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(54) SMOKING SUBSTITUTE APPARATUS

(57) A smoking substitute apparatus for generating an aerosol for inhalation by a user. The smoking substitute apparatus comprising: an air inlet and an outlet; a passage extending between the air inlet and the outlet, air flowing in use along the passage for inhalation by a user drawing air through the apparatus; and an aerosol generation chamber containing an aerosol generator being operable to generate an aerosol from an aerosol precursor, the aerosol generation chamber being in communication with the passage, a downstream portion of the passage being provided downstream of the aerosol generator. Wherein, in use, aerosol being entrained in airflow in the downstream portion of the passage, the downstream portion of the passage and the aerosol generation chamber each having at least one inner-facing wall, there being provided at least one drop guidance drain formed on the inner-facing wall of the downstream portion of the passage and/or of the aerosol generation chamber, such that, in use, when the apparatus is held upright so that air flow to the outlet is upwards, drops of condensate formed on the inner-facing wall flow downwards under gravity and are guided by the drop guidance drain to the aerosol generator.

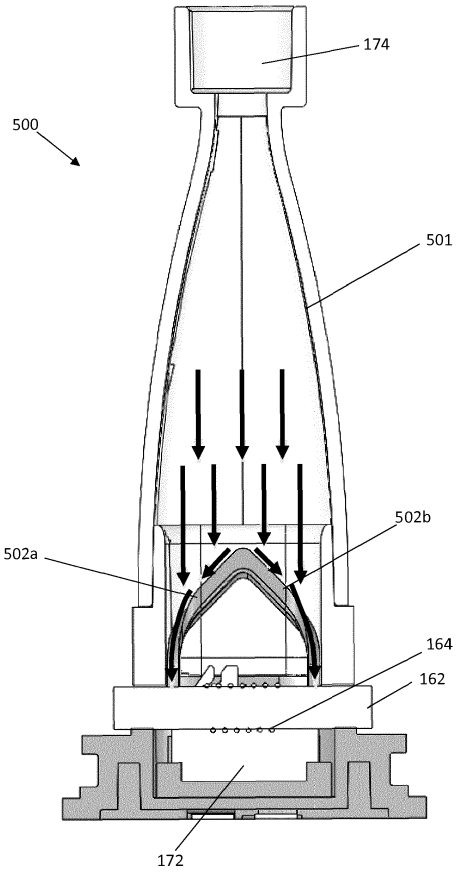

FIG. 5

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Description

Field of the Invention

[0001] The present invention relates to a smoking substitute apparatus and, in particular, a smoking substitute apparatus that is able to deliver nicotine to a user in an effective manner.

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.

Summary of the Invention

[0013] For a smoking substitute system it is desirable

to deliver nicotine into the user's lungs, where it can be absorbed into the bloodstream. However, the present disclosure is based in part on a realisation that some prior art smoking substitute systems, such delivery of nicotine is not efficient. In some prior art systems, the aerosol droplets have a size distribution that is not suitable for delivering nicotine to the lungs. Aerosol droplets of a large particle size tend to be deposited in the mouth and/or upper respiratory tract. Aerosol particles of a small (e.g. sub-micron) particle size can be inhaled into the lungs but may be exhaled without delivering nicotine to the lungs. As a result the user would require drawing a longer puff, more puffs, or vaporising e-liquid with a higher nicotine concentration in order to achieve the desired experience.

[0014] Accordingly, there is a need for improvement in the delivery of nicotine to a user in the context of a smoking substitute system.

[0015] The present disclosure has been devised in the light of the above considerations.

[0016] According to a first preferred aspect there is provided a smoking substitute apparatus for generating an aerosol for inhalation by a user, the smoking substitute apparatus comprising:

an air inlet and an outlet;

a passage extending between the air inlet and the outlet, air flowing in use along the passage for inhalation by a user drawing air through the apparatus; and

an aerosol generation chamber, containing an aerosol generator being operable to generate an aerosol from an aerosol precursor, the aerosol generation chamber being in communication with the passage, a downstream portion of the passage being provided downstream of the aerosol generator and,

in use, aerosol being entrained in airflow in the downstream portion of the passage, the downstream portion of the passage and the aerosol generation chamber having at least one inner-facing wall,

there being provided at least one drop guidance drain formed on the inner-facing wall of the downstream portion of the passage and/or of the aerosol generation chamber, such that, in use, when the apparatus is held upright so that air flow to the outlet is upwards, drops of condensate formed on the inner-facing wall flow downwards under gravity and are guided by the drop guidance drain to the aerosol generator.

[0017] Advantageously, such a smoking substitute apparatus increases the utilisation of aerosol precursor by guiding any aerosol precursor which condenses within the downstream portion of the passage and/or the aerosol generation chamber back to the aerosol generator.

[0018] At least one drop guidance drain may extend circumferentially at least part of the way around the inner-facing wall, and may slope towards the aerosol generator. Advantageously, this can reduce the likelihood of aerosol precursor leaking from the smoking substitute apparatus.

[0019] The aerosol generator may include a wick and a heater. In use, the heater may heat the wick such that the wick has a higher temperature portion and a low temperature portion, and the drop guidance drain may guide the drops of condensate to the low temperature portion of the wick. Advantageously, this can reduce the likelihood of 'spitting' whereby the aerosol precursor directly contacts the heater / the higher temperature portion of the wick. The one or more drop guidance drain may be configured to guide drops of condensate away from a central portion of the wick. The central portion of the wick may be supported by the heater, which may be a coil heater.

[0020] The air inlet may be provided below the aerosol generation chamber.

[0021] The smoking substitute apparatus may include a first and second drop guidance drain, wherein the first and second drop guidance drains start from a same point on the inner-facing wall of the downstream portion of the passage and/or of the aerosol generation chamber and respectively extend in opposite circumferential directions. The first and second drop guidance drains may therefore have an inverted V or U shape.

[0022] The smoking substitute apparatus may include a third and fourth drop guidance drain, formed on an opposing side of the inner-facing wall to the first and second drop guidance drains, the third and fourth drop guidance drain starting from a same point on the inner-facing wall of the downstream portion of the passage and/or of the aerosol generation chamber and respectively extending in opposite circumferential directions. The third and fourth drop guidance drains may therefore have an inverted V or U shape, and may substantially mirror the first and second drop guidance drains.

[0023] The first and third drop guidance drains may guide drops of condensate to a same first location. The second and fourth drop guidance drains may guide drops of condensate to a same second location. The aerosol generator may include a wick and heater, and the first location and the second location may be axially separated along the wick. The heater may be located between the first and second locations.

[0024] The passage and/or aerosol generation chamber may have an oval cross-section, and the at least one drop guidance drain may be arranged on a circumference of the oval cross-section.

[0025] The smoking substitute 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 a smoking substitute system such as a closed smoking substitute system. For example, the consumable may comprise components of the system that are disposable, and the main body may comprise non-disposable or non-con-

sumable components (e.g. power supply, controller, sensor, etc.) that facilitate the generation and/or delivery of aerosol by the consumable. In such an embodiment, the aerosol precursor (e.g. e-liquid) may be replenished by replacing a used consumable with an unused consumable.

[0026] Alternatively, the smoking substitute apparatus may be a non-consumable apparatus (e.g. that is in the form of an open smoking substitute 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 smoking substitute apparatus, with the aerosol precursor (rather than replacing a consumable component of the apparatus).

[0027] In light of this, it should be appreciated that some of the features described herein as being part of the smoking substitute apparatus may alternatively form part of a main body for engagement with the smoking substitute apparatus. This may be the case in particular when the smoking substitute apparatus is in the form of a consumable.

[0028] Where the smoking substitute 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.

[0029] Thus, the smoking substitute apparatus may comprise one or more engagement portions for engaging with a main body. In this way, one end of the smoking substitute apparatus may be coupled with the main body, whilst an opposing end of the smoking substitute apparatus may define a mouthpiece of the smoking substitute system.

[0030] The smoking substitute apparatus may comprise a reservoir configured to store an aerosol precursor, such as an e-liquid. The e-liquid may, for example, comprise a base liquid. The e-liquid may further comprise nicotine. 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.

[0031] The 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 smoking substitute 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. The reservoir may be referred to as a "clearomizer" if it includes a window, or a "cartomizer" if it does not.

[0032] The smoking substitute apparatus may comprise a passage for fluid flow therethrough. The passage may extend through (at least a portion of) the smoking substitute apparatus, between openings that may define an inlet and an outlet of the passage. The outlet may be at a mouthpiece of the smoking substitute apparatus. In this respect, a user may draw fluid (e.g. air) into and through the passage by inhaling at the outlet (i.e. using the mouthpiece). The passage may be at least partially defined by the tank. 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.

[0033] The smoking substitute apparatus may comprise an aerosol generator. The aerosol generator may comprise a wick. The aerosol generator may further comprise a heater. 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 extend 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.

[0034] The heater 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.

[0035] The smoking substitute 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 ar-

rangement around the vaporisation chamber.

[0036] In use, the user may puff on a mouthpiece of the smoking substitute apparatus, i.e. draw on the smoking substitute apparatus by inhaling, to draw in an air stream therethrough. A portion, or all, of the air stream (also referred to as a "main air flow") may pass through the vaporisation chamber so as to entrain the vapour generated at the heater. That is, such a main air flow may be heated by the heater (although typically only to a limited extent) as it passes through the vaporisation chamber. Alternatively or in addition, a portion of the air stream (also referred to as a "dilution air flow" or "bypass air flow") may bypass the vaporisation chamber and be directed to mix with the generated aerosol downstream from the vaporisation chamber. That is, the dilution air flow may be an air stream at an ambient temperature and may not be directly heated at all by the heater. The dilution air flow may combine with the main air flow for diluting the aerosol contained therein. The dilution air flow may merge with the main air flow along the passage downstream from the vaporisation chamber. Alternatively, the dilution air flow may be directly inhaled by the user without passing though the passage of the smoking substitute apparatus.

[0037] As a user puffs on the mouthpiece, vaporised e-liquid entrained in the passing air flow may be drawn towards the outlet of the passage. The vapour may cool, and thereby nucleate and/or condense along the passage to form a plurality of aerosol droplets, e.g. nicotine-containing aerosol droplets. A portion of these aerosol droplets may be delivered to and be absorbed at a target delivery site, e.g. a user's lung, whilst a portion of the aerosol droplets may instead adhere onto other parts of the user's respiratory tract, e.g. the user's oral cavity and/or throat. Typically, in some known smoking substitute apparatuses, the aerosol droplets as measured at the outlet of the passage, e.g. at the mouthpiece, may have a droplet size, dso, of less than 1μm.

[0038] In some embodiments of the invention, the d_{50} particle size of the aerosol particles is preferably at least 1 μm. Typically, the d_{50} particle size is not more than 10 μm, preferably not more than 9 μm, not more than 8 μm, not more than 7 μm, not more than 6 μm, not more than 5 μm, not more than 4 μm or not more than 3 μm. It is considered that providing aerosol particle sizes in such ranges permits improved interaction between the aerosol particles and the user's lungs.

[0039] The particle droplet size, d_{50}, of an aerosol may be measured by a laser diffraction technique. For example, the stream of aerosol output from the outlet of the passage may be drawn through a Malvern Spraytec laser diffraction system, where the intensity and pattern of scattered laser light are analysed to calculate the size and size distribution of aerosol droplets. As will be readily understood, the particle size distribution may be expressed in terms of d_{10}, d_{50} and d_{90}, for example. Considering a cumulative plot of the volume of the particles measured by the laser diffraction technique, the d_{10} particle size is the particle size below which 10% by volume of the sample lies. The dso particle size is the particle size below which 50% by volume of the sample lies. The d_{90} particle size is the particle size below which 90% by volume of the sample lies. Unless otherwise indicated herein, the particle size measurements are volume-based particle size measurements, rather than number-based or mass-based particle size measurements.

[0040] The spread of particle size may be expressed in terms of the span, which is defined as $(d_{90}-d_{10})/d_{50}$. Typically, the span is not more than 20, preferably not more than 10, preferably not more than 8, preferably not more than 4, preferably not more than 2, preferably not more than 1, or not more than 0.5.

[0041] The smoking substitute apparatus (or main body engaged with the smoking substitute apparatus) may comprise a power source. The power source may be electrically connected (or connectable) to a heater of the smoking substitute apparatus (e.g. when the smoking substitute 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.

[0042] When the smoking substitute apparatus is in the form of a consumable, the smoking substitute 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.

[0043] The electrical interface of the smoking substitute apparatus may also be used to identify the smoking substitute 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.

[0044] Again, where the smoking substitute 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.

[0045] The smoking substitute 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 of the smoking substitute 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.

[0046] The main body or smoking substitute 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.

[0047] 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 of the consumable in response to a puff detection by the sensor. The control may be in the form of activation of the heater in response to a detected puff. That is, the smoking substitute 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.

[0048] 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.

[0049] 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.

[0050] 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

[0051] So that the invention may be understood, and so that further aspects and features thereof may be appreciated, embodiments illustrating the principles of the invention will now be discussed in further detail with reference to the accompanying figures, in which:

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 reference arrangement; and

Figure 4 is an enlarged schematic cross sectional view of part of the air passage and vaporisation chamber of a reference arrangement; and

Figure 5 is a front cross sectional view of a smoking substitute apparatus according to an embodiment of the present invention;

Figure 6 is a side cross sectional view of the smoking substitute apparatus of Figure 5; and

Figure 7 is a top-down cross sectional view of the smoking substitute apparatus of Figure 5.

Detailed Description of the Invention

[0052] 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.

[0053] 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.

[0054] 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.

[0055] The system 110 is configured to vaporise an aerosol precursor, which in the illustrated embodiment is in the form of a nicotine-based e-liquid 160. The e-

liquid 160 comprises nicotine and a base liquid including propylene glycol and/or vegetable glycerine. In the present embodiment, the e-liquid 160 is flavoured by a flavourant. In other embodiments, the e-liquid 160 may be flavourless and thus may not include any added flavourant.

[0056] Figure 3 shows a schematic longitudinal cross sectional view of a reference arrangement which may form a part of the smoking substitute system shown in Figures 1 and 2. In Figure 3, the e-liquid 160 is stored within a reservoir in the form of a tank 152 that forms part of the consumable 150. The consumable 150 is a "single-use" consumable 150. That is, upon exhausting the e-liquid 160 in the tank 152, the intention is that the user disposes of the entire 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 the consumable 150 is not arranged to be refilled after the e-liquid contained in the tank 152 is depleted. 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 150 preferably includes a window 158 (see Figures 1 and 2), so that the amount of e-liquid in the tank 152 can be visually assessed. The main body 120 includes a slot 157 so that the window 158 of the consumable 150 can be seen whilst the rest of the tank 152 is obscured from view when the consumable 150 is received in the cavity of the main body 120. The consumable 150 may be referred to as a "clearomizer" when it includes a window 158, or a "cartomizer" when it does not.

[0057] The e-liquid (i.e. aerosol precursor) may be the only part of the system that is truly "single-use". That is, 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, 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).

[0058] The external wall of tank 152 is provided by a casing of the consumable 150. The tank 152 annularly surrounds, and thus defines a portion of, a passage 170 that extends between a vaporiser inlet 172 and an 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.

[0059] When the consumable 150 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 vaporiser 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 150. 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.

[0060] When the consumable 150 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 vaporiser 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 150. In Figure 3, for simplicity, the passage 170 is shown with a substantially circular cross-sectional profile with a constant diameter along its length. The passage may have other cross-sectional profiles, such as oval shaped or polygonal shaped profiles. Further, the cross sectional profile and the diameter (or hydraulic diameter) of the passage may vary along its longitudinal axis.

[0061] The smoking substitute system 110 is configured to vaporise the e-liquid 160 for inhalation by a user. To provide this operability, the consumable 150 comprises a heater having a porous wick 162 and a resistive heating element in the form of a heating filament 164 that is helically wound (in the form of a coil) around a portion of the porous wick 162. The porous wick 162 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 162 extend into the tank 152 (so as to be immersed in the e-liquid 160). In this way, e-liquid 160 contained in the tank 152 is conveyed from the opposing ends of the porous wick 162 to a central portion of the porous wick 162 so as to be exposed to the airflow in the passage 170.

[0062] The helical filament 164 is wound about the exposed central portion of the porous wick 162 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 150 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 164 is electrically connectable to the power source. In this way, power can be supplied by the main body 120 to the filament 164 in order to heat the filament 164. This heats the porous wick 162 which causes e-liquid 160 conveyed by the porous wick 162 to vaporise and thus to be released from the porous wick 162. 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.

[0063] The filament 164 and the exposed central portion of the porous wick 162 are positioned across the passage 170. More specifically, the part of passage that contains the filament 164 and the exposed portion of the porous wick 162 forms a vaporisation chamber. In the illustrated example, the vaporisation chamber has the same cross-sectional diameter as the passage 170. However the vaporisation chamber may have a different cross sectional profile compared with 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.

[0064] Figure 4 illustrates in more detail the vaporisation chamber and therefore the region of the consumable 150 around the wick 162 and filament 164. The helical filament 164 is wound around a central portion of the porous wick 162. The porous wick extends across passage 170. E-liquid 160 contained within the tank 152 is conveyed as illustrated schematically by arrows 401, i.e. from the tank and towards the central portion of the porous wick 162.

[0065] When the user inhales, air is drawn from through the inlets 176 shown in Figure 3, along inlet flow channel 178 to vaporisation chamber inlet 172 and into the vaporisation chamber containing porous wick 162. The porous wick 162 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 162. 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 162.

[0066] At substantially the same time as the airflow passes around the porous wick 162, the filament 164 is heated so as to vaporise the e-liquid which has been wicked into the porous wick. The airflow passing around the porous wick 162 picks up this vaporised e-liquid, and the vapour-containing airflow is drawn in direction 403 further down passage 170.

[0067] 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 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 filament 164. In this way, the filament 164 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.

[0068] 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.

[0069] Figure 5 shows a front cross sectional view of a smoking substitute apparatus 500 according to an embodiment of the present invention. The smoking substitute apparatus 500 broadly comprises an air inlet 172 and outlet 174, located at opposing ends of a chimney 501. The lower end of the chimney, nearest the air inlet, includes a coil 164 and wick 162 of the type discussed previously. In use, the coil is energised and produces aerosol from aerosol precursor. The chimney 501 includes the aerosol generation chamber and the downstream portion of the passage. Disposed on an inner-facing wall of the chimney 501 are first 502a and second 502b drop guidance drains.

[0070] As can be seen in Figure 5, the first 502a and second 502b drop guidance drains start from a same point part-way up the inner-facing wall of the chimney 501 between the coil and wick and the outlet 174. The black arrows indicate the direction that drops of condensate are guided by the drop guidance drains when the apparatus is held upright and air flow is from the air inlet up towards the outlet. Notably, the drops of condensate are guided away from a central axis of the apparatus and towards axially spaced portions of the wick 162. The drop guidance drains are ridges which project from the inner-wall of the chimney 501. As can be seen, the drops of condensate towards the centre of chimney 501 are directed at an approximately 45° angle away from the centre of the chimney and towards the extremities.

[0071] Figure 6 shows the smoking substitute apparatus 500 from a side on cross sectional view. Like features are indicated by like reference numerals. In this view, the second 502b and a fourth 502d drop guidance drain can be seen, extending from the inner-wall of the chimney 501 and directing drops of condensate (indicated by the black arrows) towards the wick 162. The fourth 502d drop guidance drain and a third 502c drop guidance drain are both located on an opposing side of the inner-wall to the first and second, as is discussed in more detail with relation to Figure 7. Of note, is that the third and fourth drop guidance drains are substantially identical to the first and second, but mirrored in a place intersecting the centre of the smoking substitute apparatus. In this view, the coil holders 503a and 503b can be seen, which project from a lowermost surface of the smoking substitute apparatus

to points either side of the wick 162. The coil extends from the holders in a helical manner to encompass the wick 162.

[0072] Figure 7 shows a top down cross sectional view of the smoking substitute apparatus 500. Here, all four drop guidance drains can be seen: first 502a and second 502b on one side of the smoking substitute apparatus, and third 502c and fourth 502d on an opposing side of the smoking substitute apparatus. The first 502a and third 502c drop guidance drains both guide drops of condensate to a same first 504a location on the wick 162. Similarly, the second 502b and fourth 502d drop guidance drains both guide drops of condensate to a same second 504b location which is on an opposing side of the coil 164 to the first 504a location. In use, the coil 164 is energised and so portions of the wick 162 within the helical path of the coil or very close thereto are heated to a greater extent than the portions of the wick which are further away from the coil. The first 504a and second 504b locations are axially spaced from the coil, and so the risk of drops of condensate coming into direct contact with the coil (and so 'spitting') is minimised.

[0073] Moreover, more generally, the provision of one or more drop guidance drains helps ensure that aerosol precursor does not pool around the first and second contacts 503a and 503b within a base of the smoking substitute apparatus.

[0074] 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.

[0075] 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.

[0076] 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.

[0077] Any section headings used herein are for organizational purposes only and are not to be construed as limiting the subject matter described.

[0078] 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.

[0079] 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%.

[0080] 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. A smoking substitute apparatus for generating an aerosol for inhalation by a user, the smoking substitute apparatus comprising:

   an air inlet and an outlet;
   a passage extending between the air inlet and the outlet, air flowing in use along the passage for inhalation by a user drawing air through the apparatus; and
   an aerosol generation chamber containing an aerosol generator being operable to generate an aerosol from an aerosol precursor, the aerosol generation chamber being in communication with the passage, a downstream portion of the passage being provided downstream of the aerosol generator and,
   in use, aerosol being entrained in airflow in the downstream portion of the passage, the downstream portion of the passage and the aerosol generation chamber each having at least one inner-facing wall,
   there being provided at least one drop guidance drain formed on the inner-facing wall of the downstream portion of the passage and/or of the aerosol generation chamber, such that, in use, when the apparatus is held upright so that air flow to the outlet is upwards, drops of condensate formed on the inner-facing wall flow downwards under gravity and are guided by the

drop guidance drain to the aerosol generator.

2. The smoking substitute apparatus of claim 1, wherein the at least one drop guidance drain extends circumferentially at least part of the way around the inner-facing wall, and slopes towards the aerosol generator.

3. The smoking substitute apparatus of either claim 1 or claim 2, wherein the aerosol generator includes a wick and a heater.

4. The smoking substitute apparatus of claim 3, wherein, in use, the heater heats the wick such that the wick has a high temperature portion and a low temperature portion, and wherein the drop guidance drain guides the drops of condensate to the low temperature portion of the wick.

5. The smoking substitute apparatus of either claim 3 or claim 4, wherein the one or more drop guidance drain is configured to guide the drops of condensate away from a central portion of the wick.

6. The smoking substitute apparatus of any preceding claim, wherein the air inlet is provided below the aerosol generation chamber.

7. The smoking substitute apparatus of any preceding claim, including a first and second drop guidance drain, wherein the first and second drop guidance drains start from a same point on the inner-facing wall of the downstream portion of the passage and/or of the aerosol generation chamber and respectively extend in opposite circumferential directions.

8. The smoking substitute apparatus of claim 7, including a third and fourth drop guidance drain, formed on an opposing side of the inner-facing wall to the first and second drop guidance drains, the third and fourth drop guidance drain starting from a same point on the inner-facing wall of the downstream portion of the passage and/or of the aerosol generation chamber and respectively extending in opposite circumferential directions.

9. The smoking substitute apparatus of claim 8, wherein the first and third drop guidance drains guide drops of condensate to a same first location.

10. The smoking substitute apparatus of claim 8 or 9, wherein the second and fourth drop guidance drains guide drops of condensate to a same second location.

11. The smoking substitute apparatus of claim 10 as dependent on claim 9, wherein the aerosol generator includes a wick and heater and the first location and the second location are axially separated along the wick.

12. The smoking substitute apparatus off claim 11, wherein the heater is between the first and second locations.

13. The smoking substitute apparatus of any preceding claim, wherein the passage and/or aerosol generation chamber has an oval cross-section, and the at least one drop guidance drain is arranged on a circumference of the oval cross-section.

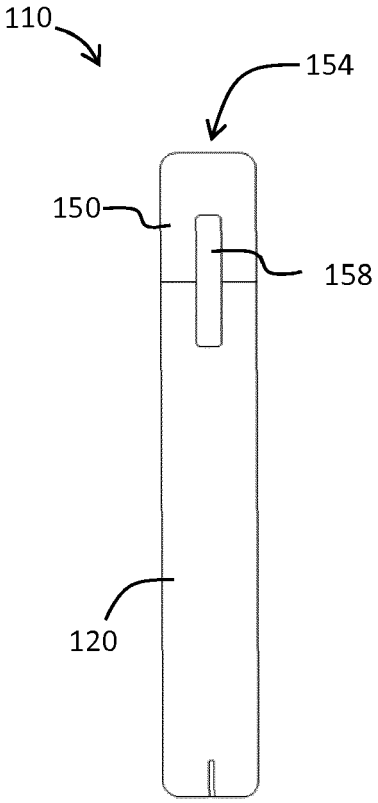

FIG. 1

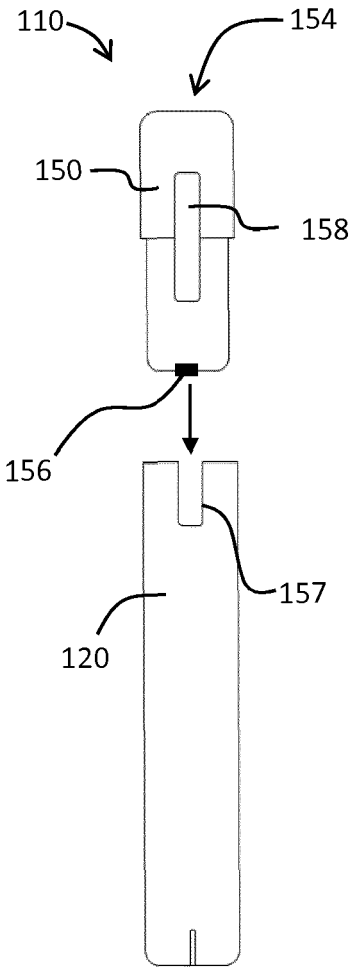

FIG. 2

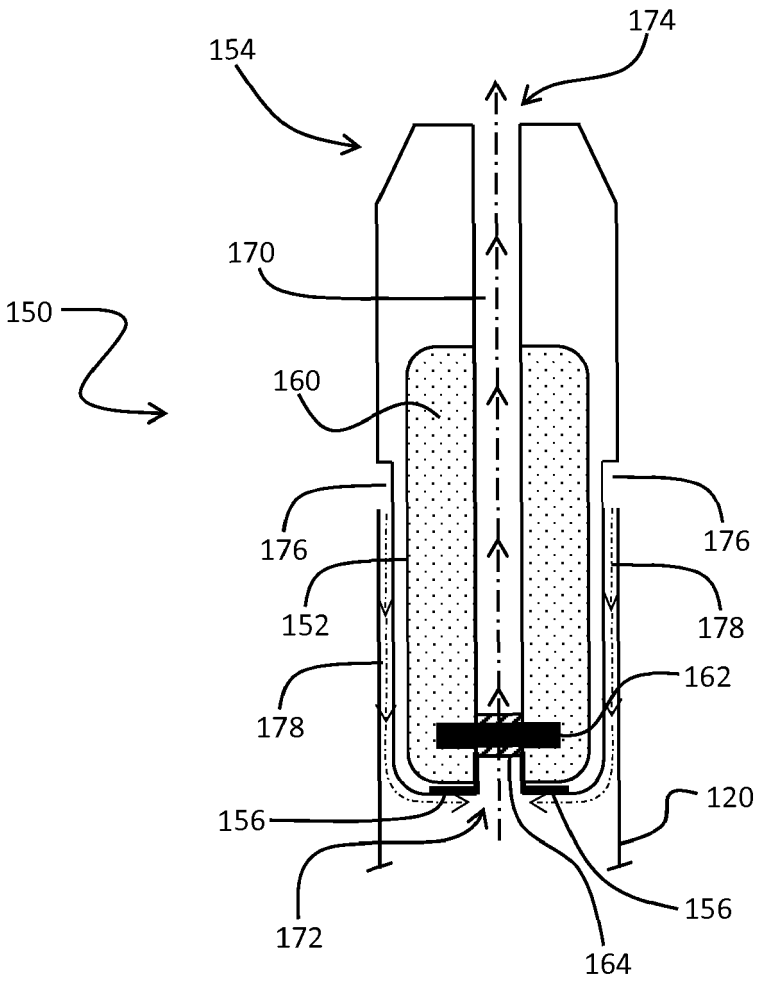

FIG. 3

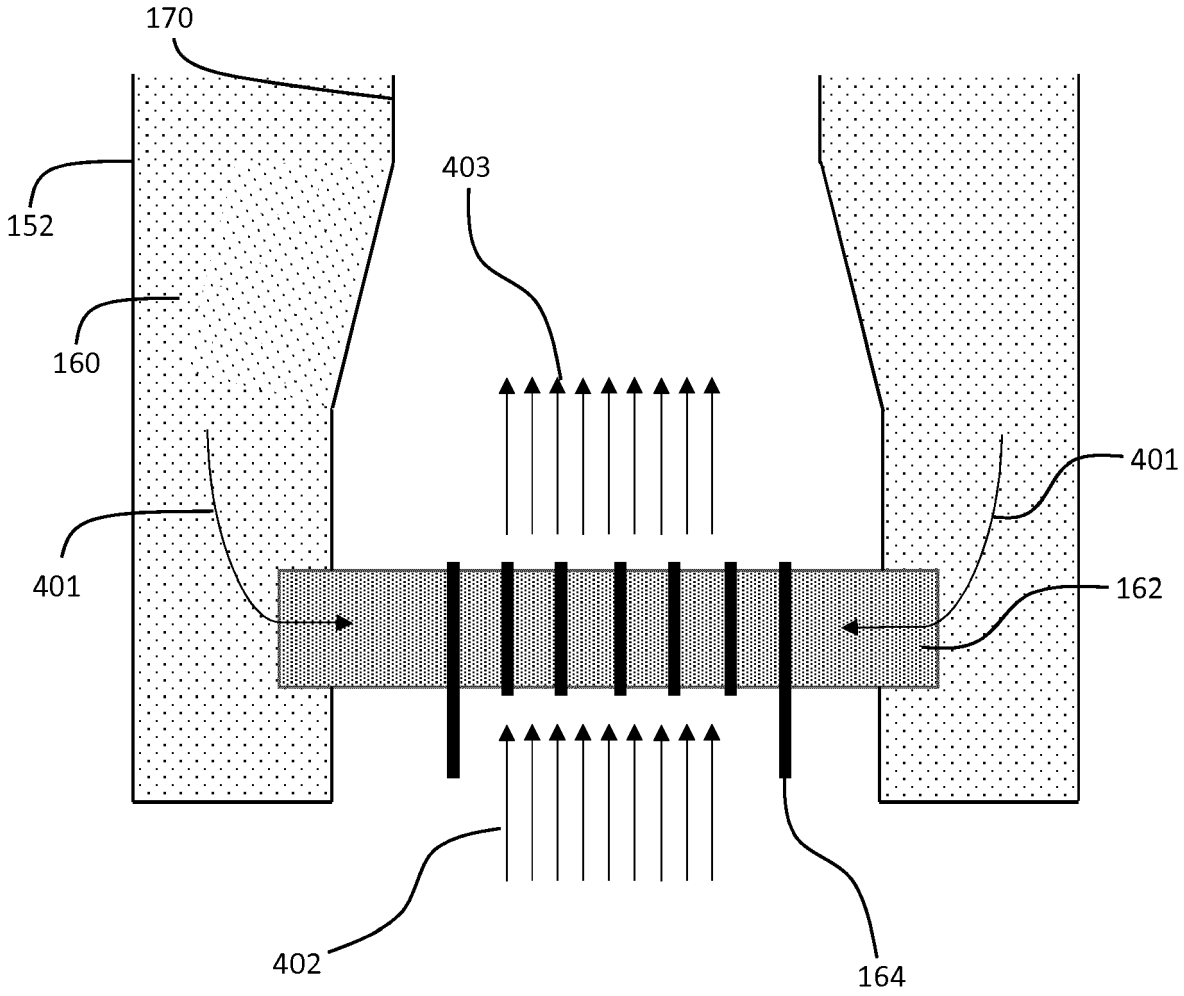

FIG. 4

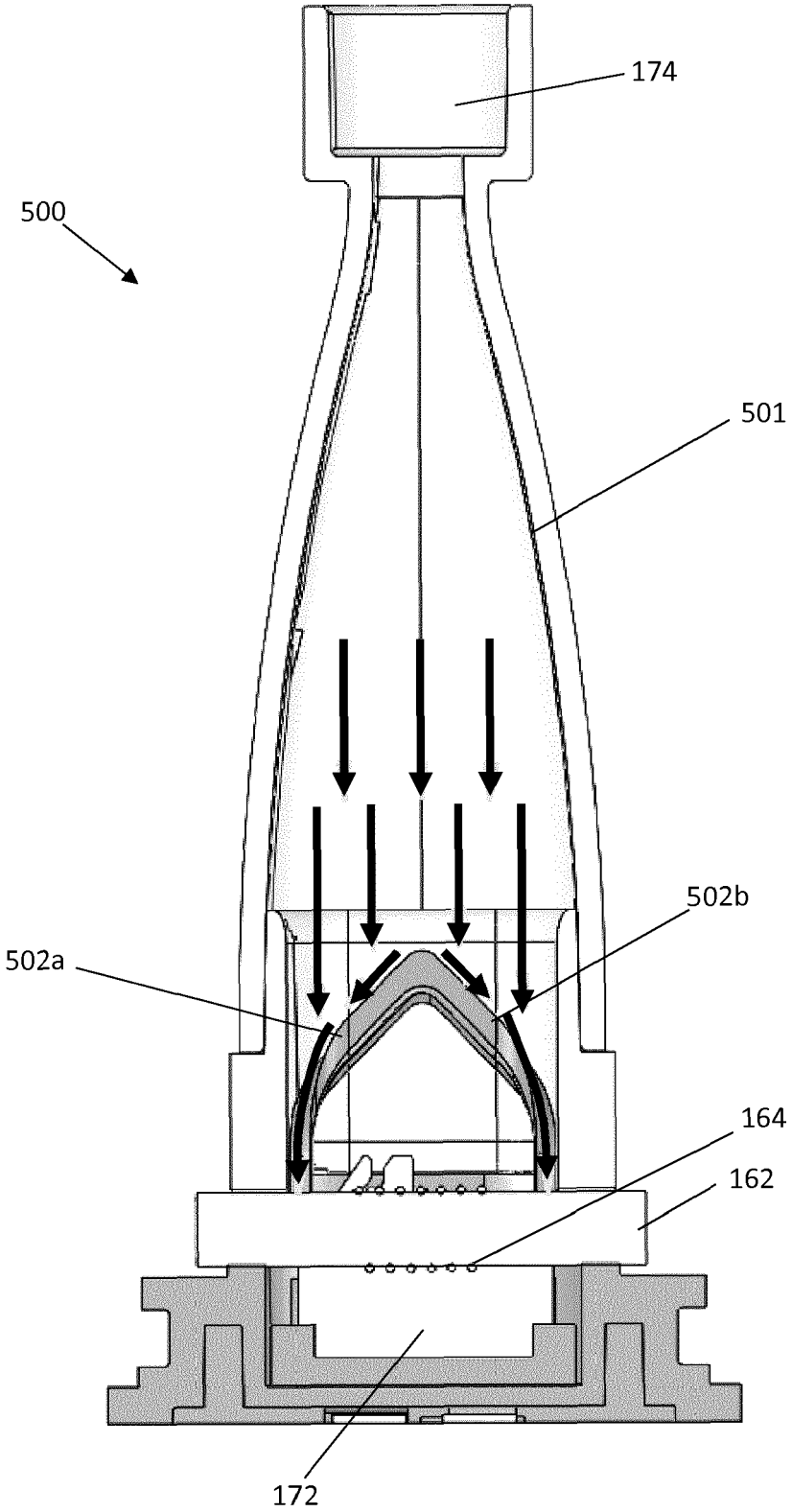

FIG. 5

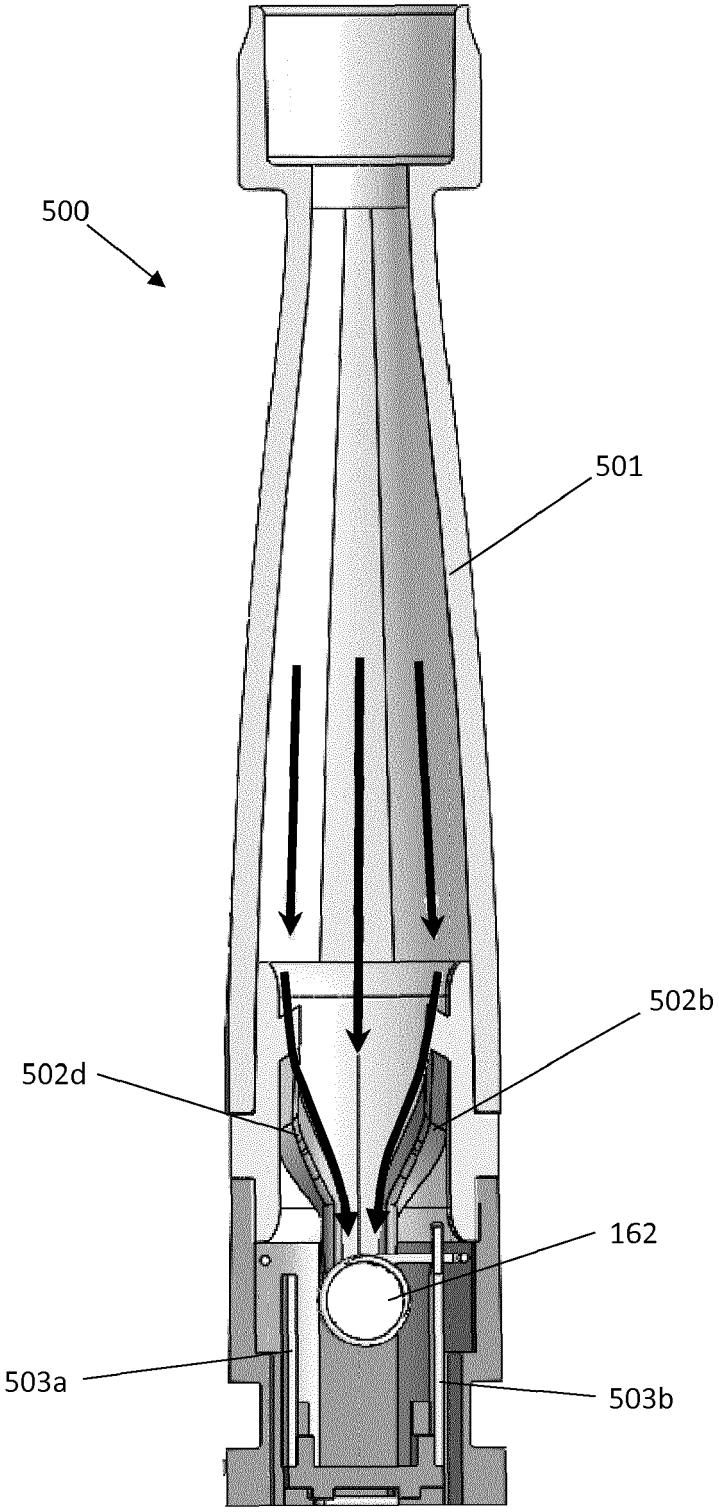

FIG. 6

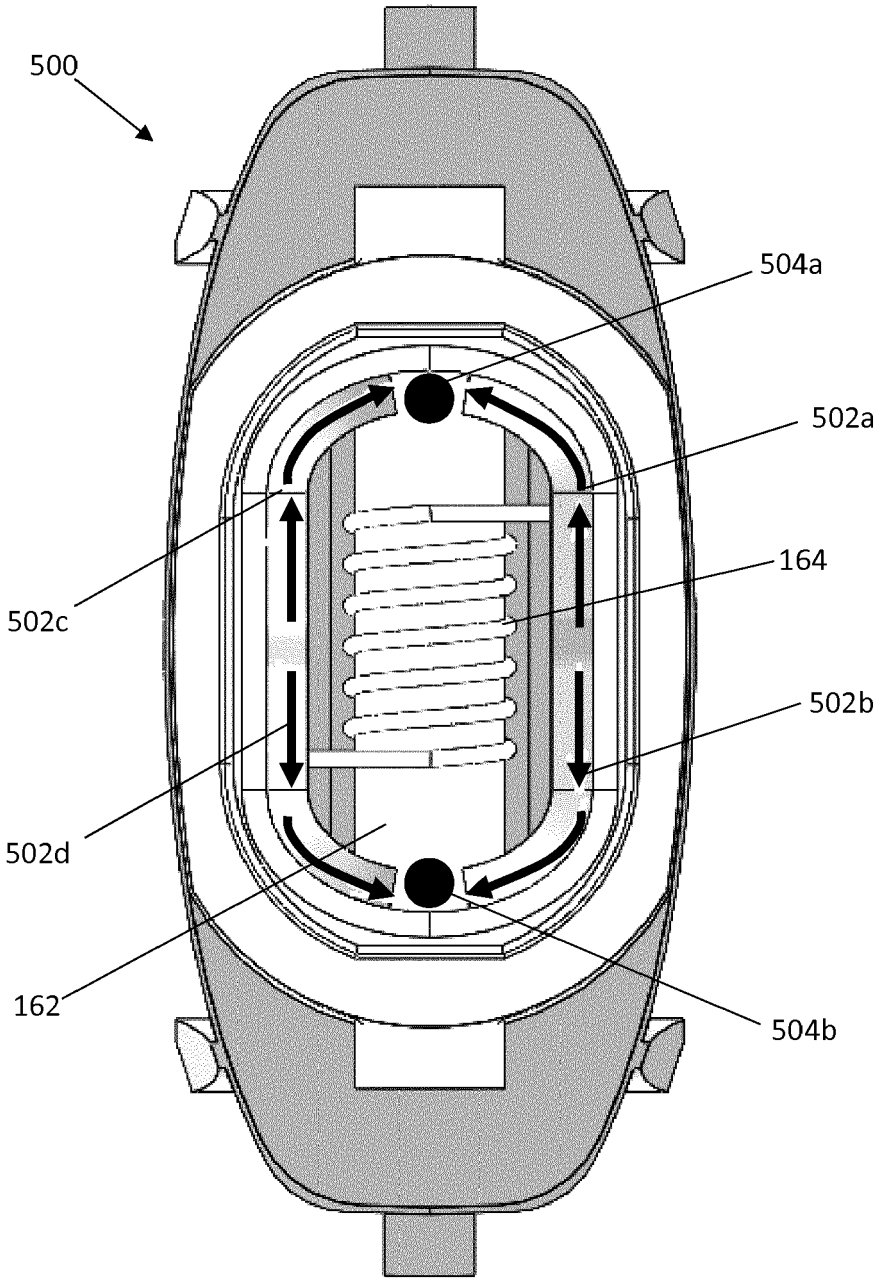

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 19 19 8631

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 108 783 594 A (CHANGZHOU PAITENG ELECTRONIC TECH SERVICE CO LTD) 13 November 2018 (2018-11-13)	1-6	INV. A24F40/40
A	* paragraph [0005] - paragraph [0006] * * paragraph [0075] * * paragraph [0081] - paragraph [0082] *	7-13	
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A	* paragraph [0005] * * paragraph [0017] *	7-13	
A	EP 3 158 883 A2 (SHENZHEN FIRST UNION TECH CO [CN]) 26 April 2017 (2017-04-26) * abstract; figure 1 * * paragraph [0002] * * paragraph [0010] *	1-13	

TECHNICAL FIELDS SEARCHED (IPC)

A24F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 March 2020	Schnitzhofer, Markus

CATEGORY OF CITED DOCUMENTS

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