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(54) **AEROSOL DELIVERY DEVICE/SYSTEM**

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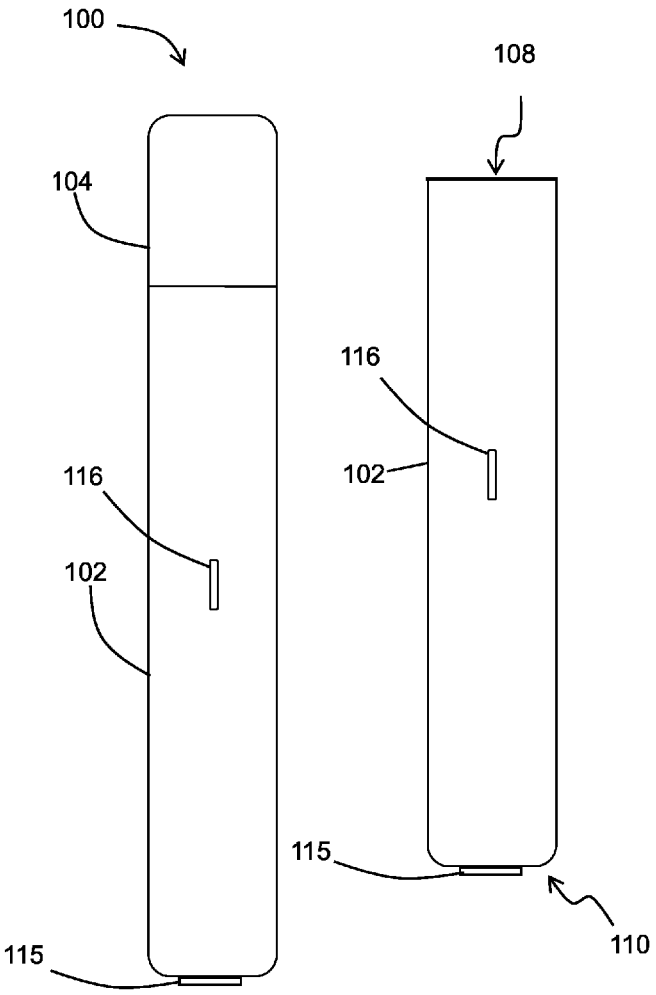
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(57) **ABSTRACT**

The present disclosure relates to an aerosol delivery system e.g. a smoking substitute system. In particular, it relates to an aerosol generating system comprising a vaporiser, an air flow sensor configured to detect a user inhalation through the system, and a controller, wherein the controller is configured to activate the vaporiser only when the duration of the user inhalation exceeds a predefined duration threshold.



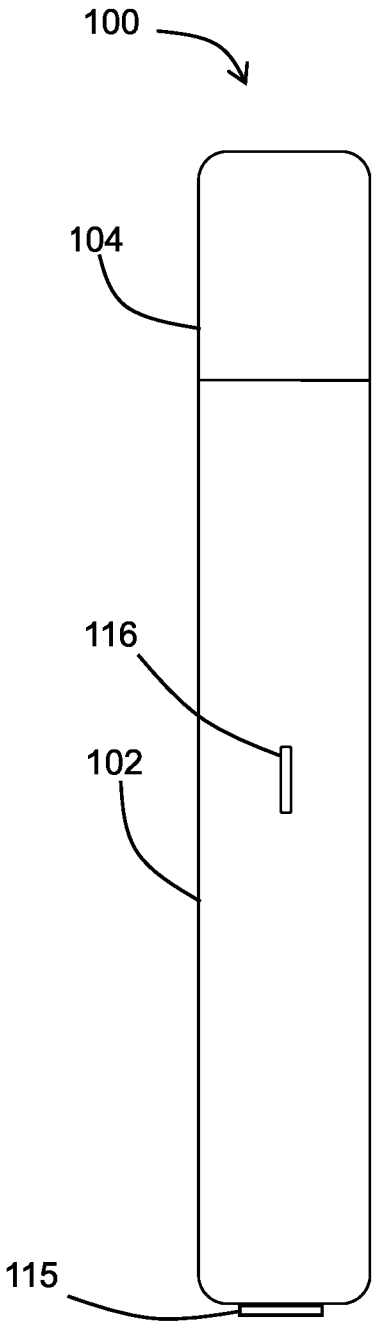


FIG 1A

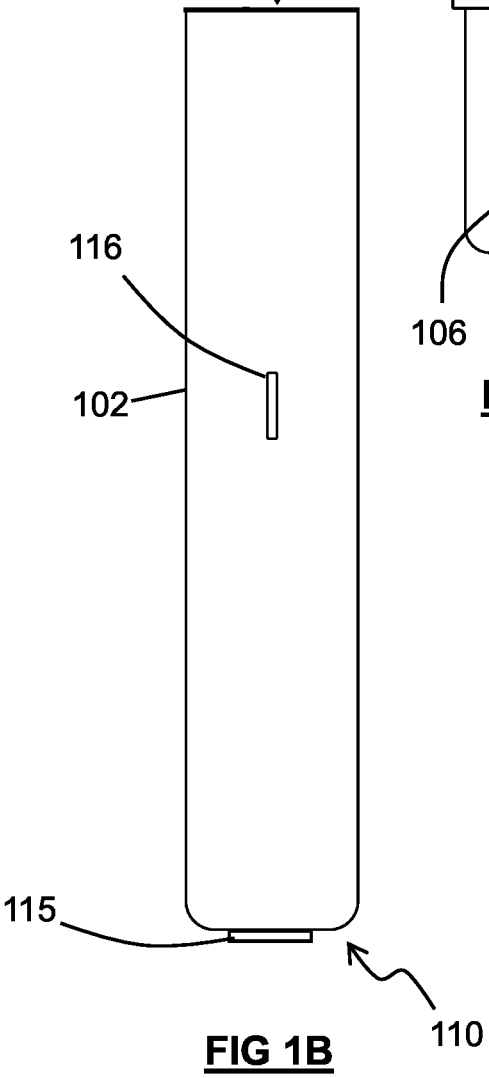


FIG 1B

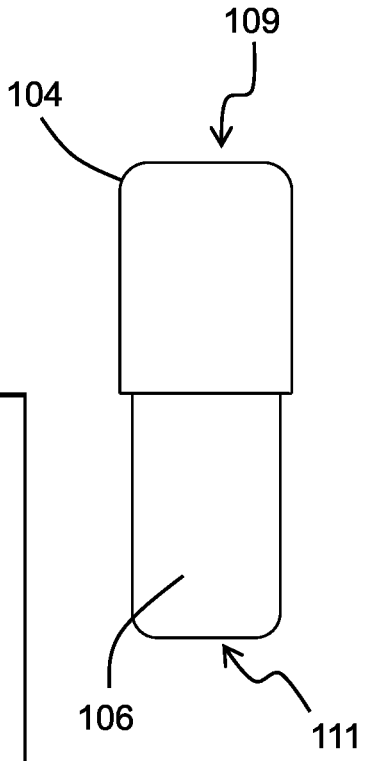


FIG 1C

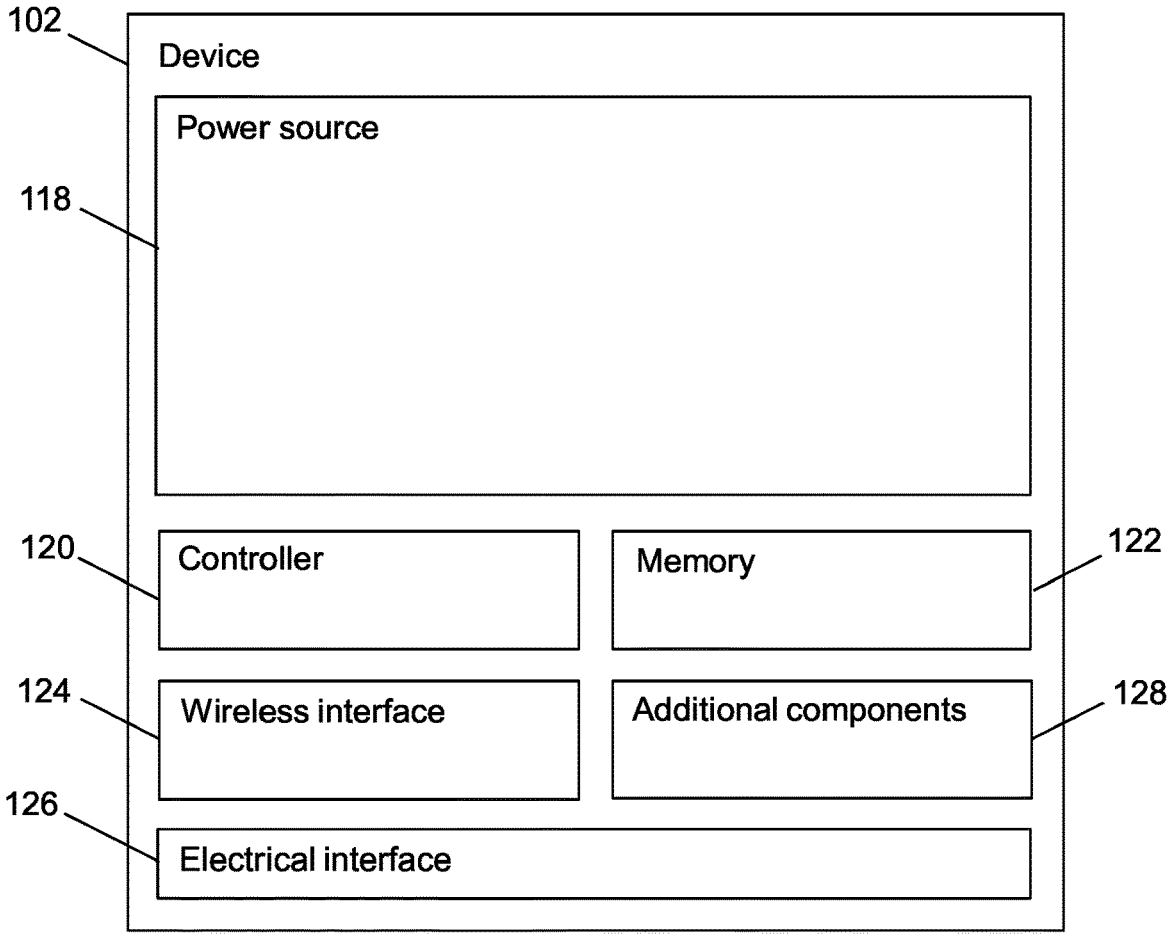

102
Device
Power source
118
120
Controller
Memory
122
124
Wireless interface
Additional components
128
126
Electrical interface

FIG 2A

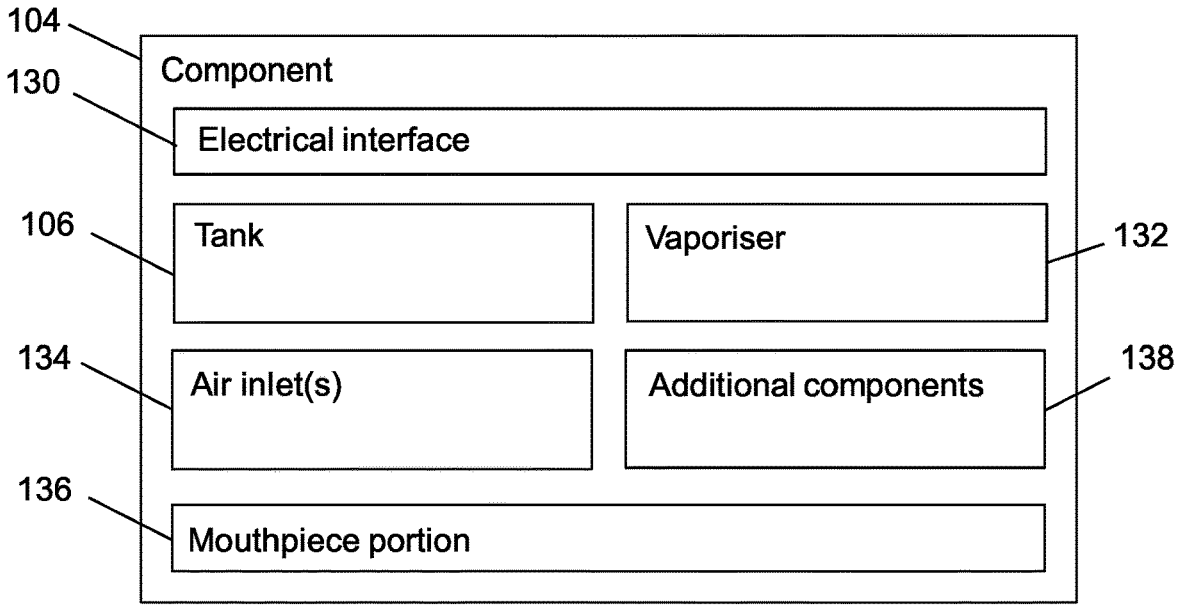

104
Component
130
Electrical interface
106
Tank
Vaporiser
132
134
Air inlet(s)
Additional components
138
136
Mouthpiece portion

FIG 2B

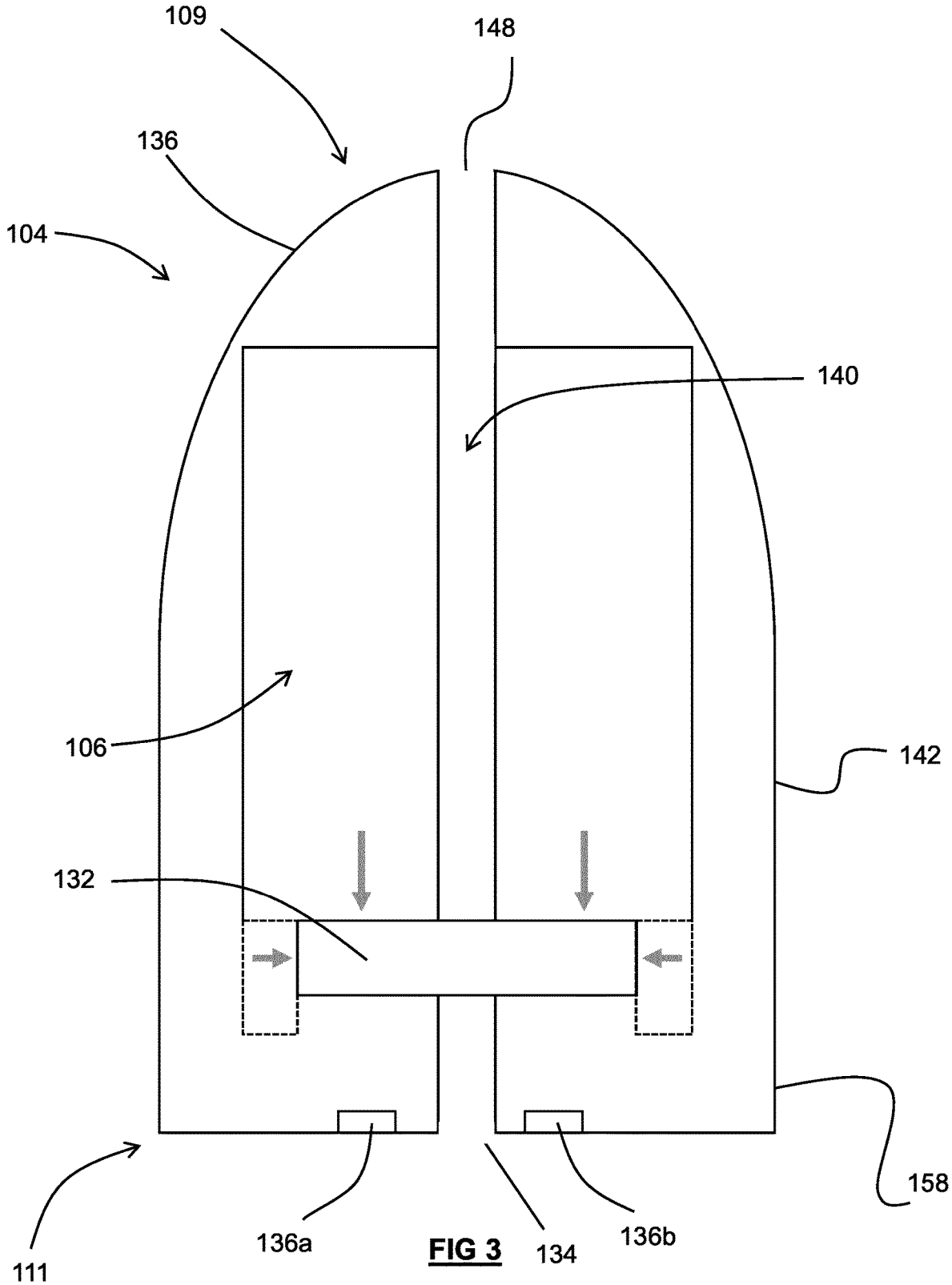


FIG 3

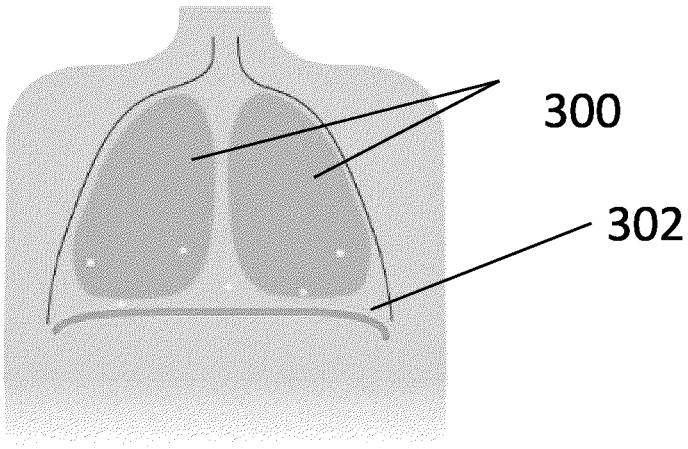


FIG 4A

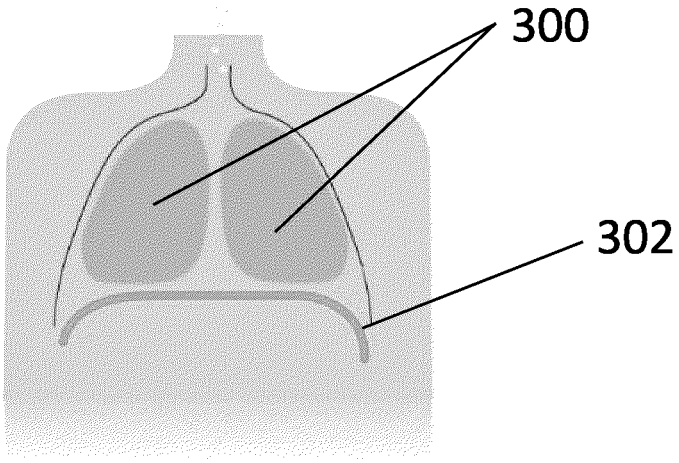


FIG 4B

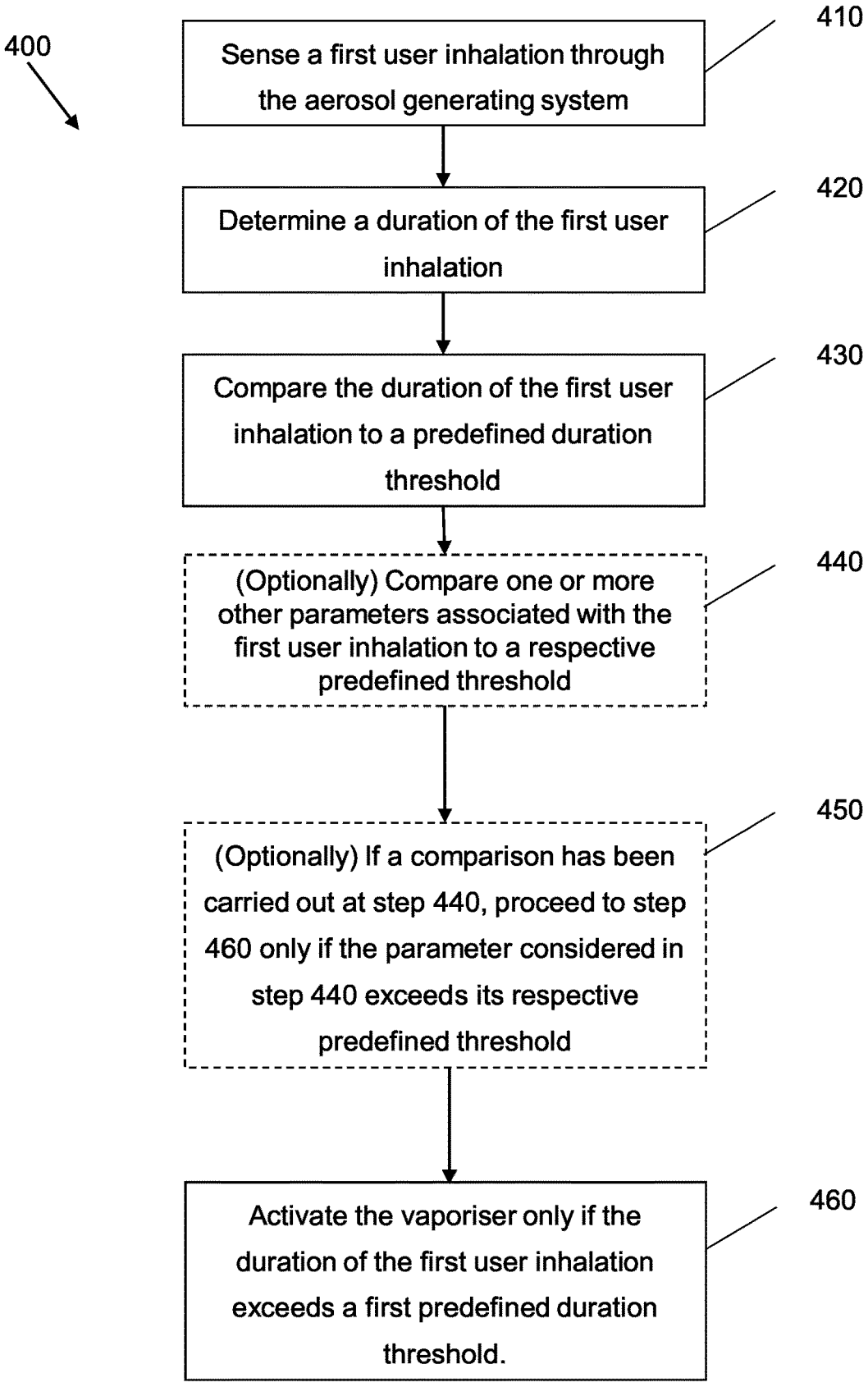

400
Sense a first user inhalation through the aerosol generating system
410
Determine a duration of the first user inhalation
420
Compare the duration of the first user inhalation to a predefined duration threshold
430
(Optionally) Compare one or more other parameters associated with the first user inhalation to a respective predefined threshold
440
(Optionally) If a comparison has been carried out at step 440, proceed to step 460 only if the parameter considered in step 440 exceeds its respective predefined threshold
450
Activate the vaporiser only if the duration of the first user inhalation exceeds a first predefined duration threshold.
460

Fig. 5

AEROSOL DELIVERY DEVICE/SYSTEM

TECHNICAL FIELD

[0001] The present disclosure relates to an aerosol generation/delivery system such as a smoking substitute system.

BACKGROUND

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

[0003] 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 order to avoid the smoking of tobacco.

[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] Smoking substitute systems, which may also be known as electronic nicotine delivery systems, may comprise electronic systems that permit a user to simulate the act of smoking by producing an aerosol, also referred to as a "vapour", which is drawn into the lungs through the mouth (inhaled) and then exhaled. The inhaled aerosol typically bears nicotine and/or flavourings without, or with fewer of, the odour and health risks associated with traditional 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 experience and satisfaction to those experienced with traditional smoking and 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. Some smoking substitute systems are designed to resemble a traditional cigarette and are cylindrical in form with a mouthpiece at one end. Other smoking substitute systems do not generally resemble a cigarette (for example, the smoking substitute device may have a generally box-like form).

[0008] There are a number of different categories of smoking substitute systems, each utilising a different smoking substitute approach. A smoking substitute approach corresponds to the manner in which the substitute system operates for a user.

[0009] One approach for a smoking substitute system is the so-called "vaping" approach, in which a vaporisable liquid, typically referred to (and referred to herein) as "e-liquid", is heated by a heater to produce an aerosol vapour which is inhaled by a user. An e-liquid typically includes a base liquid as well as nicotine and/or flavourings. The resulting vapour therefore typically contains nicotine and/or flavourings. The base liquid may include propylene glycol and/or vegetable glycerine.

[0010] A typical vaping smoking substitute system includes a mouthpiece, a power source (typically a battery), a tank or liquid reservoir for containing e-liquid, as well as a heater. In use, electrical energy is supplied from the power source to the heater, which heats the e-liquid to produce an aerosol (or "vapour") which is inhaled by a user through the mouthpiece.

[0011] Vaping smoking substitute systems can be configured in a variety of ways. For example, there are "closed system" vaping smoking substitute systems which typically have a heater and a sealed tank which is pre-filled 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 device which includes the power source, wherein the device is configured to be physically and electrically coupled to a component including the tank and the heater. In this way, when the tank of a component has been emptied, the device can be reused by connecting it to a new component. Another subset of closed system vaping smoking substitute systems are completely disposable and intended for one-use only.

[0012] There are also "open system" vaping smoking substitute systems which typically have a tank that is configured to be refilled by a user, so the system can be used multiple times.

[0013] An example vaping smoking substitute system is the Myblu™ e-cigarette. The Myblu™ e cigarette is a closed system which includes a device and a consumable component. The device and consumable component are physically and electrically coupled together by pushing the consumable component into the device. The device includes a rechargeable battery. The consumable component includes a mouthpiece, a sealed tank which contains e-liquid, as well as a vaporiser, which for this system is a heating filament coiled around a portion of a wick which is partially immersed in the e-liquid. The system is activated when a microprocessor on board the device detects a user inhaling through the mouthpiece. When the system is activated, electrical energy is supplied from the power source to the vaporiser, which heats e-liquid from the tank to produce a vapour which is inhaled by a user through the mouthpiece.

[0014] Another example vaping smoking substitute system is the blu PRO™ e-cigarette. The blu PRO™ e cigarette is an open system which includes a device, a (refillable) tank, and a mouthpiece. The device and tank are physically and electrically coupled together by screwing one to the other. The mouthpiece and refillable tank are physically coupled together by screwing one into the other, and detaching the mouthpiece from the refillable tank allows the tank to be refilled with e-liquid. The system is activated by a button on the device. When the system is activated, electrical energy is supplied from the power source to a vaporiser, which heats e-liquid from the tank to produce a vapour which is inhaled by a user through the mouthpiece.

[0015] An alternative to the "vaping" approach is the so-called Heated Tobacco ("HT") approach in which tobacco (rather than an e-liquid) is heated or warmed to release vapour. HT is also known as "heat not burn" ("HNB"). The tobacco may be leaf tobacco or reconstituted tobacco. In the HT approach the intention is that the tobacco is heated but not burned, i.e. the tobacco does not undergo combustion.

[0016] The heating, as opposed to burning, of the tobacco material is believed to cause fewer, or smaller quantities, of the more harmful compounds ordinarily produced during smoking. Consequently, the HT approach may reduce the odour and/or health risks that can arise through the burning, combustion and pyrolytic degradation of tobacco.

[0017] A typical HT smoking substitute system may include a device and a consumable component. The consumable component may include the tobacco material. The device and consumable component may be configured to be physically coupled together. In use, heat may be imparted to the tobacco material by a heating element of the device, wherein airflow through the tobacco material causes components in the tobacco material to be released as vapour. A vapour may also be formed from a carrier in the tobacco material (this carrier may for example include propylene glycol and/or vegetable glycerine) and additionally volatile compounds released from the tobacco. The released vapour may be entrained in the airflow drawn through the tobacco.

[0018] As the vapour passes through the consumable component (entrained in the airflow) from the location of vaporization to an outlet of the component (e.g. a mouthpiece), the vapour cools and condenses to form an aerosol for inhalation by the user. The aerosol may contain nicotine and/or flavour compounds.

[0019] Aerosol delivery systems such as smoking substitute systems are not appropriate for use by underage persons such as children, due to the potentially harmful effects of nicotine and other substances that may be contained within the vapour generated by such systems. However, there is a risk that a smoking substitute device (or similar) may be inadvertently left within reach of an unauthorised user such as a child, and that they may attempt to use it. Therefore, safety mechanisms are required to ensure only appropriate and authorised use of an aerosol delivery system.

[0020] Accordingly, there is a need for an improved aerosol delivery system which addresses at least some of the problems of the known systems.

SUMMARY

[0021] According to a first aspect, there is provided an aerosol generating system comprising a vaporiser, an air flow sensor configured to detect a user inhalation through the system, and a controller, wherein the controller is configured to activate the vaporiser only when the duration of the user inhalation exceeds a predefined duration threshold.

[0022] Because the controller is configured to activate the vaporiser only when the duration of the user inhalation exceeds a predefined duration threshold, a safety mechanism is provided, wherein a non-authorised user such as a child is unlikely to be physically able to (and/or, to be aware that they are required to) provide an inhale of a suitably long duration as to activate the vaporiser. If the vaporiser is not activated, the system cannot produce an aerosol/vapour, and so such an aerosol/vapour cannot be inhaled by the unauthorised user. Therefore, accidental or unauthorised use of the system by an inappropriate user such as a child is avoided, or at least the chances of it happening are significantly reduced. This provides peace of mind to the authorised user and also prevents the risk of the system causing harm to an inappropriate user such as a child. This safety and peace of mind is provided in a streamlined manner, wherein the controller can work in conjunction with one or more commonly-provided sensors, detectors or measuring components, to determine the duration of an inhale and to compare it to one or more duration thresholds. The comparison can be made quickly by the controller, such that activation of the aerosol generation means by an authorised or appropriate user and generation of the desired vapour can, from a user perspective, occur substantially instantaneously when the user inhales. Therefore, the safety mechanism is provided without causing inconvenience or delay to the authorised user.

[0023] Optional features will now be set out. These are applicable singly or in any combination with any aspect.

[0024] The aerosol generating system may further include a clock or timer configured for measuring the duration of the user inhalation. The clock or timer may be comprised within, or in communication with, the air flow sensor and/or the controller.

[0025] The air flow sensor may be, or comprise, a mechanical-to-electrical sensor, a MEMS activation sensor, a pressure differential sensor, a mass flow sensor, a temperature sensor, a fluid velocity sensor, a flow rate sensor, or any combination of these. The air flow sensor may comprise a microphone, such as a dynamic microphone, a condenser microphone, a capacitance microphone, or a piezoelectric microphone, or any combination of these. The air flow sensor may comprise one or more moveable elements such as a moveable baffle, the movement of which may be measured to determine air flow characteristics for the user inhalation.

[0026] The predefined duration threshold that the user inhalation must meet or exceed may be of any appropriate length (in units of time). For example, it may be greater or equal to 3 seconds or 4 seconds, such as greater than or equal to 5 seconds or 6 seconds.

[0027] The controller, and/or another controller associated with the aerosol generating system, may be configured to conduct one or more additional comparisons, before it enables activation of the vaporiser in response to the user inhalation.

[0028] For example, it/they may be configured only to activate the vaporiser when the duration of the user inhalation exceeds a predefined duration threshold and when a detected pressure force of the user inhalation exceeds a predefined pressure force threshold.

[0029] That predefined pressure force/volume threshold may be of a suitable value that is associated with an adult inhalation e.g. a typical maximal adult inspiratory pressure (PIMAX), and which is unlikely to be achievable by a child. The PIMAX value may be between −100 and −70 cm H_2O.

[0030] The controller, and/or another controller associated with the aerosol generating system may be configured only to activate the vaporiser when the duration of the user inhalation exceeds a predefined duration threshold and when a detected pressure differential/drop of the user inhalation exceeds a predefined pressure differential/drop threshold. That predefined pressure differential/drop threshold may be of a suitable value that is associated with an adult inhalation, and which is unlikely to be achievable by a child. For example, the pressure differential/drop threshold may be 3 psi, more preferably 5 psi, more preferably 7 psi.

[0031] The controller, and/or another controller associated with the aerosol generating system may be configured only to activate the vaporiser when the duration of the user inhalation exceeds a predefined duration threshold and when a detected "capacity on inhale" (or, mass flow volume) of the user inhalation exceeds a predefined mass flow volume threshold. That predefined mass flow volume threshold may be of a suitable value that is associated with an adult inhalation, and which is unlikely to be achievable by a child. For example, it may be equal to or greater than 10 millilitres

per second (ml/s), such as equal to or greater than 20 ml/s, or equal to or greater than 30 ml/s.

[0032] The use of one or more further comparisons (in addition to the comparison of the inhalation duration with the threshold) can enhance the reliability of the safety mechanism, by providing two or more barriers that a non-authorised user would have to overcome (and is unlikely to be physically capable of overcoming) before the system can be activated for aerosol generation. Moreover, they provide redundancy in case of a system failure in relation to one or other of the comparisons.

[0033] The user inhalation may be the first user inhalation and the controller may be configured to activate the vaporiser only when the duration of a first user inhalation exceeds the predefined duration threshold.

[0034] The system may be configured to allow continued operation of the vaporiser, at least for a predetermined period of time, once the vaporiser has been activated by a suitable first inhalation. Accordingly, in some embodiments, the system, is not configured to require the predefined duration threshold to be met or exceeded by every inhalation that a user makes, subsequent to the first inhalation, at least for a predetermined period of time or at least, for example, for a predetermined number of inhalations, following the user inhalation.

[0035] The "first user inhalation" may be the first inhalation that a user applies to the aerosol generating system. during a particular smoking session. Additionally/alternatively the "first user inhalation" may comprise an inhalation that occurs after a predetermined period of inactivity, and/or after a particular number of inhalations since the previous inhalation for which the inhalation duration was required to meet or exceed the predefined duration threshold.

[0036] The system may comprise a device for cooperation with a component for containing an aerosol precursor.

[0037] The device comprises a source of power which may be a battery. The source of power may be a capacitor. The power source may be a rechargeable power source. The device may comprise a charging connection for connection to an external power supply for recharging of the power source within the device.

[0038] The device may comprise a device body for housing the power source and/or other electrical components. The device body may be an elongate body i.e. with a greater length than depth/width. It may have a greater width than depth.

[0039] The device body may have a length of between 5 and 30 cm e.g. between 5 and 10 cm such as between 7 and 9 cm. The maximum depth of the device body may be between 5 and 15 mm e.g. between 9 and 12 mm.

[0040] The device body may have a front surface that is curved in the transverse dimension. The device body may have a rear surface that is curved in the transverse dimension. The curvatures of the front surface and rear surface may be of the opposite sense to one another. Both front and rear surfaces may be convex in the transverse dimension. They may have an equal radius of curvature.

[0041] The device body may have a substantially oval transverse cross-sectional shape.

[0042] The device body may have a linear longitudinal axis.

[0043] The front and/or rear surface of the device body may include at least one visual user feedback element, for example one or more lights e.g. one or more LEDs.

[0044] In some embodiments, the device body may include an illumination region configured to allow light provided by the visual user feedback element (e.g. one or more lights/LEDs) within the device body to shine through.

[0045] The device may comprise a movement detection unit (e.g. an accelerometer) for detecting a movement of the device.

[0046] The device may comprise a haptic feedback generation unit (e.g. an electric motor and a weight mounted eccentrically on a shaft of the electric motor).

[0047] The device may include the controller(s).

[0048] The controller may be configured to identify an operation of the device; and control the one or more lights contained within the device body, (e.g. to illuminate the illumination region) based on the operation of the device identified.

[0049] The controller may be configured to control the haptic feedback generation unit to generate the haptic feedback in response to the detection of movement of the device by the movement detection unit.

[0050] 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.

[0051] The device 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.

[0052] The device may comprise the airflow sensor. The airflow sensor may be operatively connected to the controller so as to be able to provide a signal to the controller indicative of the occurrence (and duration) of the user inhalation.

[0053] The device may comprise an electrical connection (e.g. one or more contact pins) for connection of the power source to a vaporiser.

[0054] The device may comprise a chassis within the device body and one or more of the electrical components of the device (e.g. one or more of the power source, charging connection, visual feedback element, movement detection unit, haptic feedback generation unit, controller, memory, wireless interface, air flow sensor and/or electrical connection) may be mounted on or affixed to the chassis.

[0055] The system may further comprise the component for containing the aerosol precursor.

[0056] The component may be an aerosol-delivery (e.g. a smoking substitute) consumable i.e. in some embodiments the component may be a consumable component for engagement with the aerosol-delivery (e.g. a smoking substitute) device to form the aerosol-delivery (e.g. s smoking substitute) system.

[0057] The device may be configured to receive the consumable component. The device and the consumable component may be configured to be physically coupled together. For example, the consumable component may be at least partially received in a recess of the device (e.g. in a recess defined by the device housing). There may be a snap engagement between the device and the consumable component. Alternatively, the device and the consumable com-

ponent may be physically coupled together by screwing one onto the other, or through a bayonet fitting.

[0058] Thus, the consumable component may comprise one or more engagement portions for engaging with the device.

[0059] The device and consumable component may be coupled together by magnetic attraction. For example, the device may comprise at least one magnet whilst the component may comprise a magnet or ferrous plate.

[0060] The consumable component may comprise the vaporiser. The vaporiser may comprise a heating element. Alternatively, the vaporiser may comprise an ultrasonic or flow expansion unit, or an induction heating system.

[0061] The consumable component may comprise an electrical interface for interfacing with a corresponding electrical interface of the device. One or both of the electrical interfaces may include one or more electrical contacts. Thus, when the device is engaged with the consumable component, the electrical interface may be configured to transfer electrical power from the power source to the vaporiser (e.g. heating element) of the consumable component. The electrical interface may also be used to identify the consumable component from a list of known types. The electrical interface may additionally or alternatively be used to identify when the consumable component is connected to the device.

[0062] The device may alternatively or additionally be able to detect information about the consumable component via an RFID reader, a barcode or QR code reader. This interface may be able to identify a characteristic (e.g. a type) of the consumable. In this respect, the consumable component 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.

[0063] In other embodiments, the component may be integrally formed with the aerosol-delivery (e.g. a smoking substitute) device to form the aerosol-delivery (e.g. s smoking substitute) system.

[0064] In such embodiments, the aerosol former (e.g. e-liquid) may be replenished by re-filling a tank that is integral with the device (rather than replacing the consumable). Access to the tank (for re-filling of the e-liquid) may be provided via e.g. an opening to the tank that is sealable with a closure (e.g. a cap).

[0065] The smoking substitute system may comprise an airflow path therethrough, the airflow path extending from an air inlet to an outlet. The air inlet may be provided in the device body. The outlet may be at a mouthpiece portion of the component. In this respect, a user may draw fluid (e.g. air) into and along the airflow path by inhaling at the outlet (i.e. using the mouthpiece portion). The airflow sensor may be configured to detect air at one or more points along the airflow path.

[0066] The airflow path passes the vaporiser between the air inlet and the outlet. The vaporiser may be provided in the component.

[0067] The airflow path may comprise a first portion extending from the air inlet towards the vaporiser. A second portion of the airflow path passes the vaporiser (e.g. over or around the vaporiser) to a conduit that extends to the outlet. The conduit may extend along the axial centre of the component.

[0068] References to "downstream" in relation to the airflow path are intended to refer to the direction towards the outlet/mouthpiece portion. Thus the second portion of the airflow path is downstream of the first portion of the airflow path. Conversely, references to "upstream" are intended to refer to the direction towards the air inlet. Thus the first portion of the airflow path (and the air inlet) is upstream of the second portion of the airflow path (and the outlet/mouthpiece portion).

[0069] References to "upper", "lower", "above" or "below" are intended to refer to the component when in an upright/vertical orientation i.e. with elongate (longitudinal/length) axis of the component vertically aligned and with the mouthpiece vertically uppermost.

[0070] The component may comprise a tank for housing the aerosol precursor (e.g. a liquid aerosol precursor). The aerosol precursor may comprise an e-liquid, for example, comprising a base liquid and e.g. nicotine. The base liquid may include propylene glycol and/or vegetable glycerine.

[0071] The conduit may extend through the tank with the conduit walls defining an inner region of the tank. In this respect, the tank may surround the conduit e.g. the tank may be annular.

[0072] As discussed above, the air flow path passes (e.g. passes over or around) the vaporiser between the air inlet and the outlet. The vaporiser may be within a vaporiser chamber which may form part of the airflow pathway.

[0073] The vaporiser may comprise a wick. The wick may form the base of the tank so that the aerosol precursor may be in contact with the wick. The wick may comprise one or more channels on its upper surface (facing the tank), the channels being in fluid communication with the tank.

[0074] The wick may have a length and width defining its upper surface with a depth aligned with the longitudinal axis of the component. Thus the upper surface and opposing lower surface of the wick may lie in respective planes that are perpendicular to the longitudinal axis of component and longitudinal to the first and third portions of the airflow path.

[0075] The wick may comprise a porous material e.g. a ceramic material. A portion of the wick e.g. at least a portion of the lower surface and/or at least a portion of at least one side wall extending between the upper and lower surface (in a depth direction) may be exposed to airflow in the second portion of the airflow path.

[0076] The heating element may be in the form of a heater track on the wick e.g. on the lower surface of the wick.

[0077] In other embodiments, the wick may be a cylindrical, porous wick e.g. formed of cotton or ceramic. It may be oriented so as to extend in the direction of the width dimension of the component (perpendicular to the longitudinal axis of the component). Thus the wick may extend in a direction perpendicular to the direction of airflow in the airflow path. Opposing ends of the wick may protrude into the tank and a central portion (between the ends) may extend across the airflow path so as to be exposed to airflow. Thus, fluid may be drawn (e.g. by capillary action) along the wick, from the tank to the exposed portion of the wick. The heating element may be in the form of a filament wound about the wick (e.g. the filament may extend helically about the wick). The filament may be wound about the exposed portion of the wick.

[0078] The heating element is electrically connected (or connectable) to the power source. Thus, in operation, the power source may supply electricity to (i.e. apply a voltage across) the heating element so as to heat the heating element. 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 airflow along the airflow path. This vapour may subsequently cool to form an aerosol e.g. in the conduit.

[0079] In a second aspect there is provided a method of using the aerosol-delivery (e.g. smoking substitute) system according to the first aspect, the method comprising engaging the consumable component with the aerosol-delivery (e.g. smoking substitute) device (as described above) having a power source so as to electrically connect the power source to the consumable component (i.e. to the vaporiser of the consumable component).

[0080] In a third aspect there is provided a method of controlling the activation of a vaporiser within an aerosol generating system that also comprises a controller and an air flow sensor. The method comprises sensing a user inhalation through the aerosol generating system, determining a duration of the user inhalation, comparing the duration of the user inhalation to a predefined duration threshold; and activating the vaporiser if the duration of the user inhalation exceeds the predefined duration threshold.

[0081] As discussed above, the user inhalation may be the first user inhalation.

[0082] The method may further comprise, before the vaporiser is activated, determining a pressure force of the user inhalation and comparing the determined pressure force of the user inhalation to a predefined pressure force threshold. The method may further comprise activating the vaporiser only if the duration of the user inhalation exceeds the predefined duration threshold and the determined pressure force of the user inhalation exceeds the predefined pressure force threshold.

[0083] The method may further or instead comprise, before the vaporiser is activated determining a pressure differential of the user inhalation and comparing the determined pressure differential of the user inhalation to a predefined pressure differential threshold. The method may further comprise activating the vaporiser only if the duration of the user inhalation exceeds the predefined duration threshold and the determined pressure differential of the user inhalation exceeds the predefined pressure differential threshold.

[0084] The method may further or instead comprise, before the vaporiser is activated, determining a mass flow volume (or, "capacity on inhale") of the user inhalation and comparing the determined mass flow volume of the user inhalation to a predefined mass flow volume threshold. The method may further comprise activating the vaporiser only if the duration of the user inhalation exceeds the predefined duration threshold and the determined mass flow volume of the user inhalation exceeds the predefined mass flow volume threshold.

[0085] According to a fourth aspect, a computer-readable medium is provided containing instructions configured to, when executed by a processor or by an application installed on a mobile device, cause the processor or application to perform the method of the third aspect.

[0086] The invention includes the combination of the aspects and preferred features described except where such a combination is clearly impermissible or expressly avoided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0087] So that further aspects and features thereof may be appreciated, embodiments will now be discussed in further detail with reference to the accompanying figures, in which:

[0088] FIG. **1**A is a front schematic view of a smoking substitute system;

[0089] FIG. **1**B is a front schematic view of a device of the system;

[0090] FIG. **1**C is a front schematic view of a component of the system;

[0091] FIG. **2**A is a schematic of the electrical components of the device;

[0092] FIG. **2**B is a schematic of the parts of the component;

[0093] FIG. **3** is a further schematic of the component;

[0094] FIG. **4**A shows human lungs and diaphragm during inhalation;

[0095] FIG. **4**B shows human lungs and diaphragm during exhalation; and

[0096] and

[0097] FIG. **5** shows an improved method of controlling aerosol generation

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0098] Aspects and embodiments will now be discussed with reference to the accompanying figures. Further aspects and embodiments will be apparent to those skilled in the art.

[0099] FIG. **1**A shows a first embodiment of a smoking substitute system **100**. In this example, the smoking substitute system **100** includes a device **102** and a component **104**. The component **104** may alternatively be referred to as a "pod", "cartridge" or "cartomizer". It should be appreciated that in other examples (i.e. open systems), the device may be integral with the component. In such systems, a tank of the aerosol delivery system may be accessible for refilling the device.

[0100] In this example, the smoking substitute system **100** is a closed system vaping system, wherein the component **104** includes a sealed tank **106** and is intended for single-use only. The component **104** is removably engageable with the device **102** (i.e. for removal and replacement). FIG. **1**A shows the smoking substitute system **100** with the device **102** physically coupled to the component **104**, FIG. **1**B shows the device **102** of the smoking substitute system **100** without the component **104**, and FIG. **1**C shows the component **104** of the smoking substitute system **100** without the device **102**.

[0101] The device **102** and the component **104** are configured to be physically coupled together by pushing the component **104** into a cavity at an upper end **108** of the device **102**, such that there is an interference fit between the device **102** and the component **104**. In other examples, the device **102** and the component may be coupled by screwing one onto the other, or through a bayonet fitting.

[0102] The component **104** includes a mouthpiece portion at an upper end **109** of the component **104**, and one or more air inlets (not shown) in fluid communication with the mouthpiece portion such that air can be drawn into and through the component **104** when a user inhales through the mouthpiece portion. The tank **106** containing e-liquid is located at the lower end **111** of the component **104**.

[0103] The lower end **110** of the device **102** also includes a light **116** (e.g. an LED) located behind a small translucent cover. The light **116** may be configured to illuminate when the smoking substitute system **100** is activated and/or when

charging. Whilst not shown, the component **104** may identify itself to the device **102**, via an electrical interface, RFID chip, or barcode.

[0104] The lower end **110** of the device **102** also includes a charging connection **115**, which is usable to charge a battery within the device **102**. The charging connection **115** can also be used to transfer data to and from the device, for example to update firmware thereon.

[0105] FIGS. **2**A and **2**B are schematic drawings of the device **102** and component **104**. As is apparent from FIG. **2**A, the device **102** includes a power source **118**, a controller **120**, a memory **122**, a wireless interface **124**, an electrical interface **126**, and, optionally, one or more additional components **128**.

[0106] The power source **118** is preferably a battery, more preferably a rechargeable battery. The controller **120** may include a microprocessor, for example. The memory **122** preferably includes non-volatile memory. The memory may include instructions which, when implemented, cause the controller **120** to perform certain tasks or steps of a method.

[0107] The wireless interface **124** is preferably configured to communicate wirelessly with another device, for example a mobile device, e.g. via Bluetooth®. To this end, the wireless interface **124** could include a Bluetooth® antenna. Other wireless communication interfaces, e.g. WiFi®, are also possible. The wireless interface **124** may also be configured to communicate wirelessly with a remote server.

[0108] The electrical interface **126** of the device **102** may include one or more electrical contacts. The electrical interface **126** may be located in a base of the aperture in the upper end **108** of the device **102**. When the device **102** is physically coupled to the component **104**, the electrical interface **126** is configured to transfer electrical power from the power source **118** to the component **104** (i.e. upon activation of the smoking substitute system **100**).

[0109] The electrical interface **126** may also be used to identify the component **104** from a list of known components. For example, the component **104** may be a particular flavour and/or have a certain concentration of nicotine (which may be identified by the electrical interface **126**). This can be indicated to the controller **120** of the device **102** when the component **104** is connected to the device **102**. Additionally, or alternatively, there may be a separate communication interface provided in the device **102** and a corresponding communication interface in the component **104** such that, when connected, the component **104** can identify itself to the device **102**.

[0110] The additional components **128** of the device **102** may comprise the light **116** discussed above.

[0111] The additional components **128** of the device **102** also comprises the charging connection **115** configured to receive power from the charging station (i.e. when the power source **118** is a rechargeable battery). This may be located at the lower end **110** of the device **102**.

[0112] The additional components **128** of the device **102** may, if the power source **118** is a rechargeable battery, include a battery charging control circuit, for controlling the charging of the rechargeable battery. However, a battery charging control circuit could equally be located in a charging station (if present).

[0113] The additional components **128** of the device **102** may include a sensor, such as an airflow (i.e. puff) sensor for detecting airflow in the smoking substitute system **100**, e.g. caused by a user inhaling through a mouthpiece portion **136** of the component **104**. The smoking substitute system **100** may be configured to be activated when airflow is detected by the airflow sensor. This sensor could alternatively be included in the component **104**. The airflow sensor can be used to determine, for example, how heavily a user draws on the mouthpiece or how many times a user draws on the mouthpiece in a particular time period.

[0114] The additional components **128** of the device **102** may include a user input, e.g. a button. The smoking substitute system **100** may be configured to be activated when a user interacts with the user input (e.g. presses the button). This provides an alternative to the airflow sensor as a mechanism for activating the smoking substitute system **100**.

[0115] As shown in FIG. **2**B, the component **104** includes the tank **106**, an electrical interface **130**, a vaporiser **132**, one or more air inlets **134**, a mouthpiece portion **136**, and one or more additional components **138**.

[0116] The electrical interface **130** of the component **104** may include one or more electrical contacts. The electrical interface **126** of the device **102** and an electrical interface **130** of the component **104** are configured to contact each other and thereby electrically couple the device **102** to the component **104** when the lower end **111** of the component **104** is inserted into the upper end **108** of the device **102** (as shown in FIG. **1**A). In this way, electrical energy (e.g. in the form of an electrical current) is able to be supplied from the power source **118** in the device **102** to the vaporiser **132** in the component **104**.

[0117] The vaporiser **132** is configured to heat and vaporise e-liquid contained in the tank **106** using electrical energy supplied from the power source **118**. As will be described further below, the vaporiser **132** includes a heating filament and a wick. The wick draws e-liquid from the tank **106** and the heating filament heats the e-liquid to vaporise the e-liquid.

[0118] The one or more air inlets **134** are preferably configured to allow air to be drawn into the smoking substitute system **100**, when a user inhales through the mouthpiece portion **136**. When the component **104** is physically coupled to the device **102**, the air inlets **134** receive air, which flows to the air inlets **134** along a gap between the device **102** and the lower end **111** of the component **104**.

[0119] In operation, a user activates the smoking substitute system **100**, e.g. through interaction with a user input forming part of the device **102** or by inhaling through the mouthpiece portion **136** as described above. Upon activation, the controller **120** may supply electrical energy from the power source **118** to the vaporiser **132** (via electrical interfaces **126**, **130**), which may cause the vaporiser **132** to heat e-liquid drawn from the tank **106** to produce a vapour which is inhaled by a user through the mouthpiece portion **136**.

[0120] An example of one of the one or more additional components **138** of the component **104** is an interface for obtaining an identifier of the component **104**. As discussed above, this interface may be, for example, an RFID reader, a barcode, a QR code reader, or an electronic interface which is able to identify the component. The component **104** may, therefore 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 electronic interface in the device **102**.

[0121] It should be appreciated that the smoking substitute system **100** shown in FIGS. **1**A to **2**B is just one exemplary implementation of a smoking substitute system. For example, the system could otherwise be in the form of an entirely disposable (single-use) system or an open system in which the tank is refillable (rather than replaceable).

[0122] FIG. **3** is a schematic view of an example of the component **104** described above. The component **104** comprises a tank **106** for storing e-liquid, a mouthpiece portion **136** and a conduit **140** extending along a longitudinal axis of the component **104**. In the illustrated embodiment the conduit **140** is in the form of a tube having a substantially circular transverse cross-section (i.e. transverse to the longitudinal axis). The tank **106** surrounds the conduit **140**, such that the conduit **140** extends centrally through the tank **106**.

[0123] A component housing **142** defines an outer casing of the component **104**. The component housing **142** extends from a lower shell **158** at the lower end **111** of the component **104** to the mouthpiece portion **136** at the upper end **109** of the component **104**. The component housing may define a lip or shoulder which acts as a stop feature when the component **104** is inserted into the device **102** (i.e. by contact with an upper edge of the device **102**).

[0124] The tank **106**, the conduit **140** and the mouthpiece portion **136** are integrally formed with each other so as to form a single unitary component and may e.g. be formed by way of an injection moulding process. Such a component may be formed of a thermoplastic material.

[0125] The mouthpiece portion **136** comprises a mouthpiece aperture **148** defining an outlet of the conduit **140**. The vaporiser **132** is downstream of the inlet **134** of the component **104** and is fluidly connected to the mouthpiece aperture **148** (i.e. outlet) by the conduit **140**.

[0126] In some embodiments, the vaporiser **132** comprises a porous ceramic wick and a heater track (not shown) printed onto the bottom surface (facing the inlet **34**) of the ceramic wick.

[0127] The vaporiser **132** forms the base of the tank **106** so that the aerosol precursor is in contact with the wick and liquid aerosol precursor can move axially into the wick.

[0128] In other embodiments, the vaporiser **132** comprises a porous cylindrical wick with a coiled heating filament, the wick extending into an annular portion of the tank surrounding the vaporiser so that liquid aerosol precursor can move radially into the wick.

[0129] The aerosol precursor is heated by the heater track or heating filament (when activated e.g. by detection of inhalation), which causes the aerosol precursor to be vaporised and to be entrained in air flowing past the wick. This vaporised liquid may cool to form an aerosol in the conduit **140**, which may then be inhaled by a user.

[0130] The lower shell **158** of the component housing **142** has an opening that accommodates the electrical interface **119** of the consumable component **102** comprising two electrical contacts **136***a*, **136***b* that are electrically connected to the heater track. In this way, when the consumable component **104** is engaged with the device **102**, power can be supplied from the power source **118** of the device to the heater track/heating filament.

[0131] The improved aerosol generation system disclosed herein is configured for safer, more appropriate use. In particular, it is configured to prevent, or at least to reduce the chance of, the use of the aerosol generation system by a non-authorised user, for example by an underage user, such as a child. The improved aerosol generation system provides safer, more appropriate use by being configured only to activate its aerosol generation function when a predetermined user interaction with the device occurs. In particular, it is configured only to activate the aerosol generation function when a user inhalation on the device meets one or more predetermined conditions, or falls within one or more predetermined thresholds. One or more indicators may be used, by a processor or controller comprised within or associated with the improved aerosol generation system, to determine the occurrence of such an inhalation.

[0132] The present inventors have recognised that there are inherent physical differences between a typical adult inhalation on an aerosol delivery device and a typical non-adult (or, child) inhalation on an aerosol delivery device. These differences may be apparent in particular between adults and younger children, such as children below 6 years old, however the present disclosure is not limited to only distinguishing between adults and children in that age group.

[0133] It has been recognised herein that, when a person is inhaling on a device such as an aerosol delivery device, it is generally not enough to simply insert the mouthpiece of (or, the mouthpiece of a component connected to) such a device into your mouth and breathe normally, in order to draw sufficient air to generate the desired vapour or to inhale the vapour. Instead, some deliberate force or effort must be used during the inhalation action on an aerosol delivery device. Moreover, a relatively long inhalation (i.e., an inhalation of a relatively large duration, as compared to a typical involuntary inhalation) is usual when an adult inhales on an aerosol delivery device, in order to enable them to activate the vapour generation and also to inhale the vapour itself. Typically, adult users of aerosol delivery devices use "diaphragmatic breathing" when inhaling on an aerosol delivery device, which is a mode of breathing that requires the diaphragm to contract. This type of breathing is also known as "deep breathing".

[0134] It has further been recognised herein a child would typically not use diaphragmatic breathing, particularly in a non-typical or unfamiliar situation, such as if they attempted to inhale on an aerosol delivery device that had unintentionally been left within reach of an unsupervised child. Moreover, the present inventors have recognised that, if a non-authorised or underage user such as an unsupervised child attempted to inhale on an aerosol delivery device, and even if they did attempt diaphragmatic or deep breathing, they would not typically be capable of deep breathing with the same pressure or force as an adult could, nor to inhale for the same length of time as an adult typically could. Thus, it has been recognised herein that those differences in inhalation characteristics between adults and children may be used to control the "unlocking" or "activation" of an aerosol delivery device such as a smoking substitute device, and to thereby act as a "child lock" or safety mechanism, to help prevent unauthorised use of the aerosol delivery device, particularly by children. This is particularly important when the aerosol delivery device comprises a smoking substitute device containing tobacco or other substances that are harmful to children.

[0135] Diaphragmatic breathing, or deep breathing, can be understood further in relation to FIGS. **4**A and **4**B herein. The skilled person will be aware that, in human anatomy, the

diaphragm **302** is a naturally domed or "U-shaped" muscle that is located below the lungs **300**, within a person's chest cavity. As shown in FIG. **4**A, during an inhalation phase of "deep breathing" or "diaphragmatic breathing", the diaphragm **302** is contracted, which causes it to flatten and to physically drop, thus creating space in the chest cavity for the lungs **300** to expand. This increases the volume of the lung capacity and allows additional air to enter the lungs. This type of breathing typically also causes air to be drawn in, or inhaled, with a greater pressure or force than occurs during typical involuntary breathing motion, which tends to be shallower, and which tends to cause the diaphragm to flatten less, if at all. Diaphragmatic breathing may also cause the air to be inhaled with greater speed than is achieved with shallower breathing, and typically also causes the duration of an inhalation to increase as compared to the inhalations that occur during involuntary, shallower breathing.

[0136] It will be understood that diaphragmatic breathing requires physical strength and effort, and that, as a general rule, the increases that occur during diaphragmatic breathing (vis-à-vis shallower, involuntary breathing) in factors such as pressure, force, speed and duration of an inhale will be more pronounced (i.e., greater) for larger, more physically strong individuals than for smaller, weaker individuals. Moreover, those factors will typically increase in accordance with the amount of deliberate effort that the user applies to their inhalation.

[0137] FIG. **4**B shows the lungs **300** and diaphragm **302** during an exhalation phase of "deep breathing" or "diaphragmatic breathing". As can be seen therein, during exhalation, the diaphragm **302** relaxes and returns to its domed shaped, which decreases the volume of the lung capacity and causes air to passively leave the lungs. During use of an aerosol delivery device, this is the phase during which the user would typically exhale the vapours that they had previously inhaled.

[0138] The improved aerosol generation system disclosed herein is configured to only activate its vaporiser when one or more indicators suggest that an adult inhalation on the device has occurred (or, is currently occurring). According to embodiments, the improved aerosol device is configured to only activate its vaporiser when an inhalation of at least a predetermined duration occurs. As detailed above, the length (in units of time) of an inhale in one continuous breath would typically differ between adults and children. Thus, in embodiments, the improved aerosol device is configured to require an inhale over a certain length of time (i.e., duration) to occur, in order for the vaporiser to be activated. This enables the device to protect against accidental or non-authorised use by inappropriate users such as children.

[0139] An embodiment of the improved aerosol generation system can be understood in relation to FIGS. **2**A and **2**B. In this embodiment, the improved aerosol generation system comprises a reusable smoking substitute device **102**. A disposable/replaceable component **104** comprising a pod, cartomizer, or cartridge comprises a tank that is filled or fillable with aerosol precursor and is connectable to the device **102** for smoking substitute action. The disposable component **104** may be a single-use component or, more likely, it may be suitable for multiple uses, until its tank **106** is empty, at which point the component **104** may be disposed of and a replacement component **104** may instead be used for smoking substitute action in connection with the reusable device **102**. However, the improved aerosol generation system described herein—and the inhalation sensing and comparison methods described below—is not limited to this type of aerosol generation system, such that this embodiment should be regarded as being illustrative and not as being restrictive on the present disclosure.

[0140] In this embodiment, the smoking substitute system comprises an airflow sensor. The air flow sensor may be a single entity, or it may comprise multiple parts. In this embodiment, the air flow sensor is comprised within the "additional components" **128** of the smoking substitute device **102**. However, it is envisaged that the air flow sensor may, in some arrangements, be comprised within the component **104**, or it may comprise at least one part that is located within the device **102** and at least one part that is located within the component **104**, working in conjunction with one another.

[0141] In general terms, the air flow sensor is configured to sense one or more characteristics relating to a user inhalation of air from the smoking substitute system and to work in conjunction with the controller **120** to control activation of the vaporiser only when the user inhalation meets one or more predetermined conditions or thresholds. If the user inhalation is taken when the vaporiser is not yet in an active state, and that inhalation does not satisfy the specified limit(s) or threshold(s), the device **102** is configured not to recognise the inhalation as a suitable activation, such that the device **102** will remain in an idle/inactive state and will not generate aerosol vapour.

[0142] The air flow sensor comprises an air flow sensor that is arranged to detect an air flow through the smoking substitute system when a user inhales, for example via the mouthpiece portion **136** of a component **104** when it is connected to the device **102**. The air flow sensor may be of any suitable type and may comprise any suitable component parts. For example, the air flow sensor may be, or comprise, a mechanical-to-electrical sensor, a MEMS activation sensor, a pressure differential sensor, a mass flow sensor, a temperature sensor, a fluid velocity sensor, or a flow rate sensor, or any combination of these. The air flow sensor may comprise a microphone, such as a dynamic microphone, a condenser microphone, a capacitance microphone, or a piezoelectric microphone, or any combination of these. The air flow sensor (or another part of the device **102**) may comprise one or more moveable elements such as a moveable baffle, the movement of which may be measured to determine air flow characteristics for an inhale event.

[0143] In this embodiment, the air flow sensor comprises or is in connection/communication with a clock or timer so that the duration (i.e., length in units of time, from beginning to end) of the inhalation can be measured. For example, the clock may be comprised within the controller. The air flow sensor may be configured to detect the air flow and to generate a suitable signal, to enable the controller to determine the duration of the inhalation that caused the air flow.

[0144] The device **102** is configured to compare the duration of an inhale to a predetermined time limit or time threshold and to only allow the vaporiser **132** to be activated (e.g., for power to begin being supplied to operate the vaporiser **132**, for heating of the aerosol precursor in the wick) if the duration of the inhale is at least as long (in units of time) as that predetermined time limit or time threshold. For example, the controller **120** may be configured to conduct such a comparison and to control the issuance of

one or more control signals, in order to control activation and operation of the vaporiser **132**. The control signals may be sent either directly to the vaporiser **132** or, for example, to another element such as an electrical interface **126**, **130** or other node or connection point, to allow or prevent the supply of power to the vaporiser **132** for heating and aerosol generation. Therefore, the device **102** is configured not to allow activation of the vaporiser **132** if the duration of the inhale does not meet or exceed the predetermined time limit or time threshold.

[0145] The predetermined time limit or time threshold may be stored in the memory **122** and/or it may be communicated to the controller from a memory or other source, external to the device **102**.

[0146] The predetermined time limit or time threshold to which a user inhale is compared by the smoking substitute device **102** may be pre-determined before a user purchases the device **102**. For example, the manufacturer or programmer of the device **102** may store a predetermined time limit or time threshold for such a comparison in the memory **122** of the device **102**. The predetermined time limit may be 3 seconds, more preferably 4 seconds, more preferably 5 seconds.

[0147] Once the vaporiser **132** has been activated via a suitable inhalation, the device **102** is configured to continue operation of the vaporiser **132** at least for a predetermined period of time. It may be configured to deactivate the vaporiser **132** after that predetermined period of time and/or, for example, if no user activity has been detected (e.g., no inhalations have been detected) at least for a predetermined period of time.

[0148] The device **102** may be configured to conduct a comparison of the duration of the current inhale to the predetermined time limit or time threshold at certain selected times or in certain selected circumstances.

[0149] The device **102** is configured to conduct a comparison of the duration of the current inhale to the predetermined time limit or time threshold when the vaporiser **132** is currently in an inactive/idle state. For example, the device **102** may be configured to conduct the comparison for a first inhale after the smoking substitute system has been inactive (i.e., out of use) for at least a predetermined length of time. Such an embodiment may therefore require the user to apply a deliberately long inhale at the beginning of their smoking substitute action, in order to initiate activation of the vaporiser **132** after a period of inactivity, but thereafter enable the user to continue their smoking substitute action using shorter inhalations, and only to require another deliberately long inhale following a subsequent period of time (or a subsequent period of inactivity) of at least a predetermined duration.

[0150] The improved aerosol generating system disclosed herein is advantageous because the user and/or the manufacturer can set a relatively large time limit for the first inhalation, for example a time limit that exceeds the typical desired inhale duration for an adult (or, for that particular adult, if being set by the user), such as 3 seconds, more preferably 4 seconds, more preferably 5 seconds, thereby making it less likely that a non-authorised user such as a child would be able to (or would know to) make the physical effort required to initiate aerosol generation. However, after initial activation of the vaporiser **132** by an authorised adult user, that user would not have to continue applying such long inhalations in order to operate the smoking substitute system. Therefore, the authorised user can enjoy a smoking substitute action that suits their inhalation preferences at any given time, which may include shorter inhales, without compromising on the safety function that the device **102** is configured to provide. This also fits in with a common pattern of smoking substitute action, wherein a user may wish to apply a long inhale at the beginning of their smoking substitute action, to enjoy the effects of the vapour after a period of non-use of their device, but thereafter may be happy to take shorter inhales, or "puffs".

[0151] In some embodiments, the smoking substitute system may be configured to conduct more than one comparison before initiating activation of the vaporiser **132**. Any additional comparisons (details of which follow herebelow) may be required every time the vaporiser **132** is to be activated after a period of inactivity, or just at certain times or in certain conditions.

[0152] According to an embodiment, the device **102** is configured to carry out the inhale duration comparison detailed above and also to carry out a comparison with respect to a detected pressure force of the inhale, as compared to a predetermined pressure force limit or threshold. In such embodiments, the outcomes of both comparisons must be positive—i.e., the current inhale must be of a duration that meets or exceeds a predetermined length of time, and its pressure force must meet or exceed the predetermined pressure force limit—before the device **102** will allow activation of the vaporiser **132** for aerosol generation. The pressure force of an inhale may be detected by any suitable component. The pressure force limit may be pre-set by a manufacturer or programmer, or in some embodiments it may be possible for a user to set or select their own pressure force limit, for example during an initial set up process. A requirement for the outcome of two comparisons to be positive in order for vaporiser **132** activation to be permitted increases the reliability of the safety mechanism provided by the improved aerosol generating system disclosed herein, because it is less likely that a non-authorised user such as a child would be able to emulate both aspects of an adult's inhalation, and thereby activate the device. Requiring two comparisons also provides a fail-safe, in the event of a device error. That is, in the event that the sensing, measurement or comparison of one parameter (e.g., duration) to its respective threshold is inaccurate, the remaining requirement for the respective other parameter to also yield a positive comparison makes it less likely that a non-authorised user would be successful in any attempt to inappropriately activate the device **102**.

[0153] According to an embodiment, the device **102** is configured to carry out the inhale duration comparison detailed above and also to carry out a comparison with respect to a detected pressure differential or pressure drop, during (or as a result of) an inhale event, as compared to a predetermined pressure differential/drop limit or threshold. In such embodiments, the outcomes of both comparisons must be positive—i.e., the current inhale must be of a duration that meets or exceeds a predetermined length of time, and its pressure differential/drop must meet or exceed the predetermined pressure differential/drop limit—before the device **102** will allow activation of the vaporiser **132** for aerosol generation. The pressure differential/drop of an inhale may be detected by any suitable component. The pressure differential/drop limit may be pre-set by a manufacturer or programmer, or in some embodiments it may be

possible for a user to set their own pressure differential/drop limit, for example during an initial set up process. It may be of ay suitable magnitude. For example, the pressure differential/drop threshold may be 3 psi, more preferably 5 psi, more preferably 7 psi. However, the present disclosure is not limited to these values.

[0154] According to an embodiment, the device **102** is configured to carry out the inhale duration comparison detailed above and also to carry out a comparison with respect to a detected "capacity on inhale" (which may instead be referred to as a "mass flow volume" on inhale), as compared to a predetermined capacity on inhale limit or threshold. In such embodiments, the outcomes of both comparisons must be positive—i.e., the current inhale must be of a duration that meets or exceeds a predetermined length of time and the capacity on inhale must meet or exceed the predetermined capacity on inhale limit—before the device **102** will allow activation of the vaporiser **132** for aerosol generation. The capacity on inhale may be detected by any suitable component. The capacity on inhale limit may be pre-set by a manufacturer or programmer, or in some embodiments it may be possible for a user to set their own capacity on inhale limit, for example during an initial set up process. It may be of any suitable magnitude. For example, it may be 10 millilitres per second (ml/s), more preferably 20 ml/s, more preferably 30 ml/s. However, the present disclosure is not limited to these values.

[0155] The smoking substitute system may be configured to compare any two or more of the (i) detected pressure force; (ii) detected pressure differential/drop; or (iii) capacity on inhale/mass flow volume to respective limits or thresholds, in addition to comparing inhale duration to its respective duration limit, and to require positive outcomes from all of (or, for example, from at least two of) those comparisons, before activation of the vaporiser **132** for aerosol generation is permitted. The smoking substitute system may be configured to allow an authorised adult user to select which, if any, of the additional comparisons should be made, in addition to the inhalation duration comparison, and/or to set limits or thresholds for those comparisons.

[0156] Whilst the improved aerosol generating system is described above in relation to a closed-loop embodiment of a smoking substitute system, comprising a device and a disposable component containing aerosol precursor, the improvements described herein are not limited to such an embodiment, but may be employed for any suitable aerosol generation system that comprises an vaporiser, an air flow sensor and a controller, wherein the controller is configured to activate the vaporiser only when the duration of the user inhalation exceeds a predefined duration threshold, at least in certain circumstances and/or at least at certain times.

[0157] FIG. **5** summarises an improved method that the improved aerosol generating system disclosed herein is configured to provide. The method **400** is configured to be carried out by (or on behalf of) an aerosol generating system comprising a controller, an airflow sensor and an vaporiser as detailed hereabove.

[0158] The method **400** comprises, as a first step **410**, sensing a first user inhalation through the aerosol generating system. For example, the first user inhalation may be sensed by the air flow sensor.

[0159] At a second step **420**, the method **400** comprises determining a duration of the first user inhalation. This may be carried out using the airflow sensor or the controller or any other suitable clock, timer, or processor.

[0160] At a third step **430**, the method **400** comprises comparing the duration of the first user inhalation to a predefined duration threshold. For example, this may be carried out by the controller. The predefined duration threshold may be stored in any suitable memory that is associated with or in communication with the controller.

[0161] At a fourth step **440**, which is an optional step, the method **400** comprises comparing one or more other parameters associated with the first user inhalation to a respective predefined threshold. For example, that parameter may be pressure force, pressure differential (or pressure "drop") or mass flow volume (or, "capacity on inhale") as detailed above.

[0162] At a fifth step **450**, which is also optional and applies only if the optional fourth step **440** was carried out, the method **400** is allowed to continue to the sixth step only if the parameter considered at the fourth step **440** exceeds its respective predefined threshold (i.e., only if that optional comparison step **440** yielded a positive outcome).

[0163] At a sixth step **460**, the method **400** comprises activating vaporiser only if the duration of the first user inhalation exceeds the predefined duration threshold.

[0164] The method **400** may be repeated for one or more subsequent user inhalations on the aerosol generating system, as detailed in relation to the preceding figures, above.

[0165] The improved aerosol generation system and improved methods disclosed herein enable improved safety and reduce the chances of an aerosol generation device, such as a smoking substitute device, being used by a non-authorised or inappropriate user, in particular by a child such as a young child. This is achieved in a streamlined manner, using components that are commonly found in aerosol generation and delivery systems, such as an air flow sensor and a controller. Therefore, the overall cost, bulk and complexity of the system is comparable to conventional systems, even though enhanced safety is provided. At least in some embodiments, the aerosol generation system can require multiple comparisons to be made, and multiple positive outcomes to be provided, before activation of the vaporiser is enabled. Therefore, there can be multiple layers of safety, all associated with a user inhale. The components used to sense or detect parameters required for such comparisons are typically those which are, or which can be, routinely provided in an aerosol generation system, thus not adding overall cost or bulk or complexity to the system. However, despite the use of commonly-available components, the improved aerosol generation system disclosed herein provides improved safety by embodying the inventive recognitions made herein regarding inherent physical differences between the characteristics that can be expected for authorised (adult) users and non-authorised (underage, e.g., child) users, during one or more inhale events.

[0166] A controller can be configured to process the detected, sensed, or measured parameters during (or in relation to) an inhale event quickly, such that an authorised user should not perceive any delay when they inhale, before activation of the vaporiser, if the characteristics of their inhale meet the predetermined limits or thresholds, including an inhale duration threshold. Thus, safe operation of an aerosol generation system, such as a smoking substitute system, may be provided in a manner that is suitable to the user.

[0167] While exemplary embodiments have been described above, many equivalent modifications and variations will be apparent to those skilled in the art when given this disclosure. Accordingly, the exemplary embodiments set forth above are considered to be illustrative and not limiting.

[0168] 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.

[0169] 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%.

[0170] 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.

1. An aerosol generating system comprising a vaporiser, an air flow sensor configured to detect a user inhalation through the system, and a controller, wherein the controller is configured to activate the vaporiser only when the duration of the user inhalation exceeds a predefined duration threshold.

2. An aerosol generating system according to claim **1** further comprising a clock or timer configured for measuring the duration of the user inhalation.

3. An aerosol generating system according to claim **1** wherein the predefined duration threshold that the user inhalation must meet or exceed is greater than or equal to 2 seconds.

4. An aerosol generating system according to claim **1** further configured only to activate the vaporiser when a detected further user inhalation parameter exceeds a predefined further inhalation parameter threshold.

5. An aerosol generating system according to claim **4** wherein further user inhalation parameter is selected from one or more of: a pressure force of the user inhalation; a pressure differential/drop of the user inhalation; and a mass flow volume of the user inhalation.

6. An aerosol generating system according to claim **1** wherein the user inhalation is a first user inhalation detected by the air flow sensor and the controller is configured to activate the vaporiser only when the duration of a first user inhalation exceeds the predefined duration threshold.

7. An aerosol generating system according to claim **1** comprising a device for receiving a component for containing an aerosol precursor.

8. An aerosol generating system according to claim **7** further comprising the component for containing an aerosol precursor.

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14. An aerosol generating system according to claim **2** wherein the predefined duration threshold that the user inhalation must meet or exceed is greater than or equal to 2 seconds.

15. An aerosol generating system according to claim **2** further configured only to activate the vaporiser when a detected further user inhalation parameter exceeds a predefined further inhalation parameter threshold.

16. An aerosol generating system according to claim **3** further configured only to activate the vaporiser when a detected further user inhalation parameter exceeds a predefined further inhalation parameter threshold.

17. An aerosol generating system according to claim **14** further configured only to activate the vaporiser when a detected further user inhalation parameter exceeds a predefined further inhalation parameter threshold

18. An aerosol generating system according to claim **15** wherein further user inhalation parameter is selected from one or more of: a pressure force of the user inhalation; a pressure differential/drop of the user inhalation; and a mass flow volume of the user inhalation.

19. An aerosol generating system according to claim **16** wherein further user inhalation parameter is selected from one or more of: a pressure force of the user inhalation; a pressure differential/drop of the user inhalation; and a mass flow volume of the user inhalation.

20. An aerosol generating system according to claim **17** wherein further user inhalation parameter is selected from one or more of: a pressure force of the user inhalation; a pressure differential/drop of the user inhalation; and a mass flow volume of the user inhalation.

21. An aerosol generating system according to claim **2** wherein the user inhalation is a first user inhalation detected by the air flow sensor and the controller is configured to activate the vaporiser only when the duration of a first user inhalation exceeds the predefined duration threshold.

22. An aerosol generating system according to claim **3** wherein the user inhalation is a first user inhalation detected by the air flow sensor and the controller is configured to activate the vaporiser only when the duration of a first user inhalation exceeds the predefined duration threshold.

23. An aerosol generating system according to claim **14** wherein the user inhalation is a first user inhalation detected by the air flow sensor and the controller is configured to activate the vaporiser only when the duration of a first user inhalation exceeds the predefined duration threshold.

24. An aerosol generating system according to claim **4** wherein the user inhalation is a first user inhalation detected by the air flow sensor and the controller is configured to activate the vaporiser only when the duration of a first user inhalation exceeds the predefined duration threshold.

25. An aerosol generating system according to claim **15** wherein the user inhalation is a first user inhalation detected by the air flow sensor and the controller is configured to activate the vaporiser only when the duration of a first user inhalation exceeds the predefined duration threshold.

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