

(22) Date of filing: 07.02.2019

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an outlet for conveying an aerosol generated by the smoking substitute apparatus to a user; and
one or more electrodes for stimulating the user's tongue.



Description

Field of the Invention

[0001] The present invention relates to a mouthpiece for a smoking substitute apparatus, where the mouthpiece has an electrode for stimulating a user's tongue to simulate flavour delivery.

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 byproducts. There have been proposed various smoking substitute apparatuses in order to avoid the smoking of tobacco.

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

[0005] Smoking substitute apparatuses 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 odour and health risks associated with traditional smoking.

[0006] In general, smoking substitute apparatuses 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 with combustible tobacco products.

[0007] The popularity and use of smoking substitute apparatuses 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 apparatuses as desirable lifestyle accessories. There are a number of different categories of smoking substitute apparatuses, each utilising a different smoking substitute approach.

[0008] One approach 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 heating device (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 as well as nicotine and/or 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, as well as 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 apparatuses, which typically have a sealed tank and heating element. The tank 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 apparatuses include a main body which includes the power source, wherein the main body is configured to be physically and electrically coupled to a consumable including the tank and the heating element. In this way, when the tank of a consumable (or "cartridge") has been emptied, that consumable is disposed of. The main body can 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 apparatuses which typically have a tank that is configured to be refilled by a user. In this way the device can be used multiple times.

[0012] An example vaping smoking substitute apparatus is the myblu™ e-cigarette. The myblu™ e-cigarette is a closed system which includes a main body and a consumable (cartridge). 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, a sealed tank which contains e-liquid, as well as 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 device is activated when a microprocessor on board the main body detects a user inhaling through the mouthpiece. When the device is activated, electrical energy is supplied from the power source to the heating device, which heats e-liquid from the tank to produce a vapour which is inhaled by a user through the mouthpiece.

[0013] An alternative to 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.

[0014] 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.

[0015] A typical HT smoking substitute system may include a device and a consumable. The consumable may include the tobacco material. The device and consumable 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.

[0016] As the vapour passes through the consumable (entrained in the airflow) from the location of vapourisation to an outlet of the consumable (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.

[0017] For a smoking substitute device it is desirable to deliver nicotine into the user's lungs, where it can be absorbed into the bloodstream. As explained above, in the so-called "vaping" approach, e-liquid is heated by a heating device to produce an aerosol vapour which is inhaled by a user. Many e-cigarettes also deliver flavour to the user to enhance the experience. In such e-cigarettes, flavour compounds are contained in the e-liquid that is heated. However, toxicology restrictions are placed on the amount of flavour that can be contained in the e-liquid, and this can result in some e-liquid flavours delivering a weak and underwhelming taste sensation to consumers in the pursuit of safety. Further, there is a view that providing a flavourant as part of the e-liquid, such that the flavourant is vaporised with the e-liquid, may be disadvantageous.

[0018] There may be a need for improved design of smoking substitute apparatuses, in particular in regards to the delivery of flavour to a user.

[0019] The present disclosure has been devised in the light of the above considerations.

Summary of the Invention

[0020] At its most general, the present invention relates to a mouthpiece for a smoking substitute apparatus, the mouthpiece having one or more electrodes disposed thereon to stimulate a user's tongue. Using the one or more electrodes, the user's tongue may be stimulated to simulate a flavour sensation. Simulation of flavour may be controlled, for example, by controlling electrical and/or thermal signals provided to the user via the one or more electrodes. In this manner, the mouthpiece of the present invention may enable a smoking substitute apparatus to deliver flavour to the user via stimulation of the user's tongue, rather than through a chemical flavourant delivered by the smoking substitute apparatus. This may be

referred to as "digital" flavour simulation.

[0021] As a result, there may be no need to provide a chemical flavourant in the smoking substitute apparatus. For example, the smoking substitute apparatus may include an aerosol-former (e.g. e-liquid or tobacco material) which does not have any flavour additives therein.

[0022] The ability to deliver flavour without use of a chemical flavourant may have several benefits. First, it may avoid producing smells that are perceptible by people in the vicinity of a user of the smoking substitute apparatus. This may enable more discrete use of the smoking substitute apparatus. Second, it may avoid any potential health drawbacks associated with the use of chemical flavourants. Third, as no chemical flavourant is needed, it may be possible to reduce a size of the smoking substitute apparatus (e.g. because there is no need for a flavourant reservoir).

[0023] The simulated flavour may easily be changed by varying the stimulation provided to the user's tongue by the one or more electrodes. In this manner, a wide variety of flavour sensations may be achieved using a single mouthpiece, without having to use any flavourants. This may improve the versatility of the smoking substitute apparatus, as it may enable a user to easily change the flavour delivered by the apparatus on the fly (e.g. by controlling the simulated flavour through an application on a mobile device).

[0024] The present invention is based on the recent discovery that electrical and thermal signals applied to a user's tongue may be used to simulate flavour. Reference document 1 (cited below) explains how different electrical and thermal signals may be used to simulate different types of flavours.

[0025] By adjusting the electrical and/or thermal signals applied to the user's tongue, it may be possible to simulate sweet, sour, bitter and savoury taste modalities. Accordingly, by adjusting the electrical and/or thermal signals applied to the user's tongue it may be possible to simulate a wide range of flavours, including menthol, liquorice, chocolate, fruit flavour (including e.g. citrus, cherry etc.), vanilla, spice (e.g. ginger, cinnamon) and tobacco flavour.

[0026] According to a first aspect there is provided a mouthpiece for a smoking substitute apparatus, the mouthpiece comprising: an outlet for conveying an aerosol generated by the smoking substitute apparatus to a user; and one or more electrodes for stimulating the user's tongue. In this manner, the one or more electrodes may be used to stimulate the user's tongue when the user puts the mouthpiece in their mouth (e.g. to inhale an aerosol from the smoking substitute apparatus), in order to simulate a flavour sensation for the user. Thus, flavour delivery may be simulated when the user uses the smoking substitute apparatus, e.g. when the user inhales an aerosol from the smoking substitute apparatus.

[0027] The one or more electrodes may be disposed on an outer surface of the mouthpiece. The one or more electrodes may be arranged to contact the user's tongue

when the mouthpiece is inserted into the user's mouth.

[0028] The outlet may serve to convey an aerosol from the smoking substitute apparatus to the user, when the mouthpiece is assembled with the smoking substitute apparatus. The outlet may be arranged such that, when the mouthpiece is assembled with the smoking substitute apparatus, the outlet is in fluid communication with an aerosol-conveying passage in the smoking substitute apparatus. In some embodiments, the mouthpiece may be a part or component of the smoking substitute apparatus, e.g. it may be an integral part of the smoking substitute apparatus. In other embodiments, the mouthpiece may be removably mountable on the smoking substitute apparatus or a component thereof.

[0029] Different electrode arrangements may be used, depending on the type of stimulation used. The one or more electrodes may include multiple electrodes arranged to contact different parts of the user's tongue, in order to stimulate different parts of the user's tongue. This may enable a flavour sensation to be produced over a larger area of the user's tongue.

[0030] The one or more electrodes may include one or more electrodes arranged to electrically stimulate the user's tongue. Electrical stimulation of the user's tongue may, for example, include application of a voltage and/or a current to the user's tongue. Electrical stimulation of the user's tongue may result in the user experiencing a flavour sensation on their tongue, and so may be used to simulate flavour. The flavour simulation may be controlled by controlling an electrical signal (e.g. voltage or current) delivered to the tongue via the one or more electrodes. Different electrical signals delivered to the user's tongue may result in different flavour sensations for the user. Properties of the electrical signal delivered to the user's tongue such as voltage, current level, frequency, etc. may be varied to simulate different flavours.

[0031] The one or more electrodes arranged to electrically stimulate the user's tongue may include a pair of electrodes. The pair of electrodes may be arranged to pass an electrical current through the user's tongue. In this manner, the user's tongue may be stimulated by passing a current through a part of the user's tongue located between the pair of electrodes. Preferably the current may be delivered to user's tongue in pulses. Parameters such as magnitude of the current, pulse duration, and/or pulse frequency may be controlled to simulate a desired flavour.

[0032] Additionally or alternatively, the pair of electrodes may also enable two different parts of the user's tongue to be stimulated, e.g. by applying voltage pulses to the electrodes or by changing a temperature of the electrodes.

[0033] The pair of electrodes may include a first electrode and a second electrode arranged on opposite sides of the mouthpiece relative to the outlet. In other words, the first electrode and second electrode may be disposed on either side of the outlet. This may enable substantially uniform stimulation of the user's tongue around the outlet,

which may enhance the flavour sensation experienced by the user.

[0034] At least part of the one or more electrodes may be disposed on a forward-facing surface of the mouthpiece. This may facilitate bringing the one or more electrodes into contact with the user's tongue when the user inserts the mouthpiece into their mouth. The forward-facing surface may be a surface that, in use, is oriented towards the user. The outlet may be formed in the forward-facing surface.

[0035] At least part of the one or more electrodes may be disposed on a lateral-facing surface of the mouthpiece. In other words, part of the one or more electrodes may be disposed on a side surface of the mouthpiece. This may facilitate bringing the one or more electrodes into contact with the user's tongue when the user inserts the mouthpiece into their mouth, as the tongue is typically located near a side of the mouthpiece. The lateral-facing surface may be a surface of the mouthpiece that is substantially aligned with a longitudinal axis of the mouthpiece.

[0036] The one or more electrodes may include one or more electrodes arranged to thermally stimulate the user's tongue. Thermal stimulation of the user's tongue may involve varying a temperature of the one or more electrodes (e.g. heating or cooling an electrode) to cause a temperature change at a location on the user's tongue. A local temperature change on a user's tongue may result in a flavour sensation on the user's tongue. Flavour simulation may thus be controlled by controlling or varying a temperature of an electrode on the mouthpiece.

[0037] The mouthpiece may include a temperature actuator for varying a temperature of the one or more electrodes arranged to thermally stimulate the user's tongue. The temperature actuator may be thermally coupled to the one or more electrodes arranged to thermally stimulate the user's tongue, so that a change in temperature of the temperature actuator may cause a change in temperature of the one or more electrodes. The temperature actuator may, for example, include a heater connected to the one or more electrodes arranged to thermally stimulate the user's tongue. Heating of the one or more electrodes may then be varied by controlling the heater (e.g. by controlling power supplied to the heater). As another example, a Peltier module may be used to vary the temperature of the one or more electrodes. A Peltier module may enable both heating and cooling of the electrodes, which may enable more rapid and accurate control of the temperature. In some cases, a temperature sensor may be connected to the one or more electrodes arranged to thermally stimulate the user's tongue, to monitor the temperature of the one or more electrodes. The temperature actuator may then be controlled based on an output from the temperature sensor (e.g. to bring the one or more electrodes to a desired temperature).

[0038] The mouthpiece may further include a connection interface for receiving a stimulation signal from the smoking substitute apparatus, to enable stimulation of the user's tongue based on the received stimulation sig-

nal. For example, the stimulation signal may be an electrical signal which may be applied to the user's tongue via the one or more electrodes. In this case, the connection interface may include an electrical connector for electrically connecting the one or more electrodes to a power supply and/or controller in a main body of the smoking substitute apparatus that generates the stimulation signal. In another example, the stimulation signal may be an electrical signal for activating or controlling the thermal actuator. In this case, the connection interface may include an electrical connector for electrically connecting the thermal actuator to a power supply and/or controller in the main body of the smoking substitute apparatus that generates the stimulation signal.

[0039] Where the mouthpiece is removably mountable in the smoking substitute apparatus, the connection interface may be configured to engage a corresponding connection interface in the smoking substitute apparatus when the mouthpiece is mounted in the smoking substitute apparatus. In this manner, the stimulation signal may be conveyed from a power supply and/or controller in the smoking substitute apparatus that generates the stimulation signal to the mouthpiece.

[0040] According to a second aspect of the invention, there is provided a smoking substitute apparatus including a mouthpiece according to the first aspect of the invention.

[0041] The smoking substitute apparatus may be in the form of a consumable. The consumable may be configured for engagement with a main body (i.e. so as to form 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-consumable components (e.g. power supply, controller, sensor, etc.) that facilitate the delivery of aerosol by the consumable. In such an embodiment, the aerosol former (e.g. e-liquid) may be replenished by replacing a used consumable with an unused consumable.

[0042] 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 former (rather than replacing a consumable component of the apparatus).

[0043] 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 (i.e. when the smoking substitute apparatus is in the form of a consumable).

[0044] 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.

[0045] 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.

[0046] The smoking substitute apparatus may comprise a reservoir configured to store an aerosol former, such as an e-liquid. The e-liquid may, for example, comprise a base liquid and e.g. nicotine. The base liquid may include propylene glycol and/or vegetable glycerine. The e-liquid may be flavourless. That is, the e-liquid may not contain any flavourants and may consist solely of a base liquid of propylene glycol and/or vegetable glycerine and nicotine.

[0047] The reservoir may be in the form of a tank. At least a portion of the tank may be translucent. 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 translucent 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.

[0048] 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. In this respect, the tank may surround the passage.

[0049] 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. A portion of the wick may be exposed to fluid 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 a central portion (between the ends) may extend across the passage so as to be exposed to fluid flow in the passage. Thus, fluid may be drawn (e.g. by capillary action) along the wick, from the reservoir to the exposed portion of the wick.

[0050] 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). The filament may be wound about the exposed

portion of the wick. The heating element may be electrically connected (or connectable) to a 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 fluid flowing through the passage. This vapour may subsequently cool to form an aerosol in the passage.

[0051] 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 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.

[0052] 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 may be configured to transfer electrical power from the power source to a heater of the consumable.

[0053] The electrical interface 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.

[0054] Again, where the smoking substitute apparatus is in the form of a consumable, the main body may comprise an 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 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 interface.

[0055] The smoking substitute apparatus or main body may comprise a controller, which may include a micro-processor. 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.

[0056] 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.

[0057] 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 form part of the consumable or the main body

[0058] The mouthpiece may be removably mountable on the smoking substitute apparatus.

[0059] Where the mouthpiece is provided as part of a consumable that is engageable with a main body, the consumable may include separate sets of electrical contacts for connecting the one or more electrodes and the heater to the main body.

[0060] In some embodiments, the smoking substitute apparatus may be configured to generate a vapourless aerosol. This may avoid the risk of "passive vaping" by people in a vicinity of a user of the smoking substitute apparatus. Using an aerosol-former that produces a vapourless aerosol in combination with the mouthpiece of the invention may enable a user to use the smoking substitute apparatus without emitting any smells or vapours. Thus, use of the smoking substitute apparatus may be completely "invisible", so that the apparatus may be used discretely and without affecting others.

[0061] For example, the smoking substitute apparatus may include a receptacle for receiving a nicotine-imbued porous substrate; and a heater arranged to heat an air-flow passing through a nicotine-imbued porous substrate received in the receptacle. In this manner, the heater may heat an air flow passing through the nicotine-imbued porous substrate to produce a vapourless nicotine aerosol. As an example, the receptacle may be arranged such that the nicotine-imbued porous substrate is disposed in the passage in the apparatus, such that heated air flowing through the passage may pass through the nicotine-imbued substrate to form an aerosol. The heater may be located downstream of the substrate. The nicotine-imbued substrate may be flavourless (i.e. it does not contain any flavourant additive), such that flavour is delivered to the user solely through the one or more electrodes on the mouthpiece.

[0062] Where the smoking substitute apparatus includes a controller, the controller may be configured to

control a stimulation signal provided to the one or more electrodes in the mouthpiece for stimulating the user's tongue. The controller may thus be used to control stimulation of the user's tongue via the one or more electrodes, to simulate a desired flavour. In this manner, flavour simulation may be controlled in real-time while a user is using the smoking substitute apparatus. Control of the stimulation signal by the controller may refer to generating and/or adjusting the signal. For example, the controller may adjust the stimulation signal, to vary the simulated flavour experience by the user.

[0063] The stimulation signal may be a signal (e.g. an electrical or thermal signal) that is provided to the one or more electrodes to stimulate the user's tongue to simulate a flavour. The stimulation signal may be generated by the controller itself, or via a separate component. For example, the controller may control a power supply of the smoking substitute apparatus to generate an electrical signal produced by the power supply.

[0064] The controller may be further configured to, in response to the user inhaling an aerosol from the smoking substitute apparatus, generate the stimulation signal provided to the one or more electrodes to stimulate the user's tongue. In this manner, the user's tongue may be automatically stimulated to simulate flavour when the user inhales an aerosol from the smoking substitute apparatus. For example, the smoking substitute apparatus may include a puff sensor for detecting when the user is inhaling through the mouthpiece (the puff sensor is discussed in more detail below). When such an event is detected, the controller may then generate the stimulation signal to stimulate the user's tongue. When no inhalation is detected, no stimulation signal may be generated, so that the user's tongue is not stimulated.

[0065] Where the one or more electrodes of the mouthpiece include one or more electrodes arranged to electrically stimulate the user's tongue; the stimulation signal may include an electrical current; and the controller may be configured to control one or more of a magnitude of the electrical current, a pulse duration of the electrical current, and a pulse frequency of the electrical current. In this manner, the user's tongue may be stimulated by passing an electrical current through the user's tongue. Properties of the current such as magnitude, pulse duration and pulse frequency may be varied to vary the simulated flavour experienced by the user. The controller may be configured to adjust these properties of the electrical current to predetermined values, in order to simulate a desired flavour. The controller may include a pulse generator for generating a pulsed current as the stimulation signal. A pulse width modulator may be used to control the frequency and width of the pulses. For example, the pulsed current may have a square-wave pulses.

[0066] Alternatively or additionally, the stimulation signal may include a voltage signal. For example, pulsed voltages may be applied to the user's tongue to simulate a desired flavour.

[0067] Where the one or more electrodes of the mouth-

piece include one or more electrodes arranged to thermally stimulate the user's tongue, the stimulation signal may be configured to cause a temperature change of the one or more electrodes that are arranged to thermally stimulate the user's tongue. In this manner, the user's tongue may be stimulated by varying a temperature of the one or more electrodes. For example, the stimulation signal may be arranged to vary a temperature of a temperature actuator (e.g. heater, Peltier module) which is thermally coupled to the one or more electrodes, thereby varying the temperature of the one or more electrodes. For example, the stimulation signal may be a current which is delivered to a heater to cause an increase in temperature of the heater.

[0068] The smoking substitute apparatus may include a temperature sensor arranged to monitor a temperature of the one or more electrodes. The controller may then be configured to adjust the stimulation signal delivered to the thermal actuator based on an output from the temperature sensor (e.g. to reach a desired temperature set-point).

[0069] In some embodiments, the mouthpiece may include electrodes arranged to electrically stimulate the user's tongue and electrodes arranged to thermally stimulate the user's tongue. This may enable a combination of electrical and thermal stimulation of the user's tongue, which may provide enhanced flavour simulation. In such an embodiment, the controller may be configured to generate separate stimulation signals for electrical stimulation and thermal stimulation.

[0070] More generally the one or more electrodes of the mouthpiece may include multiple sets of electrodes arranged to stimulate different parts of the user's tongue. The controller may then be configured to provide separate stimulation signals for each of the multiple sets of electrodes, so that different stimulations may be provided to different parts of the user's tongue. This may enable a more complex and realistic flavour simulation.

[0071] In a fourth aspect of the invention, the smoking substitute apparatus of the third aspect of the invention may be part of a smoking substitute system. Accordingly, the fourth aspect of the invention provides a smoking substitute system comprising: a smoking substitute apparatus according to the third aspect of the invention; and a mobile device, the mobile device being communicatively coupled to the controller of the smoking substitute apparatus; wherein the mobile device is configured to transmit a control signal to the controller; and wherein the controller is configured to control the stimulation signal based on the control signal received from the mobile device.

[0072] In this manner, a user may control the flavour simulation produced by the mouthpiece via the mobile device (e.g. via software installed on the mobile device). This may facilitate use of the smoking substitute apparatus, and enable easy and rapid change of the simulated flavour. This may also simplify construction of the smoking substitute apparatus, as it may avoid the need of in-

cluding a selection mechanism for selecting a flavour directly on the smoking substitute apparatus.

[0073] The mobile device may be communicatively coupled to the controller via a wireless connection (e.g. Bluetooth, Wi-Fi) or via a wired connection (e.g. USB). The mobile device and controller being communicatively coupled may mean that the mobile device and controller are capable of exchanging data (e.g. transmitting data to, and receiving data from, one another).

[0074] The mobile device may be any suitable computing device, e.g. smartphone, tablet computer, laptop computer, etc. The mobile device may include software installed thereon for remotely controlling the smoking substitute apparatus. The mobile device may be configured to receive data from the smoking substitute apparatus (e.g. usage data), so that a user may monitor usage of their apparatus.

[0075] The control signal transmitted by the mobile device may include instructions which cause the controller to control the stimulation signal in a desired manner (e.g. to simulate a desired flavour). For example, the control signal may include an indication of parameters for the stimulation signal. Upon receipt of the control signal, the controller controls the stimulation signal based on the control signal. For example, the controller may generate a stimulation signal having parameters specified in the control signal received from the mobile device.

[0076] The mobile device may store sets of parameters of stimulation signals corresponding to various simulated flavours. To cause simulation of a desired flavour, the mobile device may then transmit a control signal include the parameters for the stimulation signal associated with the desired flavour. In this manner, parameters for the stimulation signals may be stored in the mobile device, rather than in the smoking substitute apparatus. In some cases, the mobile device may be configured to access an online library (e.g. in "the cloud"), which includes indications of stimulation signal parameters for various different flavours.

[0077] The mobile device may be further configured to generate a user interface enabling selection of a flavour; and, in response to a user selecting a flavour via the user interface, generate the control signal based on the flavour selected by the user. In this manner, a user may selected the flavour simulated by the smoking substitute apparatus directly on the mobile device. This may enable the user to easily change the simulated flavour "on the fly". The user interface generated by the mobile device may include a series of selectable flavour options. When the user selects one of the flavour options, the mobile device may transmit a corresponding control signal to the controller, so that a corresponding stimulation signal is generated to cause stimulation of the user's tongue via the one or more electrodes on the mouthpiece.

[0078] The mobile device may be further configured to perform a calibration procedure including: transmitting a test control signal to the controller to cause the controller to control the stimulation signal based on the test control

signal; and receiving from a user, via a user interface on the mobile device, an indication of a flavour perceived by the user. Different users may respond differently to stimulation via the one or more electrodes. For instance, different users may experience different flavour sensations when a same stimulation signal is used, e.g. due to differences in how the different users perceive taste. Therefore it may be beneficial to calibrate stimulation of a user's tongue for each user, to ensure accurate flavour simulation.

[0079] Thus, the mobile device may transmit a test control signal to the controller to stimulate the user's tongue. The test control signal may, for example, correspond to a test flavour. The user may then record, via the user interface on the mobile device, what flavour they experienced when their tongue was stimulated. The user interface may include multiple selectable options corresponding to possible flavours experienced by the user. The mobile device may record the user's response.

[0080] This procedure may be repeated for multiple different test control signals, with the user indicating each time via the user interface the flavour which they perceived. In this manner, it may be possible to build up a mapping between the different control signals and flavours experienced by the user. This mapping may then be used to when generating a control signal to simulate a desired flavour. As a result, flavours may be simulated more accurately for the user, as generation of the control signal may take into account how the user responded to previous simulations.

[0081] The mobile device may be further configured to adjust the test control signal transmitted to the controller, based on the indication received from the user. In this manner, the control signal may be adjusted in real-time based on the user's response. The control signal may be adjusted until the user indicates that a desired flavour is perceived by the user. This may enable fine-tuning of the flavour simulation, so that a desired flavour may be accurately simulated for that user.

[0082] According to a fifth aspect of the invention, there is provided a method of simulating flavour delivery to a user of a smoking substitute apparatus, the smoking substitute apparatus having a mouthpiece with an outlet for conveying an aerosol generated by the smoking substitute apparatus to the user and one or more electrodes arranged to stimulate the user's tongue, the method comprising stimulating the user's tongue via the one or more electrodes to simulate a flavour. In this manner, flavour delivery may be simulated via the one or more electrodes when the user inhales an aerosol from the smoking substitute apparatus. The method of the fifth aspect may be used with the smoking substitute apparatus, cartridge and/or mouthpiece of the previous aspects of the invention. Features of the previous aspects of the invention may be shared with the fifth aspect of the invention, and are therefore not repeated.

[0083] The method may further comprise: receiving a flavour selection from the user of the smoking substitute

system; controlling, based on the flavour selection, a stimulation signal provided to the one or more electrodes to simulate the selected flavour. In this manner, a user may select a flavour simulated by the smoking substitute system.

[0084] The method may further comprise performing a calibration procedure which includes the steps of: controlling the stimulation signal to simulate a test flavour; and receiving, from the user, an indication of a flavour perceived by the user. The calibration procedure may further include adjusting the stimulation signal based on the indication received from the user. The calibration procedure may be similar to the calibration procedure discussed above in relation to the smoking substitute system.

[0085] The method may further comprise steps described above in relation to the mobile device, the controller and/or the smoking substitute system.

[0086] 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

[0087] 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 1A is a front view of a smoking substitute apparatus, according to a first embodiment of the invention, in an engaged position;

Figure 1B is a front view of smoking substitute apparatus of the first embodiment in a disengaged position;

Figure 1C is a section view of a cartridge according to an embodiment;

Figure 2 is schematic cross-sectional view of a smoking substitute apparatus according to an embodiment of the invention; and

Figure 3 is a diagrammatic representation of a smoking substitute system according to an embodiment of the invention.

Detailed Description of the Invention

[0088] 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. All documents mentioned in this text are incorporated herein by reference.

[0089] Figures 1A and 1B illustrate a smoking substitute apparatus 101 in the form of an e-cigarette. The apparatus 101 comprises an e-cigarette device defining a main body 102 of the apparatus 101, and a cartridge 103 in the form of an e-cigarette consumable (or "pod"). In the illustrated embodiment the cartridge 103 (or aerosol delivery device) is removable from the main body (e-cigarette device), so as to be a replaceable component of the apparatus 101. In other words, the e-cigarette 101 is a "closed system" smoking substitute apparatus. An expanded schematic cross-sectional view of the cartridge is shown in Fig. 1C.

[0090] As is apparent from Figures 1A and 1B, the cartridge 103 is configured to engage the main body 102. Figure 1A shows the main body 102 and the cartridge 103 in an engaged state, whilst Figure 1B shows the main body 102 and the cartridge 103 in a disengaged state. When engaged, a portion of the cartridge 103 is received in a cavity of the main body 102 and is retained in the engaged position by way of a snap-engagement mechanism. In other embodiments, the main body 102 and cartridge 103 may be engaged by screwing one into (or onto) the other, through a bayonet fitting, or by way of an interference fit.

[0091] The apparatus 101 is configured to vaporise an aerosol-former, which in the illustrated embodiment, is in the form of a nicotine-based e-liquid 104. The e-liquid 104 comprises nicotine and a base liquid including propylene glycol and/or vegetable glycerine. In the present embodiment, the e-liquid 104 is flavourless (and does not include any added flavourant). That is, if the e-liquid 104 were to be inhaled (i.e. in aerosol form) by a user, it would not have a particularly perceptible flavour or taste.

[0092] As is more apparent from Figure 1C, this e-liquid 104 is stored within a reservoir (receptacle) in the form of a tank 105 that forms part of the cartridge 103. In the illustrated embodiment, the cartridge 103 is a "single-use" cartridge 103. That is, upon exhausting the e-liquid 104 in the tank 105, the intention is that the user disposes of the entire cartridge 103. In other embodiments, the e-liquid (i.e. aerosol former) 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).

[0093] The tank 105 surrounds, and thus defines a portion of, a passage 106 that extends between an inlet 107 and an outlet 108 at opposing ends of the cartridge 103. In this respect, the passage comprises an upstream end at the end of the cartridge 103 that engages with the main body 102, and a downstream end at an opposing end of the cartridge 103 that comprises a mouthpiece 109 of the apparatus 101. When the cartridge 103 is engaged with the main body 102, a user can inhale (i.e. take a puff) via the mouthpiece 109 so as to draw air through the passage 106, and so as to form an airflow (indicated

by arrows) in a direction from the inlet 107 to the outlet 108 of the passage 106. Although not illustrated, the passage 106 may be partially defined by a tube (e.g. a metal tube) extending through the cartridge 103. The passage 106 is in fluid communication with a gap defined between the cartridge 103 and the main body 102 (when engaged) such that air outside of the system 101 is drawn into the passage 106 (during an inhale).

[0094] The smoking substitute apparatus 101 is configured to vaporise the e-liquid 104 for inhalation by a user. To provide this, the cartridge 103 comprises a heater having of a porous wick 110 and a resistive heating element in the form of a heating filament 111 that is helically wound around a portion of the porous wick 110. The porous wick 110 extends across the passage 106 (i.e. transverse to a longitudinal axis of the passage 106) and opposing ends of the wick 110 extend into the tank 105 (so as to be submerged in the e-liquid 104). In this way, e-liquid 104 contained in the tank 105 is conveyed from the opposing ends of the porous wick 110 to a central portion of the porous wick 110 so as to be exposed to the airflow in the passage 106 (i.e. caused by a user inhaling). In other embodiments the heating filament 111 and/or wick 110 may form part of the main body (but may engage the tank 105 during engagement of the main body 102 and the cartridge 103).

[0095] The helical filament 111 is wound about this exposed central portion of the porous wick 110 and is electrically connected to an electrical interface in the form of electrical contacts 112 mounted at the end of the cartridge that is proximate the main body 102 (when engaged). When the cartridge 103 is engaged with the main body 102, the electrical contacts 112 contact corresponding electrical contacts (not shown) of the main body 102. The main body electrical contacts are electrically connected to a power source (not shown) of the main body 102, such that (in the engaged position) the filament 111 is electrically connected to the power source. In this way, power can be supplied by the main body 102 to the filament 111 in order to heat the filament 111. This heat is transferred from the filament 111 to the porous wick 110 which causes e-liquid 104 conveyed by the porous wick 110 to increase in temperature to a point at which it vaporises. The vaporised e-liquid becomes entrained in the airflow and, between the vaporisation point at the filament 111 and the outlet 108 of the passage 106, condenses to form an aerosol. This aerosol is then inhaled, via the mouthpiece 109, by a user of the system 101.

[0096] The power source of the main body 102 may be in the form of a battery (e.g. a rechargeable battery). The main body 102 may comprise a connector in the form of e.g. a USB port for recharging this battery. The main body 102 also comprises a controller (not shown) that controls the supply of power from the power source to the main body electrical contacts (and thus to the filament 111). 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

111. In this way, the filament 111 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 102 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.

[0097] Although not shown, the main body 102 and cartridge 103 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 cartridge 103 engaged with the main body 102. In this respect, the cartridge 103 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.

[0098] The controller may further comprise a communication interface for communicating with an external device. For example, the controller may include a wireless interface for wireless communication (e.g. Bluetooth, Wi-Fi) or a wired interface for wired communication (e.g. USB).

[0099] The mouthpiece 109 of the cartridge 103 includes a pair electrodes 120, 122 for stimulating a user's tongue to simulate flavour delivery. The electrodes 120, 122 are arranged on either side of the outlet 108 in the mouthpiece 109. The electrodes 120, 122 are exposed on an outer surface of the mouthpiece. Each of the electrodes 120, 122 includes a first portion disposed on a forward-facing surface 124 of the mouthpiece 109, and a second portion disposed on a later-facing surface 126 of the mouthpiece 109. Such a layout of the electrodes 120, 122 may serve to increase a contact area between the electrodes 120, 122 and the user's tongue, to improve quality of flavour simulation.

[0100] The pair of electrodes 120, 122 is arranged to electrically stimulate the user's tongue by passing a current through a portion of the user's tongue located between the pair of electrodes 120, 122. The electrodes 120, 122 are connected to respective electrical contacts 128 disposed on a side of the cartridge 103. The electrodes 120, 122 are connected to the electrical contacts 128 via wires 130 which extend through a portion of the cartridge 103. When the cartridge 103 is engaged with the main body 102, the electrical contacts 128 contact corresponding electrical contacts (not shown) of the main body 102. The corresponding electrical contacts of the main body 102 are connected to the controller in the main body 102. In this manner, when the cartridge 103 is engaged with the main body 102, a stimulation signal generated by the controller may be transmitted to the electrodes 120, 122 to stimulate the user's tongue.

[0101] The controller is configured to generate and control a stimulation signal that is transmitted to the electrodes 120, 122 when the cartridge 103 is engaged with

the main body 102. In this embodiment, the stimulation signal generated by the controller is an electrical current which is to be passed through the user's tongue via the electrodes 120, 122 to stimulate the user's tongue. The controller may, for example, generate and control the stimulation signal by controlling a voltage applied across the electrodes by the power supply in the main body. The controller may control (e.g. adjust) the stimulation signal to simulate a desired flavour.

[0102] As an example the stimulation signal may include current pulses which are delivered to the user's tongue via the pair of electrodes 120, 122. The controller may adjust parameters of the current pulses including magnitude of the current pulses, pulse duration, and pulse frequency to simulate a desired flavour, as a simulated flavour perceived by the user may depend on these parameters.

[0103] Example currents that may be passed through the user's tongue to simulate flavour may include currents having a magnitude between 10 μ A and 500 μ A (preferably between 20 μ A and 200 μ A), and pulse frequencies between 50 Hz and 1200 Hz. The current pulses may, for example, be square wave pulses. The pulses may be generated using pulse-width modulation techniques.

[0104] Of course, these parameters may be adapted to a given user's physiology and sensitivity to electrical stimulation via the electrodes.

[0105] The controller may be configured to generate and transmit a stimulation signal to the electrodes 120, 122 when the puff sensor detects that the user is using the smoking substitute apparatus 101. In this manner, when a user puffs on the apparatus 101, the controller may simultaneously activate the heater (filament 111) to generate an aerosol from the e-liquid 104, and transmit a stimulation signal to the electrodes 120, 122 to simulate a flavour for the user. Thus, the user may experience simulated flavour delivery via the electrodes 120, 122 whilst they puff on the apparatus 101.

[0106] In the example shown, the electrodes 120, 122 are arranged to electrically stimulate the user's tongue. In other examples, one or both of the electrodes 120, 122 may be arranged to thermally stimulate the user's tongue (in addition or alternatively to electrical stimulation). For example, a temperature actuator (e.g. heater or Peltier module) may be provided in the mouthpiece 109 and thermally coupled to one of the electrodes, to cause a temperature change (e.g. temperature increase or decrease) of the electrode. The controller may be configured to transmit a stimulation signal (e.g. an electrical current or voltage) to the thermal actuator, to vary the temperature of the thermal actuator and hence thermally stimulate the user's tongue via the electrode.

[0107] Thermally stimulating the user's tongue may involve varying the temperature of one or both of the electrodes 120, 122 between 20°C and 35°C.

[0108] Fig. 2 shows a schematic cross-sectional view of a vapourless smoking substitute apparatus 201 that

is another embodiment of the invention. The apparatus 201 includes many components which correspond to those described above in relation to apparatus 101. Components of apparatus 201 which correspond to those already described in relation to apparatus 101 are given the same reference numeral as in Figs. 1A-1C and are not described again.

[0109] As can be seen in Fig. 2, apparatus 201 includes a battery 204 (e.g. rechargeable battery) and a controller 206 connected to the battery 204, both of which are located in its main body 102.

[0110] Instead of an e-liquid, the cartridge 103 of apparatus 201 includes a porous substrate 208 that is imbued with nicotine liquid. The porous substrate 208 may be any suitable porous material, e.g. a cloth, mesh, sponge or the like. The porous substrate 208 is disposed in a receptacle 210 of the cartridge 103. The porous substrate 208 is located so that it is disposed within the passage 106 in the cartridge 103.

[0111] A mesh heater 210 is disposed in the body 102 of the apparatus 201 and electrically connected to the controller 206 so that the controller can control power delivered to the mesh heater 210. The mesh heater 210 may be made of a resistive mesh material that generates heat when a current is passed through it.

[0112] The mesh heater 210 is disposed upstream of an inlet of the passage 106 in the cartridge 103. When a user puffs on the mouthpiece 109 of apparatus 201, ambient air may be drawn into the apparatus 201 via an air inlet (not shown) formed in a side of the main body 102. The ambient air may then be drawn through the mesh heater 210 (as illustrated by arrow 212) so that it is heated. The heated air is then entrained into the passage 106 in the cartridge 103 and through the porous substrate 208 (arrow 214). As the heated air passes through the porous substrate 208, it may pick up nicotine particles from the porous substrate 208 to form a mixture of heated air and nicotine particles (aerosol). The aerosol comprising the nicotine particles may then be inhaled by the user through the outlet 108 in the mouthpiece 109 (arrow 216). In this manner, apparatus 201 may produce a vapourless aerosol comprising heated air and nicotine particles. In this manner, a user of the apparatus 201 may not emit a cloud of vapour following an inhalation of aerosol from the apparatus 201.

[0113] The apparatus 201 includes a first one-way valve 220 located at an inlet of the passage 106 in the cartridge, and a second one-way valve 222 located in the passage 106 downstream of the porous substrate 208. The first and second one-way valves 220, 222 are arranged to only allow air flow in one direction, from the mesh heater 210 towards the outlet 108 of the mouthpiece 109. This may prevent aerosol from being blown back into the mesh heater 210, which could cause deterioration of the mesh heater 210 over time. A seal 224 is also provided at a lower end of the cartridge 103, around the inlet of the passage 106, to prevent leakage at an interface between the cartridge 103 and the main body

102.

[0114] The electrodes 120, 122 of apparatus 201 are configured in a similar way to those of apparatus 101. In particular, they are connected to the controller 206 via wires 130, so that a stimulation signal may be transmitted to the electrodes 120, 122 to stimulate the user's tongue. As can be seen in Fig. 2, different electrical connections are used for connecting the electrodes 120, 122 and the mesh heater 210 to the controller 206. This may avoid interference between signals generated by the controller to control the electrodes 120, 122 and the mesh heater 210.

[0115] Similar to the discussion above in relation to apparatus 101, the controller may be configured to a) generate a stimulation signal for stimulating the user's tongue in response to a detection that the user is puffing on the mouthpiece 109, and b) control the mesh heater 210 to heat ambient air drawn into the apparatus 201 to generate an aerosol. Puff detection may be performed via a puff detector (not shown) that is connected to the controller. In this manner, flavour delivery may be simulated when the user inhales an aerosol from the apparatus 201. As the aerosol is vapourless and substantially odourless, the apparatus 201 may provide an "invisible" experience, as it may not produce any perceptible vapours or odours.

[0116] The cartridge 103 may be removable from the main body 102 of apparatus 201, so as to be a replaceable component of the apparatus 201. In this case, a connector (not shown) may be provided in the cartridge 103 for connecting the wires 130 to the controller 206. In some cases, the porous substrate 208 may be removable from the cartridge 103, so that it can be replaced without having to replace the whole cartridge.

[0117] In some embodiments (not shown) the electrodes 120, 122 of apparatus 101 and/or apparatus 201 may be provided as part of a removable cap that is mountable over the mouthpiece 109. In this manner, the rest of the cartridge 103 may be replaced without having to replace the electrodes 120, 122. This may reduce the cost of the cartridge 103, where the cartridge is intended as a consumable component.

[0118] Fig. 3 is a diagram illustrating a smoking substitute system 300 according to an embodiment of the invention. The smoking substitute system 300 includes a smoking substitute apparatus 302 and a mobile device 304. The smoking substitute apparatus 302 may, for example, be apparatus 101 or apparatus 201 described above. The smoking substitute apparatus 302 is communicatively coupled to the mobile device 304 (as illustrated by arrow 301), so that data may be exchanged between the apparatus 302 and the mobile device. In particular, a controller in the apparatus 302 may be communicatively coupled to the mobile device 304. Preferably, they may be communicatively coupled via a Bluetooth connection or other near-field communication method. In the example shown, the mobile device 304 is a smartphone, however other types of mobile device may be used (e.g. tablet

computer, laptop, etc.).

[0119] The mobile device 304 includes software installed thereon for controlling a stimulation signal generated by the controller of apparatus 302 for stimulating a user's tongue via electrodes on a mouthpiece of the apparatus 302 (e.g. electrodes 120, 122). The mobile device 304 may transmit a control signal to the controller of apparatus 302 for controlling the stimulation signal. The controller may then generate and/or control a stimulation signal provided to the electrodes based on the received control signal. The control signal may include an indication of parameters which are to be used for the stimulation signal. In this manner, parameters of the stimulation signal may be controlled by the mobile device 304 to control flavour simulation by the apparatus 302.

[0120] The mobile device 304 includes software installed thereon for generating a user interface 306 to enable a user to select a flavour to be simulated by the apparatus 302. In the example shown, the user interface is arranged to present a user with multiple selectable flavour options 308. In the example shown, the user interface 306 includes selectable flavour options A, B, C, D and E. When the user selects one of the displayed options, the mobile device transmits a control signal to the mobile device 304, the control signal including instructions for simulating the selected flavour. In this manner, a user may easily select and control a flavour simulated by the apparatus via the electrodes on the mouthpiece of the apparatus 302.

[0121] The mobile device 304 may include a memory which stores a set of flavours and, for each of the flavours, corresponding parameters for the stimulation signal to simulate that flavour. Thus, when a flavour is selected, the mobile device 304 may transmit a control signal including an indication of the parameters for the stimulation signal to simulate that flavour to the controller of the apparatus 302. The controller may then generate and control the stimulation signal for the electrodes based on the parameters received from the mobile device 304.

[0122] The mobile device 304 may be configured to perform a calibration procedure, in order to more accurately simulate flavour for a particular user. The calibration may involve transmission of a test control signal by the mobile device 304 to the controller of the apparatus 302. The controller may then generate a stimulation signal based on the received test control signal to stimulate the user's tongue. The mobile device may present to the user a user interface including a series of selectable options corresponding to possible flavours perceived by the user as a result of the stimulation. The user may then indicate, via the user interface, which flavour they perceived. The mobile device 304 may record the user's response.

[0123] The mobile device 304 may be configured to repeat this procedure for multiple different control signals, in order to map out the user's response to different stimulation signals. In this manner, it may be possible to identify which stimulation signals result in which flavours

perceived by the user. This information may then be used by the mobile device 304 to simulate particular flavours for that user. This may enable more accurate flavour simulation for that user.

[0124] In some cases, the mobile device 304 may be configured to adjust the control signal transmitted to the controller of the apparatus based on the indication received from the user. In this manner, the control signal may be adjusted until the user indicates that they perceive a particular flavour. This may enable the flavour simulation to be fine-tuned to the user's sense of taste.

[0125] The mobile device 304 may be connected to a cloud server (not shown), so that user data relating to taste profiles and calibration data may be stored in the cloud. The mobile device 304 may also access a "flavour library" stored in the cloud, which includes information on how to simulate various flavours (e.g. parameters of the stimulation signal for simulating the various flavours). In this manner, the user may have access to a wide range of flavours stored in the cloud.

[0126] 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.

[0127] 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.

[0128] 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.

[0129] Any section headings used herein are for organizational purposes only and are not to be construed as limiting the subject matter described.

[0130] 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.

[0131] 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%.

[0132] 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.

20 Reference documents

[0133] Reference document 1: R. A. Nimesha Ranasinghe, "Digitally Simulating the Sensation of Taste Through Electrical and Thermal Stimulation", Doctoral Thesis, National University of Singapore, 2012.

Claims

- 30 1. A mouthpiece for a smoking substitute apparatus, the mouthpiece comprising:
 - 35 an outlet for conveying an aerosol generated by the smoking substitute apparatus to a user; and one or more electrodes for stimulating the user's tongue.
2. A mouthpiece according to claim 1, wherein the one or more electrodes include one or more electrodes arranged to electrically stimulate the user's tongue.
3. A mouthpiece according to claim 2, wherein the one or more electrodes arranged to electrically stimulate the user's tongue include a pair of electrodes.
4. A mouthpiece according to claim 3, wherein the pair of electrodes includes a first electrode and a second electrode arranged on opposite sides of the mouthpiece relative to the outlet.
5. A mouthpiece according to claim 3 or 4, wherein the pair of electrodes is arranged to pass an electrical current through the user's tongue.
- 55 6. A mouthpiece according to any preceding claim, wherein the one or more electrodes include one or more electrodes arranged to thermally stimulate the user's tongue.

7. A mouthpiece according to claim 6, wherein the mouthpiece includes a temperature actuator for varying a temperature of the one or more electrodes arranged to thermally stimulate the user's tongue.
8. A mouthpiece according to any preceding claim, further including a connection interface for receiving a stimulation signal from the smoking substitute apparatus, to enable stimulation of the user's tongue based on the received stimulation signal.
9. A smoking substitute apparatus including a mouthpiece according to any preceding claim.
10. A smoking substitute apparatus according to claim 9, wherein the smoking substitute apparatus is configured to generate a vapourless aerosol.
11. A smoking substitute apparatus according to claim 10, including:
- a receptacle for receiving a nicotine-imbued porous substrate; and
 - a heater arranged to heat an air flow passing through a nicotine-imbued porous substrate received in the receptacle.
12. A smoking substitute apparatus according to one of claims 9 to 11, further including:
- a controller configured to control a stimulation signal provided to the one or more electrodes in the mouthpiece for stimulating the user's tongue.
13. A smoking substitute apparatus according to claim 12, wherein the controller is further configured to, in response to the user inhaling an aerosol from the smoking substitute apparatus, generate the stimulation signal provided to the one or more electrodes to stimulate the user's tongue.
14. A smoking substitute apparatus according to claim 12 or 13, wherein:
- the one or more electrodes of the mouthpiece include one or more electrodes arranged to electrically stimulate the user's tongue;
 - the stimulation signal includes an electrical current; and
 - the controller is configured to control one or more of a magnitude of the electrical current, a pulse duration of the electrical current, and a pulse frequency of the electrical current.
15. A smoking substitute apparatus according to one of claims 12 to 15, wherein the one or more electrodes of the mouthpiece include one or more electrodes arranged to thermally stimulate the user's tongue, and the stimulation signal is configured to cause a temperature change of the one or more electrodes that are arranged to thermally stimulate the user's tongue.
16. A smoking substitute system comprising:
- a smoking substitute apparatus according to one of claims 9 to 15; and
 - a mobile device, the mobile device being communicatively coupled to the controller of the smoking substitute apparatus;
- wherein the mobile device is configured to transmit a control signal to the controller; and wherein the controller is configured to control the stimulation signal based on the control signal received from the mobile device.
17. A smoking substitute system according to claim 16, wherein the mobile device is further configured to:
- generate a user interface enabling selection of a flavour; and
 - in response to a user selecting a flavour via the user interface, generate the control signal based on the flavour selected by the user.
18. A smoking substitute system according to claim 16 or 17, wherein the mobile device is further configured to perform a calibration procedure including:
- transmitting a test control signal to the controller to cause the controller to control the stimulation signal based on the test control signal; and
 - receiving from a user, via a user interface on the mobile device, an indication of a flavour perceived by the user.
19. A smoking substitute system according to claim 18, wherein the mobile device is further configured to adjust the test control signal transmitted to the controller, based on the indication received from the user.
20. A method of simulating flavour delivery to a user of a smoking substitute apparatus, the smoking substitute apparatus having a mouthpiece with an outlet for conveying an aerosol generated by the smoking substitute apparatus to the user and one or more electrodes arranged to stimulate the user's tongue, the method comprising stimulating the user's tongue via the one or more electrodes to simulate a flavour.
21. A method according to claim 20, further comprising:
- receiving a flavour selection from the user of the smoking substitute apparatus;
 - controlling, based on the flavour selection, a stimulation signal provided to the one or more

electrodes to simulate the selected flavour.

- 22.** A method according to claim 21, further comprising performing a calibration procedure which includes the steps of :

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controlling the stimulation signal to simulate a test flavour; and
receiving, from the user, an indication of a flavour perceived by the user.

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- 23.** A method according to claim 22, wherein the calibration procedure further includes adjusting the stimulation signal based on the indication received from the user.

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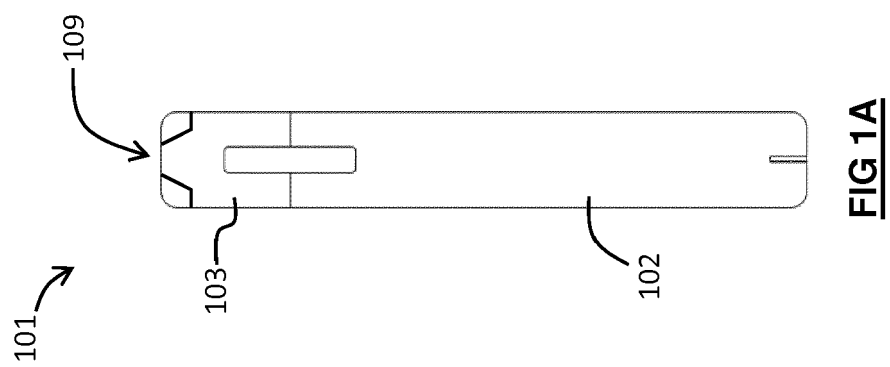
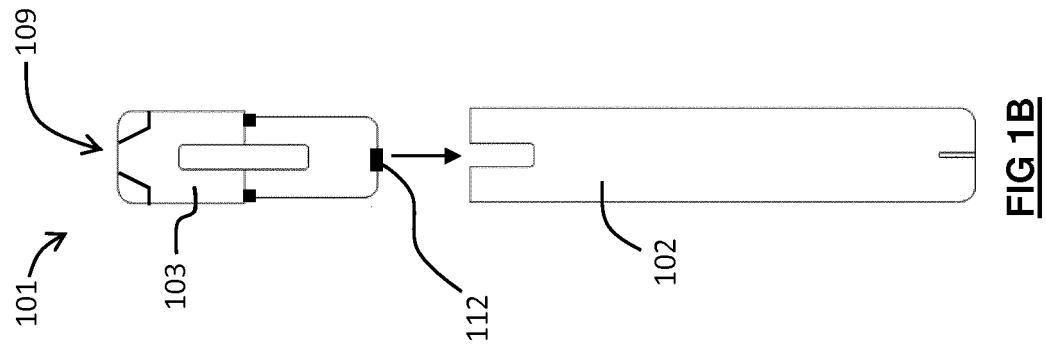
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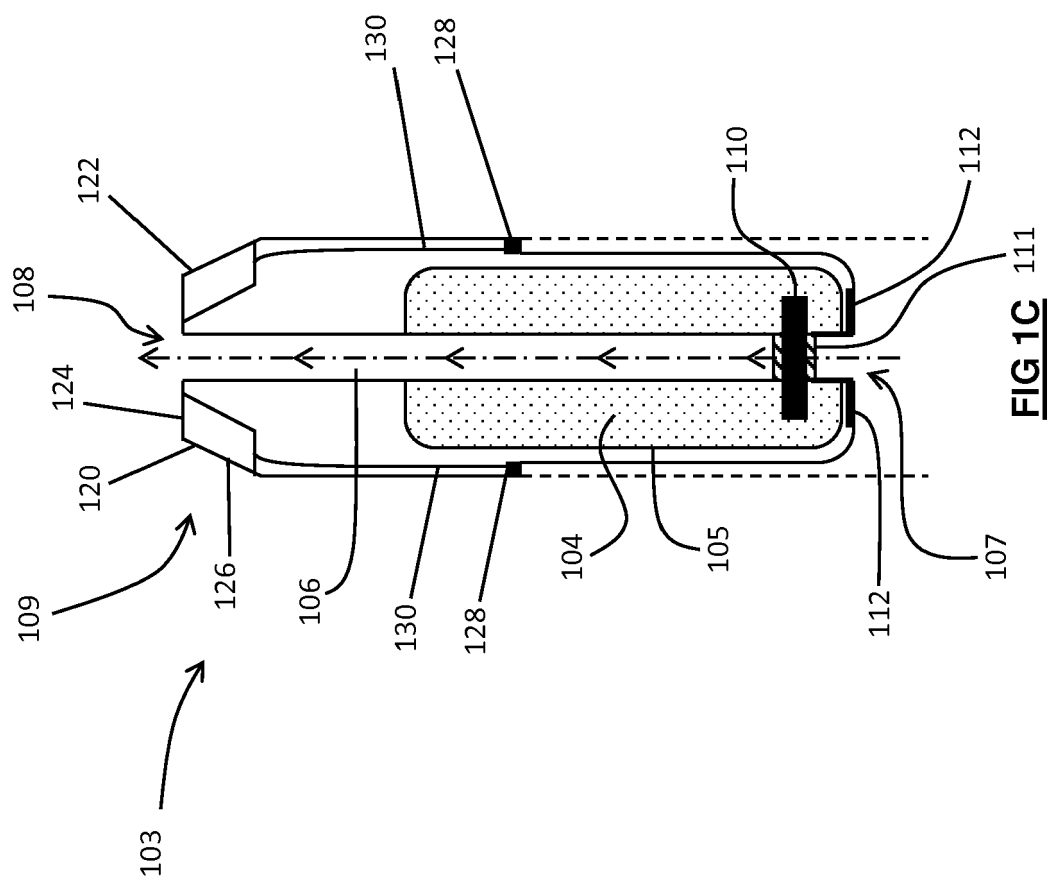
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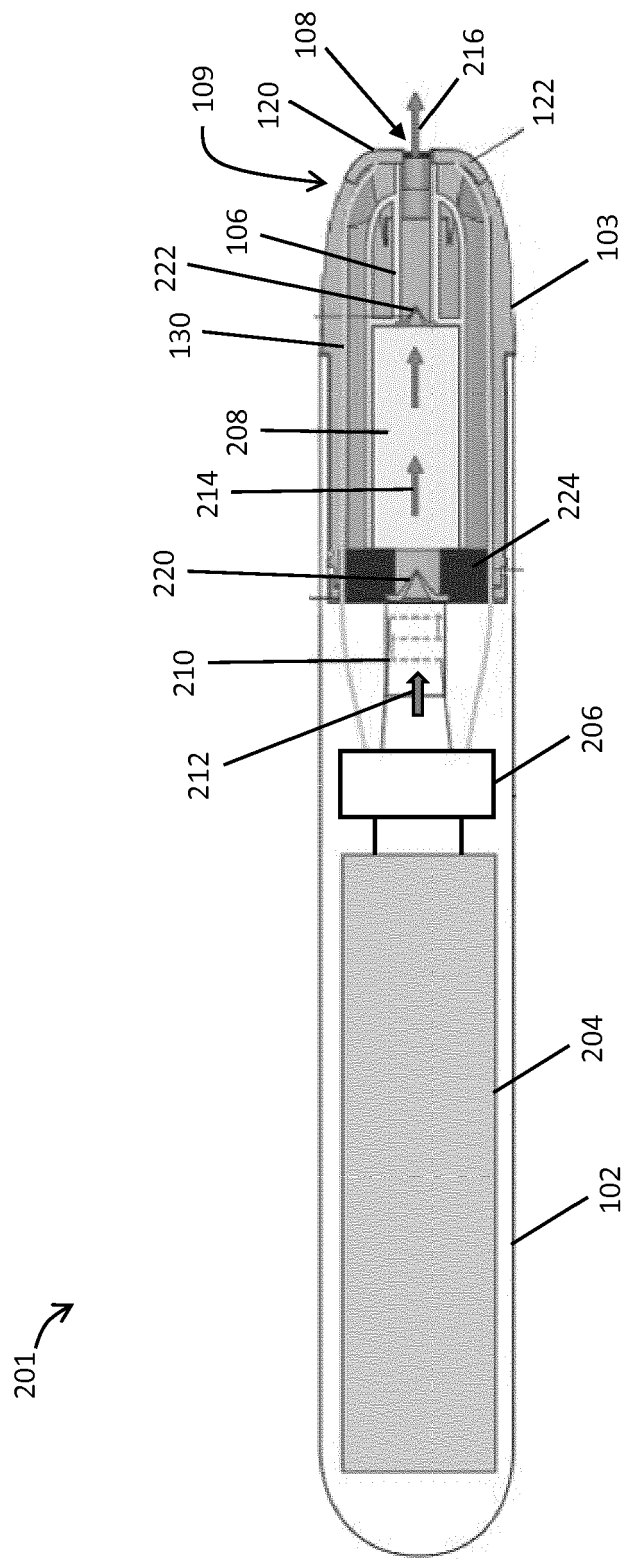


FIG 2

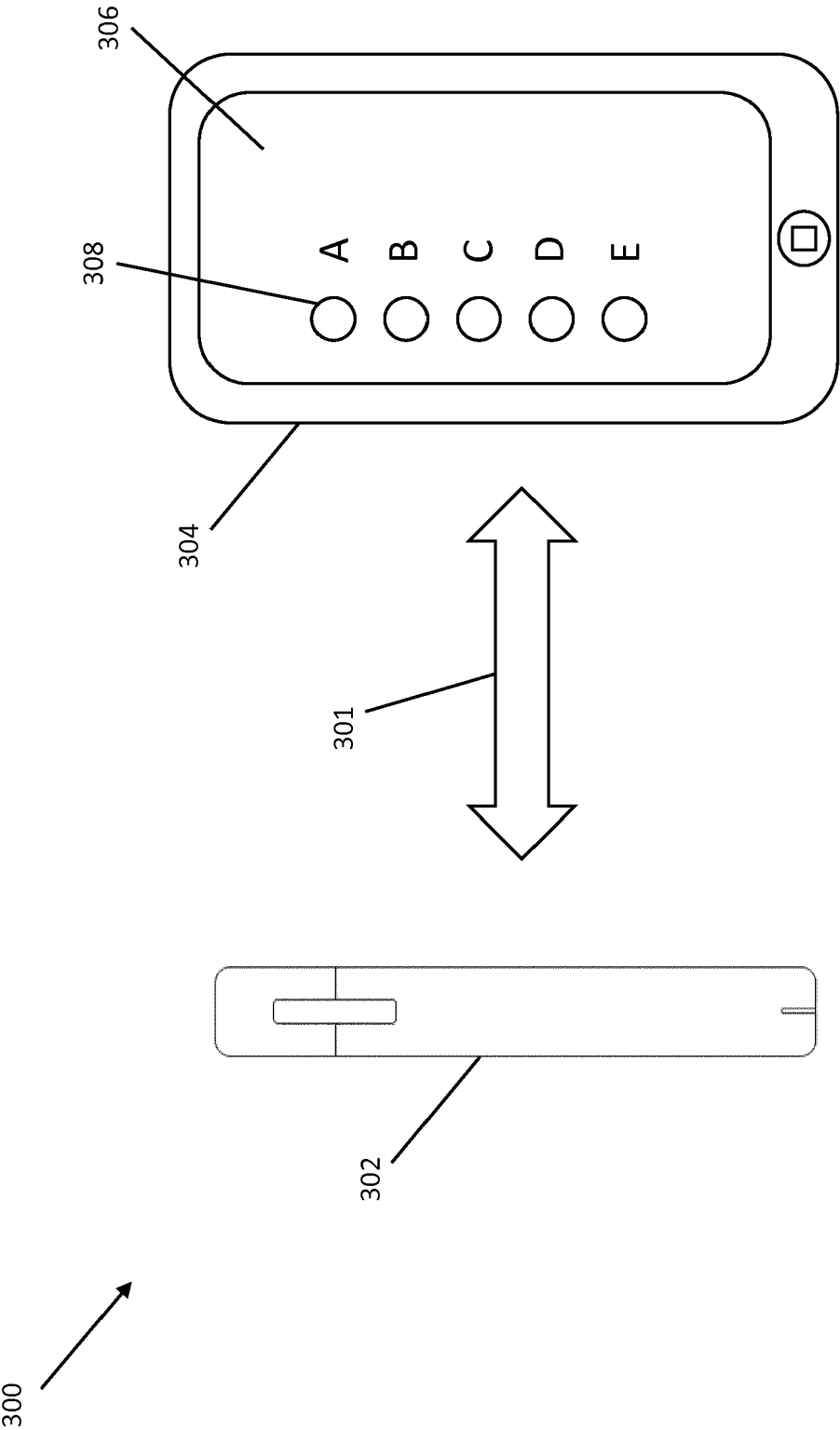


FIG 3



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