) arranged in the second air passage (170b), a heater (264), operable to heat the wick (262), and a liquid storage tank (252) arranged in fluid communication with the wick (262), the liquid storage tank (252) comprising a liquid (260), being a second source of nicotine. The aerosol delivery apparatus (150c) is configurable to selectively operate the first aerosol generator alone and/or the second aerosol generator alone and/or the first and second aerosol generators together.

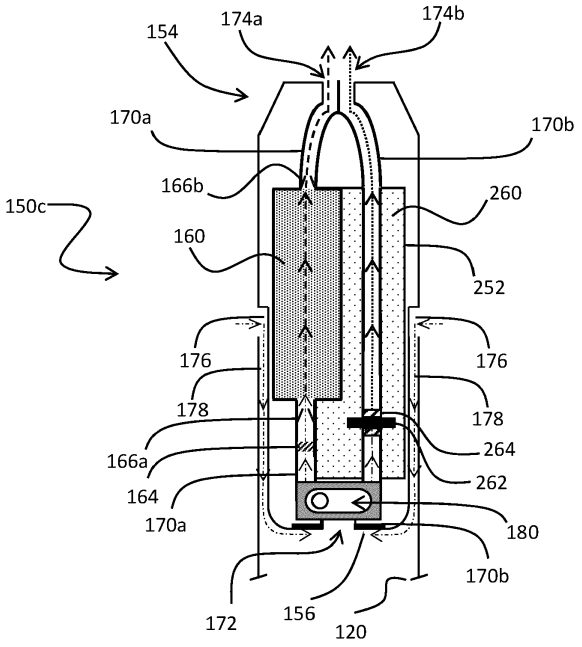


**FIG. 6**

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## Description

### *Field of the Invention*

**[0001]** The present invention relates to an aerosol delivery apparatus. Such a system is of particular, but not necessary exclusive interest as a smoking substitute apparatus. It is a preferred feature of operation of the apparatus that it is able to deliver an active ingredient (such as nicotine) to a user for inhalation without producing a visible vapour cloud.

### *Background*

**[0002]** The smoking of tobacco is generally considered to expose a smoker to potentially harmful substances. It is thought that a significant amount of the potentially harmful substances are generated through the burning and/or combustion of the tobacco and the constituents of the burnt tobacco in the tobacco smoke itself.

**[0003]** Low temperature combustion of organic material such as tobacco is known to produce tar and other potentially harmful by-products. There have been proposed various smoking substitute systems in which the conventional smoking of tobacco is avoided.

**[0004]** Such smoking substitute systems can form part of nicotine replacement therapies aimed at people who wish to stop smoking and overcome a dependence on nicotine.

**[0005]** Known smoking substitute systems include electronic systems that permit a user to simulate the act of smoking by producing an aerosol (also referred to as a "vapour") that is drawn into the lungs through the mouth (inhaled) and then exhaled. The inhaled aerosol typically bears nicotine and/or a flavourant without, or with fewer of, the health risks associated with conventional smoking.

**[0006]** In general, smoking substitute systems are intended to provide a substitute for the rituals of smoking, whilst providing the user with a similar, or improved, experience and satisfaction to those experienced with conventional smoking and with combustible tobacco products.

**[0007]** The popularity and use of smoking substitute systems has grown rapidly in the past few years. Although originally marketed as an aid to assist habitual smokers wishing to quit tobacco smoking, consumers are increasingly viewing smoking substitute systems as desirable lifestyle accessories. There are a number of different categories of smoking substitute systems, each utilising a different smoking substitute approach. Some smoking substitute systems are designed to resemble a conventional cigarette and are cylindrical in form with a mouthpiece at one end. Other smoking substitute devices do not generally resemble a cigarette (for example, the smoking substitute device may have a generally box-like form, in whole or in part).

**[0008]** One approach is the so-called "vaping" approach, in which a vaporisable liquid, or an aerosol former, sometimes typically referred to herein as "e-liquid", is heated by a heating device (sometimes referred to herein as an electronic cigarette or "e-cigarette" device) to produce an aerosol vapour which is inhaled by a user. The e-liquid typically includes a base liquid, nicotine and may include a flavourant. The resulting vapour therefore also typically contains nicotine and/or a flavourant. The base liquid may include propylene glycol and/or vegetable glycerine.

**[0009]** A typical e-cigarette device includes a mouthpiece, a power source (typically a battery), a tank for containing e-liquid and a heating device. In use, electrical energy is supplied from the power source to the heating device, which heats the e-liquid to produce an aerosol (or "vapour") which is inhaled by a user through the mouthpiece.

**[0010]** E-cigarettes can be configured in a variety of ways. For example, there are "closed system" vaping smoking substitute systems, which typically have a sealed tank and heating element. The tank is prefilled with e-liquid and is not intended to be refilled by an end user. One subset of closed system vaping smoking substitute systems include a main body which includes the power source, wherein the main body is configured to be physically and electrically couplable to a consumable including the tank and the heating element. In this way, when the tank of a consumable has been emptied of e-liquid, that consumable is removed from the main body and disposed of. The main body can then be reused by connecting it to a new, replacement, consumable. Another subset of closed system vaping smoking substitute systems are completely disposable, and intended for one-use only.

**[0011]** There are also "open system" vaping smoking substitute systems which typically have a tank that is configured to be refilled by a user. In this way the entire device can be used multiple times.

**[0012]** An example vaping smoking substitute system is the myblu™ e-cigarette. The myblu™ e-cigarette is a closed system which includes a main body and a consumable. The main body and consumable are physically and electrically coupled together by pushing the consumable into the main body. The main body includes a rechargeable battery. The consumable includes a mouthpiece and a sealed tank which contains e-liquid. The consumable further includes a heater, which for this device is a heating filament coiled around a portion of a wick. The wick is partially immersed in the e-liquid, and conveys e-liquid from the tank to the heating filament. The system is controlled by a microprocessor on board the main body. The system includes a sensor for detecting when a user is inhaling through the mouthpiece, the microprocessor then activating the device in response. When the system is activated, electrical energy is supplied from the power source to the heating device, which heats e-liquid from the tank to produce a vapour which is inhaled by a user through the mouthpiece.

**[0013]** An alternative to vaping-type smoking substi-

tute systems is an inhaler apparatus, of which a particular example is the Nicorette® inhalator (trade name). Such systems are often passive in the sense that they do not require a source of heat or other activation energy in order to generate a vapour. As with an e-cigarette, such an inhaler typically includes a mouthpiece and a main body containing a source of nicotine. In use, a user may inhale or "puff' on the mouthpiece to draw air over or through the nicotine source. The nicotine source may be, for example, an air-permeable substrate impregnated with nicotine. When the supply of nicotine in the nicotine source is depleted, such that the user no longer receives sufficient (or any) nicotine with each puff, the user can replace the nicotine source in order to continue nicotine delivery.

***Summary of the Invention***

**[0014]** Smoking substitute systems (e.g. e-cigarettes) are generally regarded as having fewer of the health risks associated with conventional smoking, not only for the user themselves, but also for those nearby (i.e. those affected by passive smoking). However, the exhaling of a visible vapour cloud by the user may still be regarded in some circumstances as socially unacceptable, in light of the negative views surrounding smoking itself. Therefore, many locations where smoking is not permitted also do not allow smoking substitute systems, instead requiring users to use the same designated smoking areas as smokers themselves. This can reduce the attractiveness of smoking substitute systems, and reduce their uptake as a smoking cessation aid.

**[0015]** Accordingly, it would be advantageous to provide a smoking substitute system that can provide a similar user experience to an e-cigarette, but without producing a visible vapour cloud. Additionally, it would be advantageous to provide a smoking substitute system that can allow a user to select whether or not the system produces a vapour cloud by switching between one system operating mode where a vapour cloud is produced and another system operating mode where a vapour cloud is not produced.

**[0016]** Still further, based on the insight of the present inventors, it would be advantageous to provide an aerosol delivery system, not necessarily limited to a smoking substitute system, for the delivery of an active ingredient to a user by inhalation, providing the beneficial effects referred to above.

**[0017]** The present disclosure has been devised in the light of the above considerations.

**[0018]** In a general aspect, the present invention relates to an aerosol delivery apparatus having two separate aerosol generators, wherein at least one of the aerosol generators can be selectively operated or not operated. A user can thereby select an operating mode that is appropriate for their present environment.

**[0019]** According to a first preferred aspect there is provided an aerosol delivery apparatus configured for engagement with a base unit, the apparatus and base unit together forming an aerosol delivery system, the aerosol delivery apparatus comprising a first air passage having a first aerosol generator, and a second air passage separate from the first air passage having a second aerosol generator. The first aerosol generator comprises an air-permeable substrate disposed in the first air passage and arranged to allow air being drawn through the first air passage to be drawn through the air-permeable substrate, the air-permeable substrate being loaded with a first source of an active ingredient for entrainment in heated air passing through the first air passage. The second aerosol generator comprises a wick arranged in the second air passage, a heater, operable to heat the wick, and a liquid storage tank arranged in fluid communication with the wick, the liquid storage tank comprising a liquid, being a second source of an active ingredient. The aerosol delivery apparatus is configurable to selectively operate the first aerosol generator alone; and/or the second aerosol generator alone; and/or the first and second aerosol generators together.

**[0020]** In some embodiments, the aerosol delivery system is a smoking substitute system. In such embodiments, the active ingredient may comprise or consist of nicotine.

**[0021]** Optionally, the aerosol delivery apparatus may comprise an aerosol generator selector to configure the aerosol delivery apparatus to selectively operate the first aerosol generator alone and/or the second aerosol generator alone and/or the first and second aerosol generators together.

**[0022]** Conveniently, the aerosol generator selector may comprise a valve operable to control air flow through the first air passage to provide selectivity of operation for the first aerosol generator.

**[0023]** Advantageously, the aerosol generator selector may comprise a valve operable to control air flow through the second air passage to provide selectivity of operation for the second aerosol generator.

**[0024]** Optionally, the aerosol generator selector may comprise a three-way valve operable to direct air flow to the first air passage or the second air passage to provide selectivity of operation for the first aerosol generator and the second aerosol generator.

**[0025]** Conveniently, the aerosol generator selector may comprise a mouthpiece comprising a mouthpiece air passage, and the mouthpiece may be configurable to place the mouthpiece air passage in fluid communication with either the first air passage or the second air passage of the aerosol delivery apparatus.

**[0026]** Advantageously, the mouthpiece may be rotatable between a first position wherein the mouthpiece air passage is in fluid communication with the first air passage of the aerosol delivery apparatus and a second position wherein the mouthpiece air passage is in fluid communication with the second air passage of the aerosol delivery apparatus.

**[0027]** Optionally, the aerosol delivery apparatus may be configurable to selectively operate the heater of the

second aerosol generator to provide selectivity of operation for the second aerosol generator.

**[0028]** Conveniently, the first aerosol generator may further comprise a heater arranged in the first air passage and configured to heat air being drawn through the first air passage.

**[0029]** Advantageously, the heater for heating the air in the first air passage may comprise an electrically heatable mesh.

**[0030]** Optionally, the heater for heating in the first air passage may be heatable by resistive heating using an electrical current.

**[0031]** Conveniently, the aerosol delivery apparatus may be configurable to selectively operate the heater of the first aerosol generator to provide selectivity of operation for the first aerosol generator.

**[0032]** Advantageously, the aerosol delivery apparatus may comprise a one-way valve arranged along the first air passage and configured to allow air to flow along the air passage in an upstream to downstream direction.

**[0033]** Optionally, the aerosol delivery apparatus may comprise a one-way valve arranged along the second air passage and configured to allow air to flow along the air passage in an upstream to downstream direction.

**[0034]** According to a second preferred aspect, there is provided an aerosol delivery system comprising a base unit, and an aerosol delivery apparatus according to the first aspect, wherein the aerosol delivery apparatus is removably engageable with the base unit.

**[0035]** According to a third preferred aspect, there is provided a method of using an aerosol delivery apparatus according to the first aspect generate an aerosol.

**[0036]** Optionally, the method may further comprise a step of configuring the aerosol delivery apparatus to operate the first aerosol generator alone; and/or the second aerosol generator alone; and/or the first and second aerosol generators together.

**[0037]** The aerosol delivery apparatus may be in the form of a consumable. The consumable may be configured for engagement with a main body. When the consumable is engaged with the main body, the combination of the consumable and the main body may form an aerosol delivery system such as a closed aerosol delivery system. For example, the consumable may comprise components of the system that are disposable, and the main body may comprise non-disposable or non-consumable components (e.g. power supply, controller, sensor, etc.) that facilitate the generation and/or delivery of aerosol by the consumable. In such an embodiment, an aerosol precursor (e.g. e-liquid) and/or other active ingredient source (e.g. nicotine-infused air-permeable substrate) may be replenished by replacing a used consumable with an unused consumable.

**[0038]** Alternatively, the aerosol delivery apparatus may be a non-consumable apparatus (e.g. that is in the form of an open aerosol delivery system). In such embodiments an aerosol former (e.g. e-liquid) of the system may be replenished by re-filling, e.g. a reservoir of the aerosol delivery apparatus, with the aerosol precursor (rather than replacing a consumable component of the apparatus).

**[0039]** In light of this, it should be appreciated that some of the features described herein as being part of the aerosol delivery apparatus may alternatively form part of a main body for engagement with the aerosol delivery apparatus. This may be the case in particular when the aerosol delivery apparatus is in the form of a consumable.

**[0040]** Where the aerosol delivery apparatus is in the form of a consumable, the main body and the consumable may be configured to be physically coupled together. For example, the consumable may be at least partially received in a recess of the main body, such that there is an interference fit between the main body and the consumable. Alternatively, the main body and the consumable may be physically coupled together by screwing one onto the other, or through a bayonet fitting, or the like.

**[0041]** Thus, the aerosol delivery apparatus may comprise one or more engagement portions for engaging with a main body. In this way, one end of the aerosol delivery apparatus may be coupled with the main body, whilst an opposing end of the smoking substitute apparatus may define a mouthpiece of the aerosol delivery system.

**[0042]** In order to generate an aerosol, the first aerosol generator and the second aerosol generator independently comprise at least one volatile compound that is intended to be vaporised/aerosolised and that may provide the user with a recreational, wellness, nutritional, physiological and/or medicinal effect when inhaled. Such a volatile compound is referred to herein as an "active agent" or "active ingredient".

**[0043]** The active ingredient may comprise or consist of nicotine. However, in some embodiments, the active ingredient may not comprise nicotine, and may instead comprise or consist of one or more of a nutritional agent, a pharmaceutical agent or a flavour agent.

**[0044]** The active ingredient used in the first aerosol generator may be the same as, or different to, the active ingredient used in the second aerosol generator.

**[0045]** Suitable active agents include the group consisting of: nicotine, cocaine, caffeine (anhydrous or salts thereof), vitamins, minerals, amino acids, plant or herbal concentrated extracts, sugars, opiates and opioids, cathine and cathinone, kavalactones, mysticin, beta-carboline alkaloids, salvinorin A, cannabinoids, phytocannabinoids, one or more flavourants, together with any combinations, functional equivalents to, and/or synthetic alternatives of the foregoing.

**[0046]** Example flavourants may include menthol, liquorice, chocolate, fruit flavour (including e.g. citrus, cherry etc.), vanilla, spice (e.g. ginger, cinnamon) and tobacco flavour.

**[0047]** Cannabinoid compounds include phyto-cannabinoids which include:

- cannabidiol (CBD) and its derivatives/homologues

(e.g. cannabidiol mono(m)ethyl ether, cannabidivarin (CBDV), cannabidiorcol, cannabidiolic acid, cannabidivarinic acid);

- cannabinodiol (CBND) and its derivatives/homologues (e.g. carrabinodivarin);
- cannabigerol (CBG) and its derivatives/homologues (e.g. cannabigerol mono(m)ethyl ether, cannabinerolic acid A, cannabigerovarin, cannabigerolic acid A, cannabigerolic acid A mono(m)ethyl ether, cannabigerovarinic acid A);
- cannabinol (CBN) and its derivatives/homologues (e.g. cannabivarin/cannabivarol (CBV), cannabiorcol, cannabinolic acid, cannabinol (m)ethyl ester);
- tetrahydrocannabinol (THC) and its derivatives/homologues (e.g. tetrahydrocannabivarin (THCV), tetrahydrocannabiorcol, tetrahydrocannabinolic acid A/B, tetrahydrocannabivarinic acid A, tetrahydrocannabiorcolic acid A/B, isotetrahydrocannabinol, isotetrahydrocannabivarin);
- cannabicyclol (CBL) and its derivatives/homologues (e.g. cannabicyclolic acid, cannabicyclovarin);
- cannabichromene (CBC) and its derivatives/homologues (e.g. cannabichromenic acid A, cannabichromevarin (CBCV), cannabichromevarinic acid A);
- cannabielsoin (CBE) and its derivatives/homologues (e.g. cannabielsoic acid A/B, cannabiglendol, dehydrocannabifuran, cannabifuran);
- cannabicitran (CBT) and its derivatives/homologues;
- cannabitriol and its derivatives/homologues (e.g. ethyl cannabitriol, dihydroxy-tetrahydrocannabinol, cannabidiolic acid A cannabitriol ester, dihydroxy-hexahydrocannabinol (cannabiripsol), cannabitetrol, oxo-tetrahydrocannabinol); and
- cannabichromanone (CBCN) and its derivatives/homologues (e.g. cannabicoumaronone).

**[0048]** In some embodiments, the cannabinoid compound is selected from at least one of cannabidiol (CBD) and its derivatives/homologues e.g. cannabiodiol-$C_5$ (CBD-$C_5$), cannabidiol-$C_4$ (CBD-$C_4$), cannabidiol mono(m)ethyl ether (CBDM-$C_5$), cannabidivarin (CBDV-$C_3$), cannabidiorcol (CBD-$C_1$), cannabidiolic acid (CBDA-$C_5$), cannabidivarinic acid (CBDVA-$C_3$).

**[0049]** In some embodiments, the cannabinoid compound is selected from at least one of tetrahydrocannabinol (THC) and its derivatives/homologues, e.g. $\Delta^9$-tetrahydrocannabinol ($\Delta^9$-THC-$C_5$ / *cis*-$\Delta^9$-THC-$C_5$), $\Delta^8$-tetrahydrocannabinol ($\Delta^8$-THC-$C_5$), $\Delta^8$-tetrahydrocannabinolic acid A ($\Delta^8$-THCA-$C_5$ A), $\Delta^9$-tetrahydrocannabinol-$C_4$ ($\Delta^9$-THC-$C_4$), $\Delta^9$-tetrahydrocannabivarin ($\Delta^9$-THCV-$C_3$), $\Delta^9$-tetrahydrocannabiorcol ($\Delta^9$-THCO-$C_1$), $\Delta^9$-tetrahydrocannabinolic acid A ($\Delta^9$-THCA-$C_5$ A), $\Delta^9$-tetrahydrocannabinolic acid B ($\Delta^9$-THCA-$C_5$ B), $\Delta^9$-tetrahydrocannabinolic acid-$C_4$ A and/or B ($\Delta^9$-THCA-$C_4$A and/or B), $\Delta^9$-tetrahydrocannabivarinic acid A ($\Delta^9$-THCVA-$C_3$ A), $\Delta^9$-tetrahydrocannabiorcolic acid A and/or B ($\Delta^9$-THCOA-$C_1$ A and/or B), isotetrahydrocannabinol and isotetrahydrocannabivarin.

**[0050]** The total amount of cannabinoid compounds in the substrate may be at least 200 mg; for example, it may be at least 250 mg, at least 300 mg, at least 400 mg, at least 500 mg. In some cases, lower amounts may be preferred. The total amount of cannabinoid compounds in the substrate may therefore be at least 10 mg, at least 20 mg, at least 30 mg, at least 40 mg, at least 50 mg, at least 75 mg, at least 100 mg.

**[0051]** In some cases, it may be desirable to limited the total amount of cannabinoid compounds, which may be not more than 200 mg, not more than 175 mg, not more than 150 mg, not more than 125 mg, not more than 100 mg, not more than 75 mg, not more than 50 mg, not more than 40 mg, not more than 30 mg, not more than 20 mg, not more than 10 mg. In some cases, the total amount of the cannabinoid compounds may be not more than 5 mg.

**[0052]** Where THC is included, either as one cannabinoid compound in a mixture or as the only cannabinoid, the total of amount of THC may be limited. In some cases, the total amount of THC in the substrate is not more than 100 mg, not more than 75 mg, not more than 50 mg, not more than 40 mg, not more than 30 mg, not more than 20 mg, not more than 15 mg, not more than 10 mg, not more than 5 mg, not more than 3 mg. In some cases, the amount of THC may be 0.1 to 30 mg, for example 1 to 30 mg, for example 1 to 20 mg, for example 1 to 10 mg, for example 1 to 5 mg, for example 1 to 3 mg.

**[0053]** The aerosol delivery apparatus comprises a reservoir configured to store an aerosol precursor. The aerosol precursor may be formulated so as to produce a non-visible or substantially non-visible vapour.

**[0054]** The aerosol precursor may comprise a base liquid. The aerosol precursor may additionally comprise nicotine. The aerosol precursor may be an e-liquid. The aerosol precursor may consist substantially of nicotine or a nicotine compound. The aerosol precursor may further comprise a flavourant. Alternatively, the aerosol precursor may be substantially flavourless. That is, the aerosol precursor may not contain any deliberately added additional flavourant. A flavourant may be provided as a separate flavourant aerosol precursor, such that the aerosol precursor and flavourant aerosol precursor may be separately vaporised to form an aerosol comprising both the aerosol precursor and the flavourant aerosol precursor.

**[0055]** The reservoir configured to store a first aerosol

precursor and/or a first flavourant aerosol precursor consists of an air-permeable substrate impregnated with the aerosol precursor and/or the flavourant aerosol precursor. The substrate material may be a foamed polymer which will allow for airflow to pass through the substrate at a given pressure drop value, so as to provide a comfortable 'draw' sensation for the user. The substrate may be, for example, a sintered polyethylene or a PET foam.

**[0056]** The substrate may be impregnated with nicotine via immersion in a liquid containing nicotine and a volatile carrier (for example a solution of nicotine in ethanol). The substrate may be immersed to evenly soak the substrate. Once removed and left to dry or baked in an oven, the carrier may be evaporated and the nicotine may be left evenly spread throughout the substrate.

**[0057]** The aerosol precursor and/or the flavourant aerosol precursor may be formulated to form a vapour when ambient air is drawn through the reservoir. Alternatively, the aerosol precursor and/or the flavourant aerosol precursor may be formulated to form a vapour when heated air is drawn through the reservoir. The reservoir may comprise a monolithic substrate. The reservoir may consist of a plurality of substrates, each arranged to allow air to be drawn therethrough, and each comprising one or both of an aerosol precursor and the flavourant aerosol precursor. The aerosol precursor and/or the flavourant aerosol precursor may be provided in spatially coterminous or spatially distinct regions of the reservoir.

**[0058]** The aerosol delivery apparatus comprises an additional reservoir configured to store a second aerosol precursor such as an e-liquid. The second aerosol precursor may, for example, comprise a base liquid. The second aerosol precursor may further comprise nicotine. The second aerosol precursor, when vapourised, may form a visible vapour. The base liquid may include propylene glycol and/or vegetable glycerine. The e-liquid may be substantially flavourless. That is, the e-liquid may not contain any deliberately added additional flavourant and may consist solely of a base liquid of propylene glycol and/or vegetable glycerine and nicotine.

**[0059]** The second aerosol precursor reservoir may be in the form of a tank. At least a portion of the tank may be light-transmissive. For example, the tank may comprise a window to allow a user to visually assess the quantity of e-liquid in the tank. A housing of the aerosol delivery apparatus may comprise a corresponding aperture (or slot) or window that may be aligned with a light-transmissive portion (e.g. window) of the tank.

**[0060]** The aerosol delivery apparatus may comprise one or more passages for fluid (e.g. air) flow therethrough. Where more than one passage is present, one or more of the passages may be distinct, such that there is no intersection between the passages. One or more of the passages may comprise junctions or openings therebetween such that fluid within the passages can mix within the aerosol delivery apparatus.

**[0061]** One or more of the passages may comprise one or more valves to control fluid flow. The valve may be, for example, a one-way valve to ensure fluid (i.e. air) can only flow through the passage in a desired direction. The valve may be operable to open and close the passage such that fluid is enabled to or prevented from flowing through the passage. More than one valve may be linked such that the valves may be operated in combination or in synchronism with each other. A valve to open and close a passage may be controlled by mechanical means (i.e. the user moves the valve using a control lever or similar) or by electrical control (i.e. moved in response to a control signal from a processor or control system of the aerosol delivery apparatus).

**[0062]** The passages may extend through (at least a portion of) the aerosol delivery apparatus, between openings that may define an inlet and an outlet of a passage. Each inlet and outlet may be in fluid communication with only one passage, or a subset of the passages, or all the passages in the aerosol delivery apparatus. The outlet or outlets may be at a mouthpiece of the aerosol delivery apparatus. In this respect, a user may draw fluid (e.g. air) into and through a passage by inhaling at the outlet (i.e. using the mouthpiece).

**[0063]** A passage through the aerosol delivery apparatus may be at least partially defined by a tank forming the first or second aerosol precursor reservoir. The tank may substantially (or fully) define the passage, for at least a part of the length of the passage. In this respect, the tank may surround the passage, e.g. in an annular arrangement around the passage.

**[0064]** One or more of the fluid passages may comprise a heater for heating the fluid (i.e. air) passing through the passage. The heater may, for example, be arranged upstream of a reservoir formed from an air permeable substrate such that air warmed by the heater is drawn through the reservoir to enable or increase nicotine or flavourant vapourisation and subsequent entrainment in the air-flow. The heater to heat the air may comprise one or more meshes arranged within the fluid passage. The heater to heat the air may comprise one or more thermally conductive elements to conduct heat from a heater to the air passage or to increase the heat transfer between the heater and the air. Alternatively, the heat source may be non-electrical. For example, the heat to heat the air may be generated by an exothermic reaction. An exothermic reaction heat source may comprise a single-use (i.e. consumable) reaction container. Alternatively, an exothermic reaction heat source may be rechargeable (e.g. by using a reversible reaction such as a crystallisation process).

**[0065]** One or more of the fluid passages may comprise a wick in fluid communication with a tank containing an aerosol precursor. The wick may comprise a porous material, capable of wicking the aerosol precursor. A portion of the wick may be exposed to air flow in the passage. The wick may also comprise one or more portions in contact with liquid stored in the reservoir. For example, opposing ends of the wick may protrude into the reservoir and an intermediate portion (between the ends) may ex-

tend across the passage so as to be exposed to air flow in the passage. Thus, liquid may be drawn (e.g. by capillary action) along the wick, from the reservoir to the portion of the wick exposed to air flow.

**[0066]** The wick may be heated by a heater. The heater of the wick may comprise a heating element, which may be in the form of a filament wound about the wick (e.g. the filament may extend helically about the wick in a coil configuration). The heating element may be wound about the intermediate portion of the wick that is exposed to air flow in the passage. The heating element may be electrically connected (or connectable) to a power source. Thus, in operation, the power source may apply a voltage across the heating element so as to heat the heating element by resistive heating. This may cause liquid stored in the wick (i.e. drawn from the tank) to be heated so as to form a vapour and become entrained in air flowing through the passage. This vapour may subsequently cool to form an aerosol in the passage, typically downstream from the heating element.

**[0067]** In an arrangement where the aerosol delivery apparatus comprises a wick arranged so as to be exposed to air flow in the passage, the aerosol delivery apparatus may comprise a vaporisation chamber. The vaporisation chamber may form part of the passage in which the heater is located. The vaporisation chamber may be arranged to be in fluid communication with the inlet and outlet of the passage. The vaporisation chamber may be an enlarged portion of the passage. In this respect, the air as drawn in by the user may entrain the generated vapour in a flow away from heater. The entrained vapour may form an aerosol in the vaporisation chamber, or it may form the aerosol further downstream along the passage. The vaporisation chamber may be at least partially defined by the tank. The tank may substantially (or fully) define the vaporisation chamber. In this respect, the tank may surround the vaporisation chamber, e.g. in an annular arrangement around the vaporisation chamber.

**[0068]** The aerosol delivery apparatus (or main body engaged with the aerosol delivery apparatus) may comprise a power source. The power source may be electrically connected (or connectable) to a heater of the aerosol delivery apparatus (e.g. when the aerosol delivery apparatus is engaged with the main body). The power source may be a battery (e.g. a rechargeable battery). A connector in the form of e.g. a USB port may be provided for recharging this battery.

**[0069]** When the aerosol delivery apparatus is in the form of a consumable, the aerosol delivery apparatus may comprise an electrical interface for interfacing with a corresponding electrical interface of the main body. One or both of the electrical interfaces may include one or more electrical contacts. Thus, when the main body is engaged with the consumable, the electrical interface of the main body may be configured to transfer electrical power from the power source to a heater of the consumable via the electrical interface of the consumable.

**[0070]** The electrical interface of the aerosol delivery apparatus may also be used to identify the aerosol delivery apparatus (in the form of a consumable) from a list of known types. For example, the consumable may have a certain concentration of nicotine and the electrical interface may be used to identify this. The electrical interface may additionally or alternatively be used to identify when a consumable is connected to the main body.

**[0071]** Again, where the aerosol delivery apparatus is in the form of a consumable, the main body may comprise an identification means, which may, for example, be in the form of an RFID reader, a barcode or QR code reader. This identification means may be able to identify a characteristic (e.g. a type) of a consumable engaged with the main body. In this respect, the consumable may include any one or more of an RFID chip, a barcode or QR code, or memory within which is an identifier and which can be interrogated via the identification means.

**[0072]** The aerosol delivery apparatus or main body may comprise a controller, which may include a microprocessor. The controller may be configured to control the supply of power from the power source to the heater(s) of the aerosol delivery apparatus (e.g. via the electrical contacts). A memory may be provided and may be operatively connected to the controller. The memory may include non-volatile memory. The memory may include instructions which, when implemented, cause the controller to perform certain tasks or steps of a method.

**[0073]** The main body or aerosol delivery apparatus may comprise a wireless interface, which may be configured to communicate wirelessly with another device, for example a mobile device, e.g. via Bluetooth®. To this end, the wireless interface could include a Bluetooth® antenna. Other wireless communication interfaces, e.g. WiFi®, are also possible. The wireless interface may also be configured to communicate wirelessly with a remote server.

**[0074]** A puff sensor may be provided that is configured to detect a puff (i.e. inhalation from a user). The puff sensor may be operatively connected to the controller so as to be able to provide a signal to the controller that is indicative of a puff state (i.e. puffing or not puffing). The puff sensor may, for example, be in the form of a pressure sensor or an acoustic sensor. That is, the controller may control power supply to the heater(s) of the consumable and/or aerosol delivery apparatus in response to a puff detection by the sensor. The control may be in the form of activation of the heater(s) in response to a detected puff. That is, the aerosol delivery apparatus may be configured to be activated when a puff is detected by the puff sensor. When the smoking substitute apparatus is in the form of a consumable, the puff sensor may be provided in the consumable or alternatively may be provided in the main body. Where multiple independent passages are provided within the aerosol delivery apparatus, each of the passages may have a puff sensor.

**[0075]** The term "flavourant" is used to describe a compound or combination of compounds that provide flavour

and/or aroma. For example, the flavourant may be configured to interact with a sensory receptor of a user (such as an olfactory or taste receptor). The flavourant may include one or more volatile substances.

**[0076]** The flavourant may be provided in solid or liquid form. The flavourant may be natural or synthetic. For example, the flavourant may include menthol, liquorice, chocolate, fruit flavour (including e.g. citrus, cherry etc.), vanilla, spice (e.g. ginger, cinnamon) and tobacco flavour. The flavourant may be evenly dispersed or may be provided in isolated locations and/or varying concentrations.

**[0077]** The first aerosol generator comprises an air-permeable substrate. This may comprise plant material. The plant material may comprise least one plant material selected from the list including *Amaranthus dubius, Arctostaphylos uva-ursi* (Bearberry), *Argemone mexicana, Amica, Artemisia vulgaris,* Yellow Tees, *Galea zacatechichi, Canavalia maritima* (Baybean), *Cecropia mexicana* (Guamura), *Cestrum noctumum, Cynoglossum virginianum* (wild comfrey), *Cytisus scoparius, Damiana, Entada rheedii, Eschscholzia califomica* (California Poppy), *Fittonia albivenis, Hippobroma longiflora, Humulus japonica* (Japanese Hops), *Humulus lupulus* (Hops), *Lactuca virosa* (Lettuce Opium), *Laggera alata, Leonotis leonurus, Leonurus cardiaca* (Motherwort), *Leonurus sibiricus* (Honeyweed), *Lobelia cardinalis, Lobelia inflata* (Indian-tobacco), *Lobelia siphilitica, Nepeta cataria* (Catnip), *Nicotiana species* (Tobacco), *Nymphaea alba* (White Lily), *Nymphaea caerulea* (Blue Lily), Opium poppy, *Passiflora incamata* (Passionflower), *Pedicularis densiflora* (Indian Warrior), *Pedicularis groenlandica* (Elephant's Head), *Salvia divinorum, Salvia dorrii* (Tobacco Sage), Salvia species (Sage), *Scutellaria galericulata, Scutellaria lateriflora, Scutellaria nana, Scutellaria* species (Skullcap), *Sida acuta* (Wireweed), *Sida rhombifolia, Silene capensis, Syzygium aromaticum* (Clove), *Tagetes lucida* (Mexican Tarragon), *Tarchonanthus camphoratus, Tumera diffusa* (Damiana), *Verbascum* (Mullein), *Zamia latifolia* (Maconha Brava) together with any combinations, functional equivalents to, and/or synthetic alternatives of the foregoing.

**[0078]** In some embodiments, the plant material is tobacco. Any type of tobacco may be used. This includes, but is not limited to, flue-cured tobacco, burley tobacco, Maryland Tobacco, dark-air cured tobacco, oriental tobacco, dark-fired tobacco, perique tobacco and rustica tobacco. This also includes blends of the above mentioned tobaccos.

**[0079]** Any suitable parts of the tobacco plant may be used. This includes leaves, stems, roots, bark, seeds and flowers.

**[0080]** The tobacco may comprise one or more of leaf tobacco, stem tobacco, tobacco powder, tobacco dust, tobacco derivatives, expanded tobacco, homogenised tobacco, shredded tobacco, extruded tobacco, cut rag tobacco and/or reconstituted tobacco (e.g. slurry recon or paper recon).

**[0081]** The air-permeable substrate may comprise a gathered sheet of homogenised (e.g. paper/slurry recon) tobacco or gathered shreds/strips formed from such a sheet.

**[0082]** In some embodiments, the sheet used to form the aerosol-forming substrate has a grammage greater than or equal to 100 g/m$^2$, e.g. greater than or equal to 110 g/m$^2$ such as greater than or equal to 120 g/m$^2$.

**[0083]** The sheet may have a grammage of less than or equal to 300 g/m$^2$ e.g. less than or equal to 250 g/m$^2$ or less than or equal to 200 g/m$^2$.

**[0084]** The sheet may have a grammage of between 120 and 190 g/m$^2$.

**[0085]** The air-permeable substrate may comprise at least 50 wt% plant material, e.g. at least 60 wt% plant material e.g. around 65 wt% plant material. The air-permeable substrate may comprise 80 wt% or less plant material e.g. 75 or 70 wt% or less plant material.

**[0086]** The air-permeable substrate may comprise one or more additives selected from flavourants, fillers and binders.

**[0087]** Typically, the air-permeable substrate does not comprise a humectant. Humectants may be provided in heat not burn (HNB) tobacco charges. In such cases, humectants are provided as vapour generators, the generated vapour being used to help carry volatile active compounds and to increase visible vapour. Accordingly, it is preferred that the air-permeable substrate does not comprise one or more humectants such as polyhydric alcohols (e.g. propylene glycol (PG), triethylene glycol, 1,2-butane diol and vegetable glycerine (VG)) and their esters (e.g. glycerol mono-, di- or tri-acetate). If such humectants are present in the air-permeable substrate, they may be present at a low level, such as less than 0.5 wt%, more preferably less than 0.1 wt%.

**[0088]** Suitable binders are known in the art and may act to bind together the components forming the air-permeable substrate. Binders may comprise starches and/or cellulosic binders such as methyl cellulose, ethyl cellulose, hydroxypropyl cellulose, hydroxyethyl cellulose and methyl cellulose, gums such as xanthan, guar, arabic and/or locust bean gum, organic acids and their salts such as alginic acid/ sodium alginate, agar and pectins.

**[0089]** Preferably the binder content is 5 to 10 wt% of the air-permeable substrate e.g. around 6 to 8 wt%.

**[0090]** Suitable fillers are known in the art and may act to strengthen the air-permeable substrate. Fillers may comprise fibrous (non-tobacco) fillers such as cellulose fibres, lignocellulose fibres (e.g. wood fibres), jute fibres and combinations thereof.

**[0091]** Preferably, the filler content is 5 to 10 wt% of the aerosol-forming substrate e.g. around 6 to 9 wt%.

**[0092]** The air-permeable substrate may comprise an aqueous and/or non-aqueous solvent. In some embodiments, the air-permeable substrate has a water content of between 4 and 10 wt% e.g. between 6-9 wt% such as between 7-9 wt%. Such low moisture content in the air-

permeable substrate typically has the effect that, when the air-permeable substrate is exposed to heated air, there would typically not be produced a substantial visible vapour. It is to be noted that in one embodiment it is possible to use as the air-permeable substrate a low moisture tobacco material with its natural nicotine content. The natural nicotine content then meets the requirements of the active agent.

**[0093]** The air-permeable substrate may be at least partly circumscribed by a wrapping layer e.g. a paper wrapping layer. The wrapping layer may overlie an inner foil layer or may comprise a paper/foil laminate (with the foil innermost).

**[0094]** The plant material may comprise cannabis plant material including *Cannabis sativa, Cannabis indica* and *Cannabis rudealis.* The plant material may comprise *Echinacea purpurea, Echinacea angustifolia, Acmella oleracea, Helichrysum umbraculigerum,* or *Radula marginata.* This also includes blends of the above mentioned plant material.

**[0095]** In some embodiments, the cannabinoid-containing plant material is cannabis. The plant may be a traditional strain, or may be a strain bred or other modified (e.g. genetically) to produce certain levels of some cannabinoids compounds, e.g. low levels of THC or high levels of THC.

**[0096]** Any suitable parts of the cannabinoid-containing plant may be used. Thus the cannabinoid-containing plant material may comprise leaves, stems, roots, bark, seeds, buds and flowers (which may be cured).

**[0097]** The invention includes the combination of the aspects and preferred features described except where such a combination is clearly impermissible or expressly avoided.

### *Summary of the Figures*

**[0098]**

Figure 1 is a schematic front view of a smoking substitute system, according to a first embodiment, in an engaged position;

Figure 2 is a schematic front view of the smoking substitute system of the first embodiment in a disengaged position;

Figure 3 is a schematic longitudinal cross sectional view of a smoking substitute apparatus of a first reference arrangement; and

Figure 4 is a schematic longitudinal cross sectional view of a smoking substitute apparatus of a second reference arrangement;

Figure 5 is an enlarged schematic cross sectional view of part of the air passage and vaporisation chamber of the second reference arrangement;

Figure 6 is a schematic longitudinal cross sectional view of a smoking substitute apparatus of a first embodiment;

Figures 7A and 7B are a schematic longitudinal cross sectional view of a means for aerosol generator selection of a smoking substitute system of a first embodiment;

Figures 8A and 8B are a schematic longitudinal cross sectional view of a means for aerosol generator selection of a smoking substitute system of a first embodiment;

Figures 9A and 9B are a schematic longitudinal cross sectional view of a means for aerosol generator selection of a smoking substitute system of a first embodiment; and

Figures 10A and 10B are a schematic longitudinal cross sectional view of a smoking substitute apparatus of a second embodiment.

### *Detailed Description of the Invention*

**[0099]** Further background to the present invention and further aspects and embodiments of the present invention will now be discussed with reference to the accompanying figures. Further aspects and embodiments will be apparent to those skilled in the art. The contents of all documents mentioned in this text are incorporated herein by reference in their entirety.

**[0100]** The embodiments of the invention are described as smoking substitute apparatuses or systems, in which the active ingredient typically comprises or consists of nicotine. However, on the basis of the present disclosure it will be apparent that the invention can be embodied more generally as an aerosol delivery apparatus or system. In such aerosol delivery apparatuses or systems the active ingredient may not comprise nicotine, and may instead comprise or consist of one or more of a nutritional agent, a pharmaceutical agent or a flavour agent.

**[0101]** Figures 1 and 2 illustrate a smoking substitute system in the form of an e-cigarette system 110. The system 110 comprises a main body 120 of the system 110, and a smoking substitute apparatus in the form of an e-cigarette consumable (or "pod") 150. In the illustrated embodiment the consumable 150 (sometimes referred to herein as a smoking substitute apparatus) is removable from the main body 120, so as to be a replaceable component of the system 110. The e-cigarette system 110 is a closed system in the sense that it is not intended that the consumable should be refillable with e-liquid by a user.

**[0102]** As is apparent from Figures 1 and 2, the consumable 150 is configured to engage the main body 120. Figure 1 shows the main body 120 and the consumable

150 in an engaged state, whilst Figure 2 shows the main body 120 and the consumable 150 in a disengaged state. When engaged, a portion of the consumable 150 is received in a cavity of corresponding shape in the main body 120 and is retained in the engaged position by way of a snap-engagement mechanism. In other embodiments, the main body 120 and consumable 150 may be engaged by screwing one into (or onto) the other, or through a bayonet fitting, or by way of an interference fit. In the illustrated embodiment, the consumable 150 is a "single-use" consumable 150. The term "single-use" does not necessarily mean the consumable is designed to be disposed of after a single smoking session. Rather, it defines that the consumable 150 is not designed to be refilled, and is instead disposed of and replaced after usage.

**[0103]** The power source of the main body 120 may be in the form of a battery (e.g. a rechargeable battery such as a lithium ion battery). The main body 120 may comprise a connector in the form of e.g. a USB port for recharging this battery. The main body 120 may also comprise a controller that controls the supply of power from the power source to the main body electrical contacts (and thus to the filament 264 or heater 164). That is, the controller may be configured to control a voltage applied across the main body electrical contacts, and thus the voltage applied across the heater 164 or filament 264. In this way, the heater 164 or filament 264 may only be heated under certain conditions (e.g. during a puff and/or only when the system is in an active state). In this respect, the main body 120 may include a puff sensor (not shown) that is configured to detect a puff (i.e. inhalation). The puff sensor may be operatively connected to the controller so as to be able to provide a signal, to the controller, which is indicative of a puff state (i.e. puffing or not puffing). The puff sensor may, for example, be in the form of a pressure sensor or an acoustic sensor.

**[0104]** Although not shown, the main body 120 and consumable 150 may comprise a further interface which may, for example, be in the form of an RFID reader, a barcode or QR code reader. This interface may be able to identify a characteristic (e.g. a type) of a consumable 150 engaged with the main body 120. In this respect, the consumable 150 may include any one or more of an RFID chip, a barcode or QR code, or memory within which is an identifier and which can be interrogated via the interface.

**[0105]** The system 110 is configured to vaporise an aerosol precursor. Figures 3 and 4 illustrate, respectively, first and second reference arrangements for aerosol generators.

**[0106]** Figure 3 illustrates an aerosol generator, wherein the aerosol precursor is provided as a nicotine-based liquid impregnated into a substrate 160. The nicotine-impregnated substrate 160 may be referred to as a first aerosol generator. When air is drawn through or over the nicotine-impregnated substrate 160, the nicotine is vaporised and entrained in the airflow to thereby be delivered to a user. The vapour or aerosol produced by the first aerosol generator is less visible than that produced by a conventional e-liquid from an e-cigarette when exhaled by a user. Preferably, the vapour or aerosol generated by the first aerosol generator is invisible or substantially invisible when exhaled by a user.

**[0107]** A substrate 160 may be impregnated with nicotine by immersion in a solution of nicotine in a volatile carrier solvent (e.g. ethanol) such that the substrate 160 is evenly soaked. The substrate 160 can then be removed and left to dry or baked in an oven, meaning that the carrier is evaporated and the nicotine is left evenly spread throughout the substrate.

**[0108]** The nicotine-impregnated substrate 160 may be provided within a consumable 150a. In such an arrangement, when the supply of nicotine in the nicotine-impregnated substrate 160 is depleted, the consumable 150a may be replaced. In other arrangements, the nicotine-impregnated substrate 160 itself may be a consumable component of the system 110. For example, the nicotine-impregnated substrate may be locatable within and removable from the system 110.

**[0109]** Further details are now set out relating to the air-permeable substrate and its impregnation with an active ingredient.

**[0110]** Suitable materials and methods for manufacturing air permeable substrates are disclosed, for example, in US4800903, US4284089, US4813437, and US5167242, the entire contents of which are incorporated herein by reference.

**[0111]** US4800903 discloses that preferred materials for a polymeric plug are olefinic polymers, and preferably polyethylene or polypropylene, most preferably high density polyethylene. Use of high density polyethylene is preferred over, for example, amorphous polyethylene, since it provides a balance between ease of manufacturing and capacity for reversible nicotine absorption.

**[0112]** Meanwhile, some polymers are considered to be inherently unsuitable for use as an air permeable substrate. For example, some polymeric substances such as polystyrene and polycarbonate are dissolved by nicotine, rendering them unsuitable for forming a nicotine impregnated substrate. Furthermore, polymers containing halogens or nitrogen or sulphur are undesirable since they can produce noxious fumes.

**[0113]** To improve user satisfaction, it may be preferable to use an air permeable substrate that provides an equivalent resistance to draw to that of a conventional cigarette. For example, US4284089 discloses that a non-combustible cigarette with a draw resistance approximating that of a conventional cigarette would permit about 35 millilitres of air to be drawn through it during a 2 second period.

**[0114]** A substrate may be impregnated with nicotine by a variety of methods. For example, US4800903 indicates that liquid nicotine, nicotine vapour or a solution of nicotine may be used, and suggests that a solution of nicotine in supercritical liquid carbon dioxide may advan-

tageously be used to impregnate the substrate. Alternatively, the substrate may be impregnated with nicotine via immersion in a liquid containing nicotine and a volatile carrier (for example a solution of nicotine in ethanol). The substrate is immersed to evenly soak the substrate. Once the substrate is removed from the liquid it can be left to dry or baked in an oven, evaporating away the carrier so that the nicotine is left evenly distributed throughout the substrate.

**[0115]** US5167242 discloses that a polyethylene plug can be charged or loaded with a mixture of nicotine, menthol and ethanol in a weight ratio (nicotine:menthol:ethanol) of about 10:1:120 or 10:1:160. The menthol and nicotine are sequentially added to the ethanol in a mixing vessel to produce a solution. Meanwhile, the plugs are placed in a vacuum dryer, which is partially evacuated to create a lower internal pressure than that of the mixing vessel, allowing the nicotine/ethanol/methanol solution to be sucked into the vacuum dryer. The plugs remain immersed in the solution within the vacuum dryer for 10 minutes, after which the temperature is raised and the vacuum pump is started to evaporate the ethanol. The vacuum dryer is then filled with nitrogen, and a nitrogen atmosphere is maintained for the remainder of the packaging procedure to prevent oxygen contamination of the nicotine.

**[0116]** In alternative embodiments, the air-permeable substrate may be formed in a different manner. For example, the air-permeable substrate may be formed from tobacco. The tobacco may be leaf tobacco, tobacco derivatives, expanded tobacco, shredded tobacco, reconstituted tobacco or tobacco substitutes. Preferably the tobacco has a relatively low moisture content, for example less than 10wt% moisture. A typical minimum moisture content for the tobacco is not less than 4wt% moisture. Such low moisture content tobacco, when exposed to heated air, would typically not produce a substantial vapour. Accordingly, such an air-permeable substrate may be loaded with a source of an active ingredient, as described above.

**[0117]** Where the air-permeable substrate is formed for example of tobacco, the active agent may be applied to the air-permeable substrate by mixing and/or dissolving the active agent in a suitable carrier liquid such as a solvent (e.g. water, ethanol, PG, glycerine, macrogol, caster oil, paraffin, (and derivatives thereof)).

**[0118]** The air is typically heated to a suitable temperature. This temperature may be at least 30°C. This is in order to promote vaporisation of the active ingredient. The temperature is typically not greater than 80°C, or typically not greater than 70°C. This is in order to promote user comfort. It may also reduce or prevent the degradation of the air-permeable substrate and/or the active ingredient.

**[0119]** An arrangement comprising a nicotine-impregnated substrate 160 within a consumable 150a is illustrated in Figure 3. The nicotine-impregnated substrate 160 is arranged within a passage 170. The passage 170 extends between a first aerosol generator inlet 172 and a first aerosol generator outlet 174 at opposing ends of the consumable 150. In this respect, the passage 170 comprises an upstream end at the end of the consumable 150 that engages with the main body 120, and a downstream end at an opposing end of the consumable 150 that comprises a mouthpiece 154 of the system 110.

**[0120]** When the consumable 150a is received in the cavity of the main body 120 as shown in Figure 3, a plurality of device air inlets 176 are formed at the boundary between the casing of the consumable and the casing of the main body. The device air inlets 176 are in fluid communication with the aerosol generator inlet 172 through an inlet flow channel 178 formed in the cavity of the main body which is of corresponding shape to receive a part of the consumable 150a. Air from outside of the system 110 can therefore be drawn into the passage 170 through the device air inlets 176 and the inlet flow channels 178.

**[0121]** When the consumable 150a is engaged with the main body 120, a user can inhale (i.e. take a puff) via the mouthpiece 154 so as to draw air through the passage 170, and so as to form an airflow (indicated by the dashed arrows in Figure 3) in a direction from the first aerosol generator inlet 172 to the first aerosol generator outlet 174. Air is thereby drawn through and/or around the nicotine-impregnated substrate 160, such that nicotine from the nicotine-impregnated substrate 160 can be entrained in the airflow. The nicotine-impregnated substrate 160 is arranged to extend across a cross-section of at least a portion of the passage 170, such that substantially all of the air drawn through the passage 170 passes through at least a part of the reservoir 160. The resistance to drawing air through the consumable 150a may be configured by altering the air permeability of the nicotine-impregnated substrate, or by the provision of one or more bypass passages separate from the passage 170 (not illustrated).

**[0122]** In this arrangement, a heater 164 is arranged upstream of the nicotine-impregnated substrate 160 along the passageway 170. The heater 164 is operable to heat air passing through the passageway 170 to enable or enhance nicotine entrainment. In this arrangement, the heater 164 comprises an electrically heatable mesh located in the airflow stream. The mesh may be formed of a material that is heatable by resistive heating using an electrical current. In other arrangements, the heater 164 may comprise a plurality of meshes. The heater 164 may be located in a passage in the base unit 120 (not illustrated), with the base unit passageway being in fluid communication with the passageway 170 of the consumable 150a. In further arrangements, the heater 164 may be located externally of the passageway 170 but placed in thermal communication with the airflow via thermally conductive elements which extend into or across the passageway 170 (not illustrated). In still further arrangements, the heater may be omitted.

**[0123]** When the consumable 150a is engaged with the main body 120, electrical contacts 156 make contact

with corresponding electrical contacts (not shown) of the main body 120. The main body electrical contacts are electrically connectable to a power source (not shown) of the main body 120, such that (in the engaged position) the heater 164 is electrically connectable to the power source. In this way, power can be supplied by the main body 120 to the heater 164 in order to heat the heater 164.

**[0124]** The passageway 170 may comprise one or more one-way valves 166. The one or more valves are provided to prevent, substantially prevent or reduce airflow from a downstream to upstream direction along the passageway 170. In Figure 3, two valves 166 are located immediately upstream and immediately downstream, respectively, of the nicotine-impregnated substrate 160. In some arrangements, only one valve 166 may be provided. In further arrangements, a valve 166 may be located upstream of the heater 164. In still further arrangements, the valves may be omitted.

**[0125]** The system 110 may alternatively be configured to vaporise an aerosol precursor, which in the illustrated second reference arrangement of Figure 4 is in the form of a nicotine-based e-liquid 260. The e-liquid 260 comprises nicotine and a base liquid including propylene glycol and/or vegetable glycerine. In the present arrangement, the e-liquid 260 is flavoured by a flavourant. In other arrangements, the e-liquid 260 may be flavourless and thus may not include any added flavourant. In the present reference arrangement, the e-liquid 260 produces a visible vapour cloud when vapourised.

**[0126]** The aerosol precursor is vaporised by the aerosol generator of the system 110. Figure 4 shows a schematic longitudinal cross-sectional view of the aerosol generator which can form part of the substitute smoking system shown in Figures 1 and 2. In Figure 4, the e-liquid 260 is stored within a reservoir in the form of a tank 252 that forms part of the system 110 or a consumable 150b.

**[0127]** The tank may include a vent (not shown) to allow ingress of air to replace e-liquid that has been used from the tank. The consumable 150b preferably includes a window 158 (see Figures 1 and 2), so that the amount of e-liquid in the tank 252 can be visually assessed. The main body 120 includes a slot 157 so that the window 158 of the consumable 150b can be seen whilst the rest of the tank 252 is obscured from view when the consumable 150b is received in the cavity of the main body 120. The consumable 150b may be referred to as a "clearomizer" when it includes a window 158, or a "cartomizer" when it does not.

**[0128]** In other arrangements, the tank may be refillable with e-liquid or the e-liquid may be stored in a non-consumable component of the system. For example, in such other arrangements, the e-liquid may be stored in a tank located in the main body or stored in another component that is itself not single-use (e.g. a refillable cartomizer).

**[0129]** In Figure 4, the tank 252 annularly surrounds, and thus defines a portion of, a passage 170 that extends between an aerosol generator inlet 172 and an outlet 174 at opposing ends of the consumable 150b. In this respect, the passage 170 comprises an upstream end at the end of the consumable 150b that engages with the main body 120, and a downstream end at an opposing end of the consumable 150b that comprises a mouthpiece 154 of the system 110.

**[0130]** When the consumable 150b is received in the cavity of the main body 120 as shown in Figure 4, a plurality of device air inlets 176 are formed at the boundary between the casing of the consumable and the casing of the main body. The device air inlets 176 are in fluid communication with the aerosol generator inlet 172 through an inlet flow channel 178 formed in the cavity of the main body which is of corresponding shape to receive a part of the consumable 150b. Air from outside of the system 110 can therefore be drawn into the passage 170 through the device air inlets 176 and the inlet flow channels 178.

**[0131]** When the consumable 150b is engaged with the main body 120, a user can inhale (i.e. take a puff) via the mouthpiece 154 so as to draw air through the passage 170, and so as to form an airflow (indicated by the dashed arrows in Figure 4) in a direction from the aerosol generator inlet 172 to the outlet 174. Although not illustrated, the passage 170 may be partially defined by a tube (e.g. a metal tube) extending through the consumable 150b. In Figure 3, for simplicity, the passage 170 is shown with a substantially circular cross-sectional profile with a constant diameter along its length. In other arrangements, the passage may have other cross-sectional profiles, such as oval shaped, racetrack shaped or polygonal shaped profiles. Further, in other arrangements, the cross sectional profile and the diameter (or hydraulic diameter) of the passage may vary along its longitudinal axis.

**[0132]** The aerosol generator of the smoking substitute system 110 is configured to vaporise the e-liquid 260 for inhalation by a user. To provide this operability, the aerosol generator comprises a heater having a porous wick 262 and a resistive heating element in the form of a heating filament 264 that is helically wound (in the form of a coil) around a portion of the porous wick 262. The porous wick 262 extends across the passage 170 (i.e. transverse to a longitudinal axis of the passage 170 and thus also transverse to the air flow along the passage 170 during use) and opposing ends of the wick 262 extend into the tank 252 (so as to be immersed in the e-liquid 260). In this way, e-liquid 260 contained in the tank 252 is conveyed from the opposing ends of the porous wick 262 to a central portion of the porous wick 262 so as to be exposed to the airflow in the passage 170.

**[0133]** The helical filament 264 is wound about the exposed central portion of the porous wick 262 and is electrically connected to an electrical interface in the form of electrical contacts 156 mounted at the end of the consumable that is proximate the main body 120 (when the consumable and the main body are engaged). When the consumable 150b is engaged with the main body 120, electrical contacts 156 make contact with corresponding

electrical contacts (not shown) of the main body 120. The main body electrical contacts are electrically connectable to a power source (not shown) of the main body 120, such that (in the engaged position) the filament 264 is electrically connectable to the power source. In this way, power can be supplied by the main body 120 to the filament 264 in order to heat the filament 264. This heats the porous wick 262 which causes e-liquid 260 conveyed by the porous wick 262 to vaporise and thus to be released from the porous wick 262. The vaporised e-liquid becomes entrained in the airflow and, as it cools in the airflow (between the heated wick and the outlet 174 of the passage 170), condenses to form an aerosol. This aerosol is then inhaled, via the mouthpiece 154, by a user of the system 110. As e-liquid is lost from the heated portion of the wick, further e-liquid is drawn along the wick from the tank to replace the e-liquid lost from the heated portion of the wick.

**[0134]** The filament 264 and the exposed central portion of the porous wick 262 are positioned across the passage 170. More specifically, the part of passage that contains the filament 264 and the exposed portion of the porous wick 262 forms a vaporisation chamber. In the illustrated example, the vaporisation chamber has the same cross-sectional diameter as the passage 170. However, in other arrangements the vaporisation chamber may have a different cross sectional profile as the passage 170. For example, the vaporisation chamber may have a larger cross sectional diameter than at least some of the downstream part of the passage 170 so as to enable a longer residence time for the air inside the vaporisation chamber.

**[0135]** Figure 5 illustrates in more detail the vaporisation chamber and therefore the region of the consumable 150b around the wick 262 and filament 264. The helical filament 264 is wound around a central portion of the porous wick 262. The porous wick extends across passage 170. E-liquid 260 contained within the tank 252 is conveyed as illustrated schematically by arrows 401, i.e. from the tank and towards the central portion of the porous wick 262.

**[0136]** When the user inhales, air is drawn from through the inlets 176 shown in Figure 4, along inlet flow channel 178 to vaporisation chamber inlet 172 and into the vaporisation chamber containing porous wick 262. The porous wick 262 extends substantially transverse to the airflow direction. The airflow passes around the porous wick, at least a portion of the airflow substantially following the surface of the porous wick 262. In examples where the porous wick has a cylindrical cross-sectional profile, the airflow may follow a curved path around an outer periphery of the porous wick 262.

**[0137]** At substantially the same time as the airflow passes around the porous wick 262, the filament 264 is heated so as to vaporise the e-liquid which has been wicked into the porous wick. The airflow passing around the porous wick 262 picks up this vaporised e-liquid, and the vapour-containing airflow is drawn in direction 403 further down passage 170.

**[0138]** Figure 6 illustrates a consumable or smoking substitute apparatus 150c according to a first embodiment of the present invention. The apparatus 150c comprises features from the reference arrangements of both Figure 3 and Figure 4. Features which are in common with the reference arrangements are indicated with the same reference numerals. The apparatus 150c differs from that of either the first or second reference arrangements in that it includes two independent aerosol generators arranged in separate air passages 170a, 170b, and further comprises means 180 for mechanically or electrically controlling the operation of at least the second aerosol generator.

**[0139]** The apparatus 150c comprises a first air passage 170a, extending from the means for aerosol generator selection 180 to a first aerosol generator outlet 174a arranged at the mouthpiece 154 of the system 110. A nicotine-impregnated substrate 160 is arranged in the first passage 170a such that air drawn through the passage 170a passes through the nicotine-impregnated substrate 160. In the present embodiment, one-way valves 166a and 166b are arranged upstream and downstream, respectively, of the nicotine-impregnated substrate 160 along the passage 170a. In other embodiments, only one one-way valve may be provided. In still further embodiments, the one-way valves 166a and 166b may be omitted.

**[0140]** In this embodiment, the first air passage 170a further comprises a heater 164, which is operable to heat air passing through the first air passage 170a, enabling or enhancing the nicotine entrainment from the nicotine-impregnated substrate 160. In other embodiments, the heater 164 may be omitted.

**[0141]** The apparatus 150c further comprises a second air passage 170b, extending from the aerosol generator selector 180 to a second aerosol generator outlet 174b arranged at the mouthpiece 154 of the system 110. A tank 252 comprising aerosol precursor 260 annularly surrounds, and thus defines a portion of, the passage 170b. A porous wick 262 and heating coil 264 are provided, as already described in the context of the second reference arrangement.

**[0142]** In the illustrated embodiment, the aerosol generator selector 180 is a physical means for allowing air to enter or pass through either the first air passage 170a or the second air passage 170b. The aerosol generator selector 180 may comprises a valve that is controllable via a mechanical switch 182 to physically move a valve. Additionally or alternatively, the aerosol generator selector 180 may comprise a valve that is movable or controllable by an actuator (not illustrated).

**[0143]** Where the aerosol generator selector 180 comprises a valve to allow or prevent air flow through an air passage, a valve may be provided only in the first air passage 170a, only in the second air passage 170b, or in both the first air passage 170a and second air passage 170b. One or more of the valves may be linked either

mechanically or electrically such that they are configured to operate in combination or synchronism.

**[0144]** For example, the aerosol generator selector 180 may comprise a sliding wall or barrier 184 that blocks either the first air passage 170a or the second air passage 170b, as illustrated in Figures 7A, 7B. Alternatively, a component 186 which configures a connection between the air inlet 172 and the first air passage 170a or the second air passage 170b may be provided as illustrated in Figures 8A, 8B. In further embodiments, the aerosol generator selector 180 may comprise a three-way valve 188 as illustrated in Figures 9A, 9B. In still further embodiments, the aerosol generator selector 180 may comprise a ball valve (not illustrated) operable to open or close one of the first air passage 170a and the second air passage 170b.

**[0145]** In alternative embodiments, selecting an aerosol generator may be done via control of the heater 164 and heating coil 264. In such an embodiment, both the first air passage 170a and the second air passage 170b may remain open such that air can be drawn through. This configuration may be advantageous for providing a consistent resistance to draw for the smoking substitute apparatus 150c, since the air passages through the apparatus are not required to be changed to effect the switching. A switch may be provided to selectively operate one of the heating mesh 164 in the first air passage 170a or the heating coil 264 in the second air passage 170b. Alternatively, the switching function may be implemented by a controller of the substitute smoking system 110. This latter configuration may be advantageous by enabling the switching function in the absence of moving mechanical parts.

**[0146]** In still further embodiments, the means for control may be both a physical control of the respective air passages 170a, 170b and an electrical control of the respective heaters 164, 264. This configuration may be advantageous for reducing the electrical power requirements of the system 110 by avoiding unnecessary operation of the heaters 164, 264.

**[0147]** In still further embodiments, the aerosol generator selector 180 may control only one of the first aerosol generator and the second aerosol generator. In particular, the aerosol generator selector 180 may enable or prevent operation of the second aerosol generator, while the first aerosol generator remains operable whenever air is drawn through the system 110. In such an embodiment, a user can therefore switchably control the generation of a visible vapour or aerosol by the second aerosol generator A second embodiment of the present invention is as illustrated in Figures 10A, 10B. The substitute smoking apparatus 150d of the second embodiment differs from that of the first embodiment in that the means for aerosol generator selection is provided at the mouthpiece 154a of the apparatus. The mouthpiece 154a comprises a single air passage therethrough which can be placed in fluid communication with either the first air passage 170a or the second air passage 170b, and which leads to a single outlet 174c. The mouthpiece 154a can be moved between a first position wherein the air passage is in fluid communication with the first air passage 170a and a second position wherein the air passage is in fluid communication with the second air passage 170b. For example, the mouthpiece may be rotatable between the first position and the second position. A pivot point (not illustrated) may be provided at the join between the mouthpiece 154a and the substitute smoking apparatus 150d to provide this functionality. Alternatively, the mouthpiece 154a may be detachable from the substitute smoking apparatus 150d for rotation. The mouthpiece 154a may further comprise means for electrical connection of the heaters 164, 264 to a power source located in a base unit 120, thereby controlling which of the heaters 164, 264 is operable according to the mouthpiece position.

**[0148]** The features disclosed in the foregoing description, or in the following claims, or in the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for obtaining the disclosed results, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

**[0149]** While the invention has been described in conjunction with the exemplary embodiments described above, many equivalent modifications and variations will be apparent to those skilled in the art when given this disclosure. Accordingly, the exemplary embodiments of the invention set forth above are considered to be illustrative and not limiting. Various changes to the described embodiments may be made without departing from the spirit and scope of the invention.

**[0150]** For the avoidance of any doubt, any theoretical explanations provided herein are provided for the purposes of improving the understanding of a reader. The inventors do not wish to be bound by any of these theoretical explanations.

**[0151]** Any section headings used herein are for organizational purposes only and are not to be construed as limiting the subject matter described.

**[0152]** Throughout this specification, including the claims which follow, unless the context requires otherwise, the words "have", "comprise", and "include", and variations such as "having", "comprises", "comprising", and "including" will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

**[0153]** It must be noted that, as used in the specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise. Ranges may be expressed herein as from "about" one particular value, and/or to "about" another particular value. When such a range is expressed, another embodiment includes from the one particular value and/or to the other particular value. Similarly,

when values are expressed as approximations, by the use of the antecedent "about," it will be understood that the particular value forms another embodiment. The term "about" in relation to a numerical value is optional and means, for example, +/- 10%.

**[0154]** The words "preferred" and "preferably" are used herein refer to embodiments of the invention that may provide certain benefits under some circumstances. It is to be appreciated, however, that other embodiments may also be preferred under the same or different circumstances. The recitation of one or more preferred embodiments therefore does not mean or imply that other embodiments are not useful, and is not intended to exclude other embodiments from the scope of the disclosure, or from the scope of the claims.

## Claims

1. An aerosol delivery apparatus (150c, 150d) configured for engagement with a base unit (120), the apparatus and base unit together forming an aerosol delivery system (110), the aerosol delivery apparatus (150c, 150d) comprising:

    a first air passage (170a) having a first aerosol generator, and
    a second air passage (170b) separate from the first air passage (170a) having a second aerosol generator,
    wherein the first aerosol generator comprises:
    an air-permeable substrate (160) disposed in the first air passage (170a) and arranged to allow air being drawn through the first air passage (170a) to be drawn through the air-permeable substrate (160), the air-permeable substrate being loaded with a first source of an active ingredient for entrainment in heated air passing through the first air passage (170a);
    and wherein the second aerosol generator comprises:

        a wick (262) arranged in the second air passage (170b),
        a heater (264), operable to heat the wick (262), and
        a liquid storage tank (252) arranged in fluid communication with the wick (262), the liquid storage tank (252) comprising a liquid (260), being a second source of an active ingredient;

    wherein the aerosol delivery apparatus (150c) is configurable to selectively operate:

        the first aerosol generator alone; and/or
        the second aerosol generator alone; and/or
        the first and second aerosol generators together.

2. An aerosol delivery apparatus (150c, 150d) according to claim 1 comprising an aerosol generator selector to configure the aerosol delivery apparatus (150c, 150d) to selectively operate the first aerosol generator alone; and/or the second aerosol generator alone; and/or the first and second aerosol generators together.

3. An aerosol delivery apparatus (150c, 150d) according to claim 2, wherein the aerosol generator selector comprises:
    a valve operable to control air flow through the first air passage (170a) to provide selectivity of operation for the first aerosol generator.

4. An aerosol delivery apparatus (150c, 150d) according to either of claims 2 or 3, wherein the aerosol generator selector comprises:
    a valve operable to control airflow through the second air passage (170b) to provide selectivity of operation for the second aerosol generator.

5. An aerosol delivery apparatus (150c, 150d) according to claim 2, wherein the aerosol generator selector comprises:
    a three-way valve (188) operable to direct air flow to the first air passage (170a) or the second air passage (170b) to provide selectivity of operation for the first aerosol generator and the second aerosol generator.

6. An aerosol delivery apparatus (150d) according to claim 2, wherein the aerosol generator selector comprises:
    a mouthpiece (154a) comprising a mouthpiece air passage (170c), wherein the mouthpiece (154a) is configurable to place the mouthpiece air passage (170c) in fluid communication with either the first air passage (170a) or the second air passage (170b) of the aerosol delivery apparatus (150d).

7. An aerosol delivery apparatus (150d) according to claim 6, wherein:
    the mouthpiece (154a) is rotatable between a first position wherein the mouthpiece air passage (170c) is in fluid communication with the first air passage (170a) of the aerosol delivery apparatus (150d) and a second position wherein the mouthpiece air passage (170c) is in fluid communication with the second air passage (170b) of the aerosol delivery apparatus (150d).

8. An aerosol delivery apparatus (150c, 150d) according any preceding claim, wherein:
    the aerosol delivery apparatus (150c, 150d) is configurable to selectively operate the heater (254) of the second aerosol generator to provide selectivity

of operation for the second aerosol generator.

**9.** An aerosol delivery apparatus (150c, 150d) according to any preceding claim, wherein the first aerosol generator further comprises:
a heater (164) arranged in the first air passage (170a) and configured to heat air being drawn through the first air passage (170a).

**10.** An aerosol delivery apparatus (150c, 150d) according to claim 9, wherein the heater (164) for heating the air in the first air passage (170a) comprises an electrically heatable mesh.

**11.** An aerosol delivery apparatus (150c, 150d) according to any of claims 9 to 10, wherein:
the aerosol delivery apparatus (150c, 150d) is configurable to selectively operate the heater (164) of the first aerosol generator to provide selectivity of operation for the first aerosol generator.

**12.** An aerosol delivery apparatus (150c, 150d) according to any preceding claim, further comprising:
at least one one-way valve (166) arranged along at least one of the first air passage (70a, 170a) and the second air passage (70b, 170b) and configured to allow air to flow through the valve (166) in an upstream to downstream direction.

**13.** An aerosol delivery system (110) comprising:

a base unit (120), and
an aerosol delivery apparatus (150c, 150d) according to any of claims 1 to 12, wherein the aerosol delivery apparatus (150b) is removably engageable with the base unit (120).

**14.** A method of using an aerosol delivery apparatus (150c, 150d) according to any one of claims 1 to 12 to generate an aerosol.

**15.** A method of using an aerosol delivery apparatus (150c, 150d) according to claim 14, further comprising the step of configuring the aerosol delivery apparatus (150c, 150d) to operate the first aerosol generator alone; and/or the second aerosol generator alone; and/or the first and second aerosol generators together.

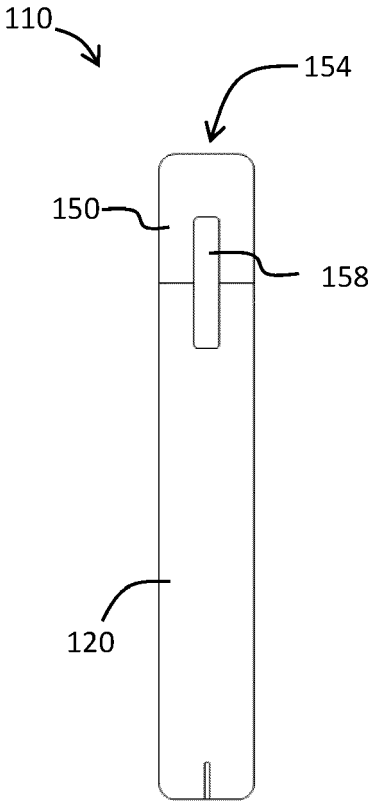


FIG. 1

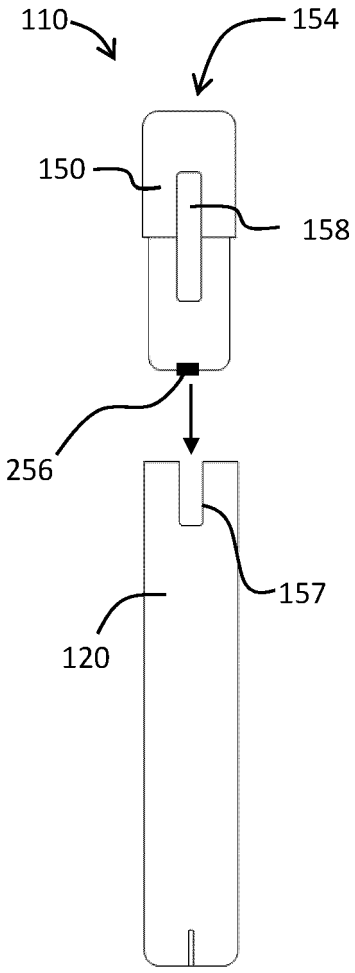


FIG. 2

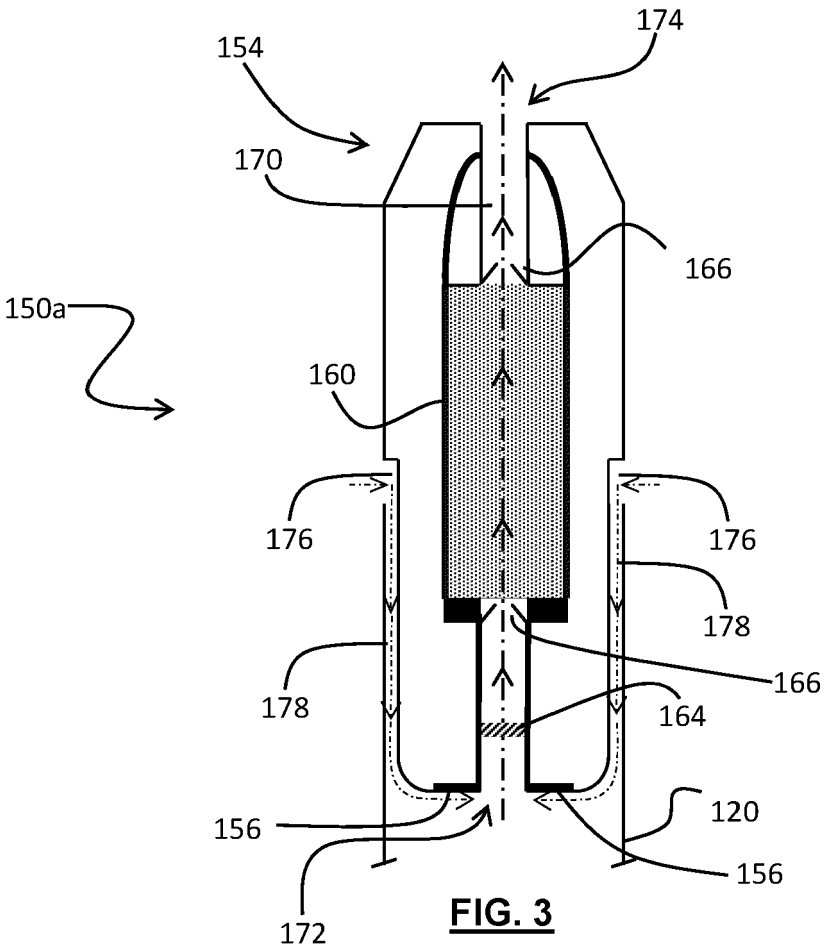


FIG. 3

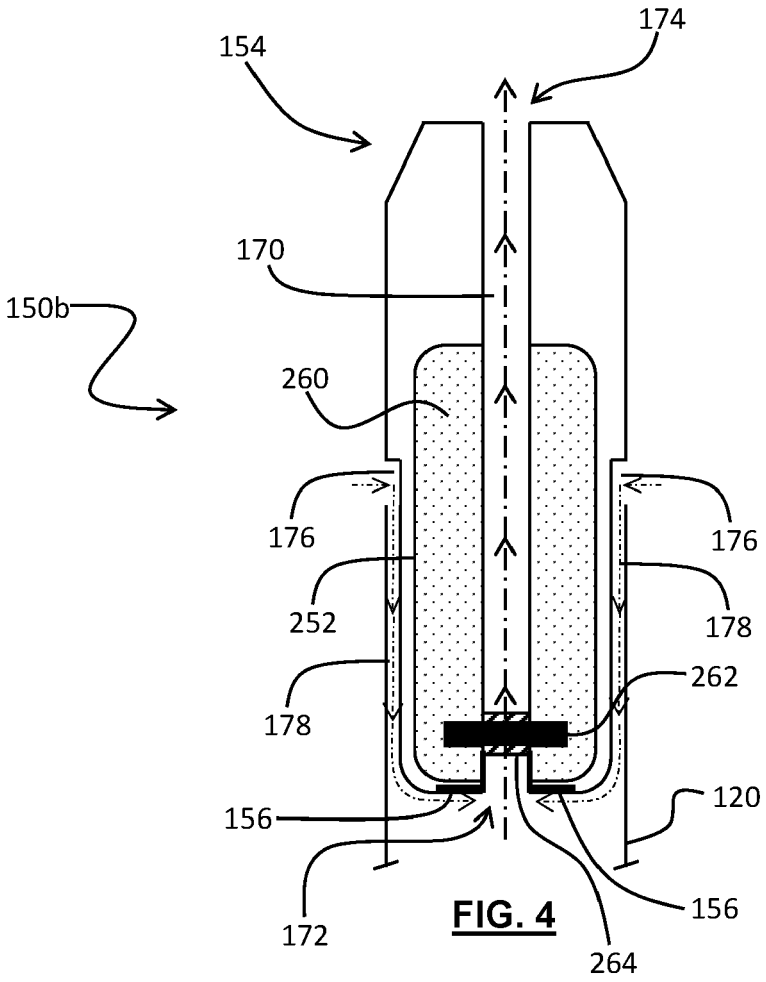


FIG. 4

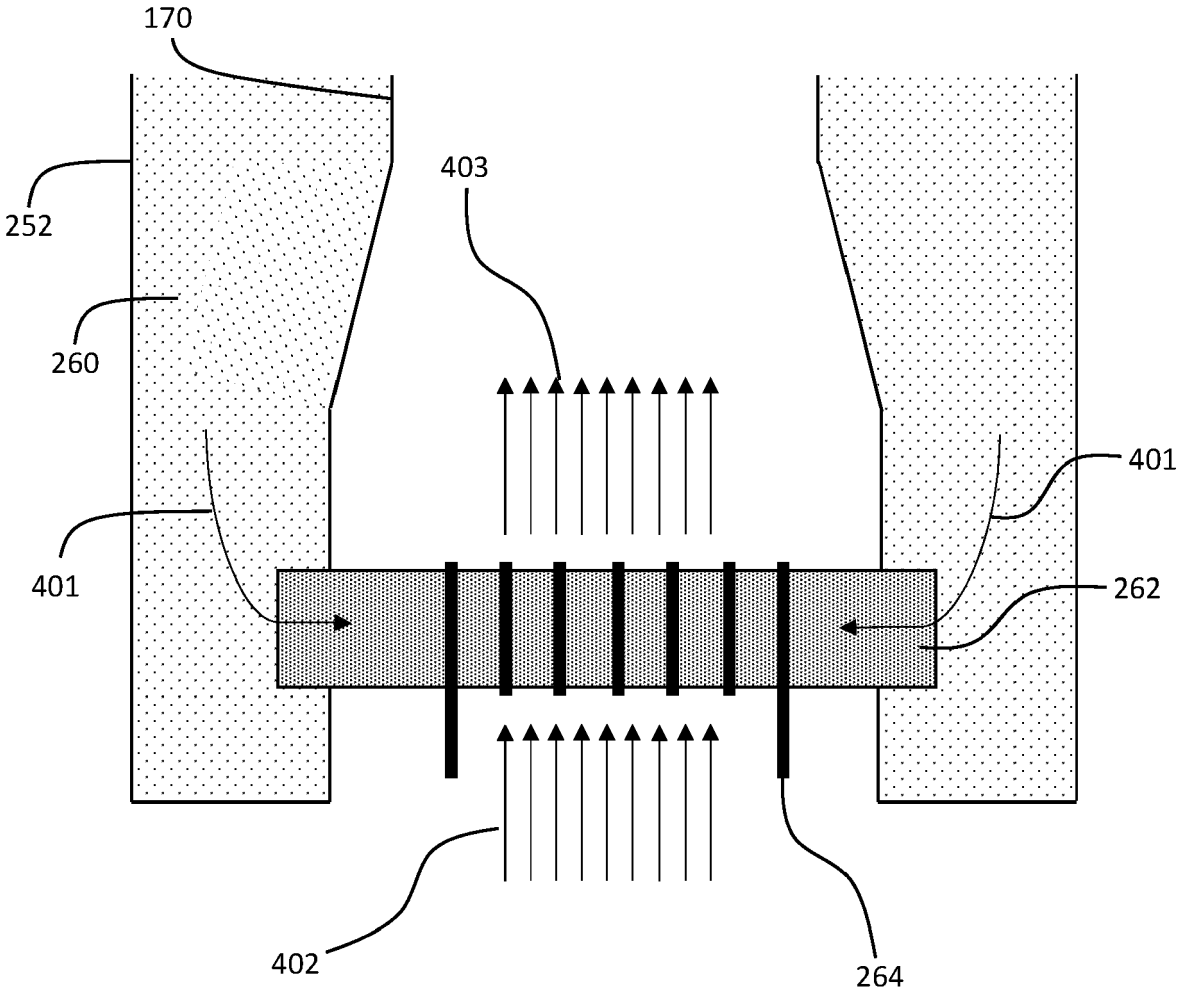


FIG. 5

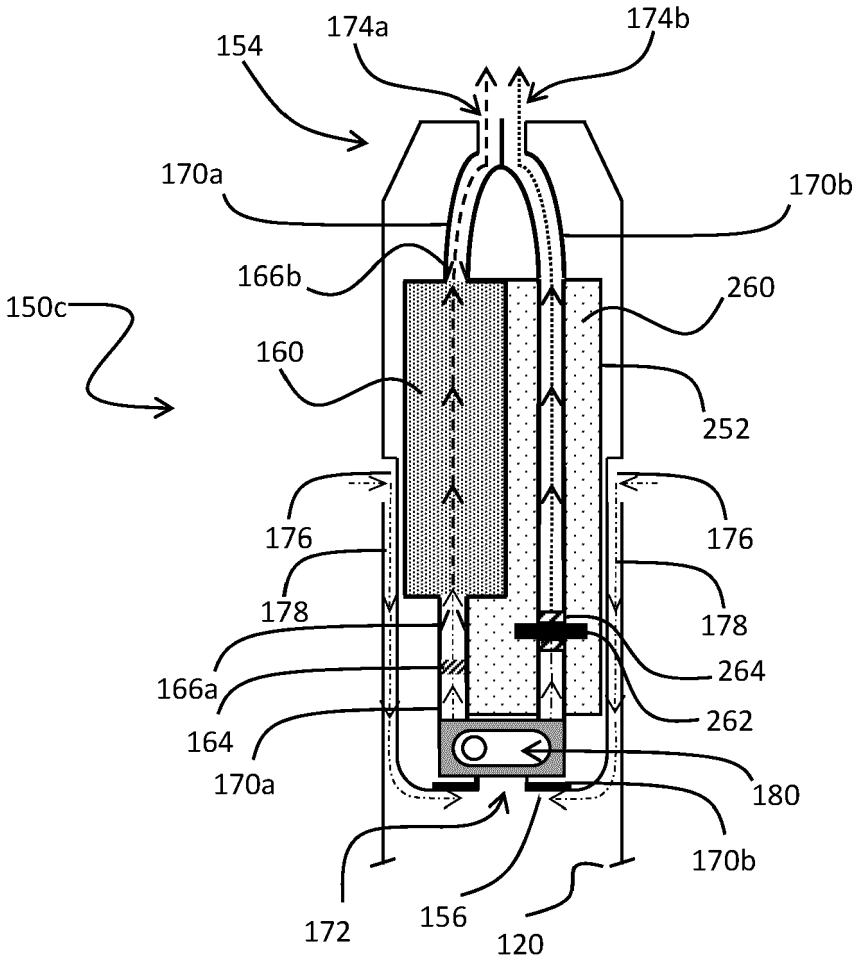
154
174a
174b
170a
170b
166b
260
150c
160
252
176
176
178
178
166a
264
262
164
170a
180
170b
172
156
120

FIG. 6

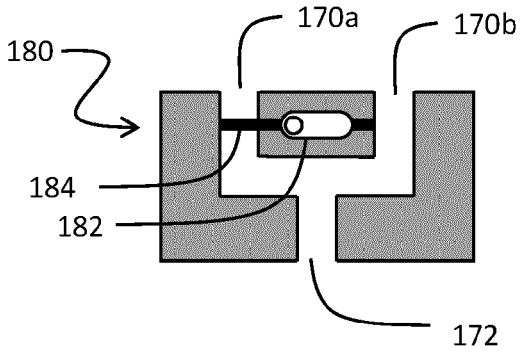


FIG. 7A

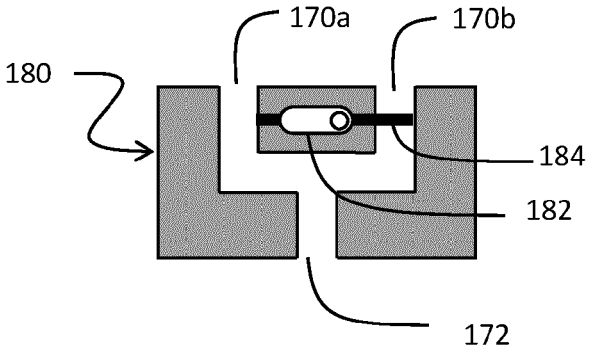


FIG. 7B

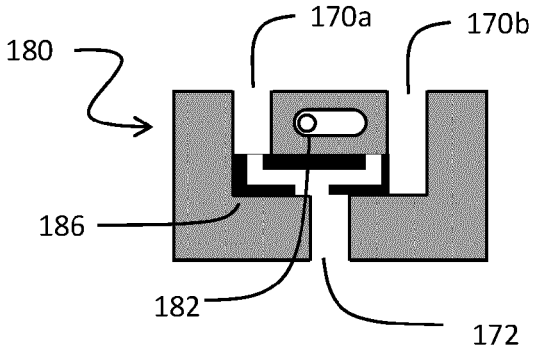


FIG. 8A

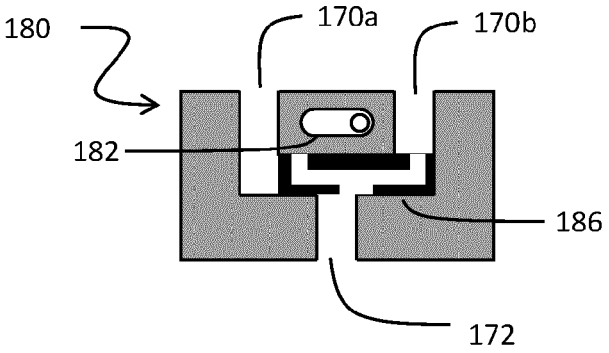


FIG. 8B

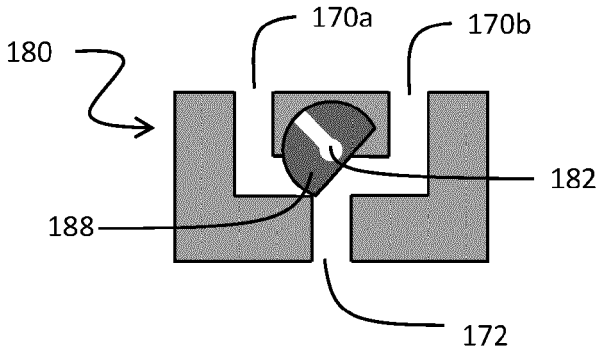


FIG. 9A

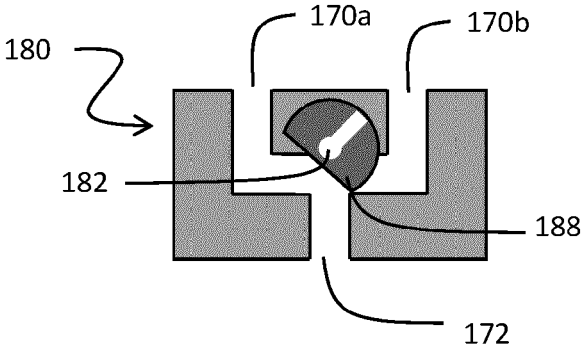


FIG. 9B

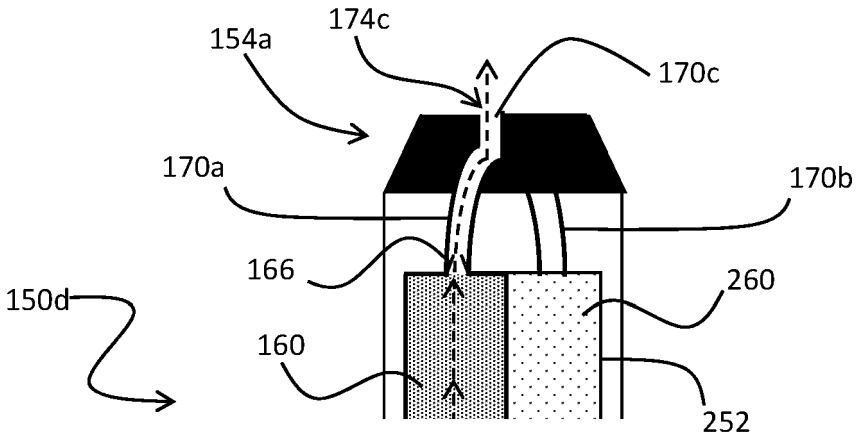


FIG. 10A

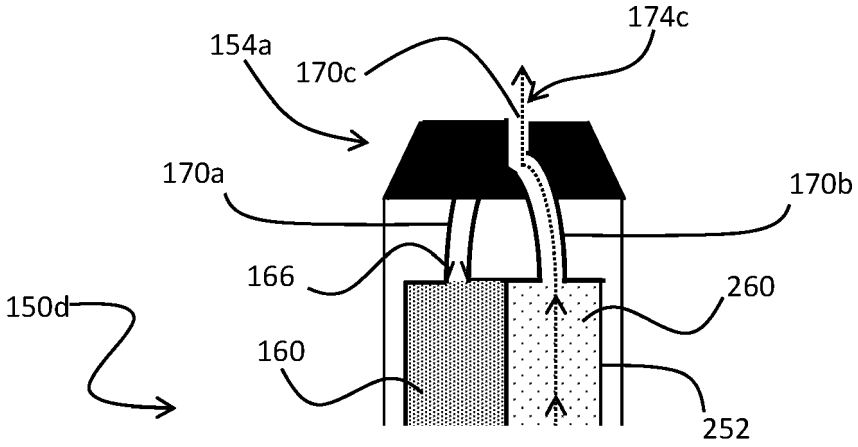


FIG. 10B

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# EUROPEAN SEARCH REPORT

Application Number
EP 20 15 4517

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| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 15 July 2020 | Kock, Søren |

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L : document cited for other reasons

& : member of the same patent family, corresponding document

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