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(54) **SMOKING SUBSTITUTE SYSTEM**

(57) A smoking substitute system (110) comprising an air passage (170), a reservoir (160) formed from an air-permeable substrate comprising a porous foamed polymer and arranged in the air passage (170) such that substantially all of the air drawn through the passage

(170) is drawn through the reservoir (160), the porous foamed polymer (160) being loaded with nicotine, and a heater (164) arranged in the air passage (170) and upstream of the reservoir (160), the heater (164) being operable to heat air passing through the air passage (170).

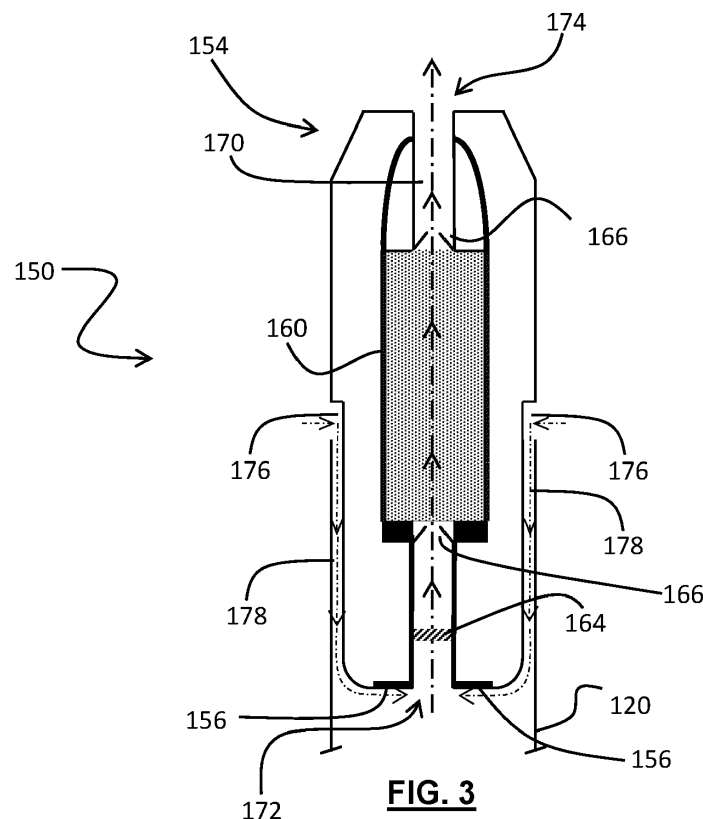


FIG. 3

Description

Field of the Invention

[0001] The present invention relates to a smoking substitute system and, in particular, a smoking substitute system that is able to deliver nicotine to a user without producing a visible vapour cloud.

Background

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

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

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

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

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

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

[0008] One approach is the so-called "vaping" approach, in which a vaporisable liquid, or an aerosol former, sometimes typically referred to herein as "e-liquid", is heated by a heating device (sometimes referred to herein as an electronic cigarette or "e-cigarette" de-

vice) to produce an aerosol vapour which is inhaled by a user. The e-liquid typically includes a base liquid, nicotine and may include a flavourant. The resulting vapour therefore also typically contains nicotine and/or a flavourant. The base liquid may include propylene glycol and/or vegetable glycerine.

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

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

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

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

[0013] An alternative to vaping-type smoking substitute systems is an inhaler apparatus, of which a particular example is the Nicorette® inhalator (trade name). Such systems are often passive in the sense that they do not

require a source of heat or other activation energy in order to generate a vapour. As with an e-cigarette, such an inhaler typically includes a mouthpiece and a main body containing a source of nicotine. In use, a user may inhale or "puff" on the mouthpiece to draw air over or through the nicotine source. The nicotine source may be, for example, an air-permeable substrate impregnated with nicotine. When the supply of nicotine in the nicotine source is depleted, such that the user no longer receives sufficient (or any) nicotine with each puff, the user can replace the nicotine source in order to continue nicotine delivery.

Summary of the Invention

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

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

[0016] The present disclosure has been devised in the light of the above considerations.

[0017] In a general aspect, the present invention relates to a smoking substitute system wherein the nicotine reservoir is a porous polymer loaded with nicotine, and wherein a heater is arranged upstream of the reservoir to improve nicotine entrainment in air drawn through the system.

[0018] According to a first preferred aspect there is provided a smoking substitute system comprising an air passage, a reservoir formed from an air-permeable substrate arranged in the air passage such that substantially all of the air drawn through the passage is drawn through the reservoir, the air-permeable substrate being loaded with substantially pure nicotine, and a heater arranged in the air passage and upstream of the reservoir, the heater being operable to heat air passing through the air passage.

[0019] Configuring a system in this way allows enhanced delivery of a non-visible aerosol by heating air

before it is drawn through a porous reservoir, increasing the level of nicotine entrainment.

[0020] The air-permeable substrate may be formed from a polymer such as a porous foamed polymer.

[0021] Optionally, the heater for heating the air in the air passage may comprise an electrically heatable mesh.

[0022] Conveniently, the electrically heatable mesh may be formed as a sheet and the sheet may be configured in a helical arrangement extending along the passage. This allows for increased heater surface area for improved heating of the air.

[0023] Advantageously, the heater for heating the air in the air passage may comprise a plurality of meshes having a common electrical connection.

[0024] Optionally, the heater for heating the air in the air passage may comprise a plurality of meshes connected in series.

[0025] Conveniently, the heater for heating the air in the air passage may comprise a plurality of meshes connected in parallel.

[0026] Advantageously, the heater for heating the air in the air passage may comprise a plurality of meshes which are independently operable.

[0027] This may allow, for example, for redundancy for failed meshes, and/or for configuring different heater profiles by controlling each of the plurality of meshes to operate for a different time period or at a different power level.

[0028] Optionally, the heater for heating the air in the air passage may comprise an electrically heatable heating coil.

[0029] Conveniently, the heater for heating the air in the air passage may comprise an electrically heatable heating plate.

[0030] Advantageously, the heating plate may surround and define a part of the air passage.

[0031] Providing a heating plate as part of the wall of the air passage allows for heating without obstructing air flow through the passage, which may be advantageous if consistent airflow is required.

[0032] Optionally, the heater for heating the air in the air passage may be heatable by resistive heating using an electrical current.

[0033] Conveniently, one or more one-way valves may be arranged along the air passage and configured to allow air to flow along the air passage in an upstream to downstream direction.

[0034] Providing one or more one-way valves arranged both upstream and downstream of an aerosol generator in the air passage can reduce, prevent or substantially prevent air flow along the air passage in a downstream to upstream direction, controlling flow of both air and vapour through the passage and apparatus.

[0035] According to a second preferred aspect, there is provided a kit of parts for a smoking substitute system according to the first aspect, comprising a base unit and a smoking substitute apparatus removably engageable with the base unit. The base unit comprises a base unit

air passage, said base unit air passage comprising the heater. The smoking substitute apparatus is a cartridge configured for engagement with the base unit, the cartridge comprising a cartridge air passage in fluid communication with the base unit air passage to collectively form the air passage of the smoking substitute system, said cartridge air passage comprising the reservoir.

[0036] According to a third preferred aspect, there is provided a kit of parts for a smoking substitute system according to the first aspect comprising a base unit, and a smoking substitute apparatus removably engageable with the base unit. The smoking substitute apparatus is a cartridge configured for engagement with the base unit, the cartridge comprising at least the portion of the air passage that comprises the heater and the reservoir of the smoking substitute system.

[0037] According to a fourth preferred aspect, there is provided a method of using a smoking substitute system according to the first aspect to generate an aerosol.

[0038] The smoking substitute apparatus may be in the form of a consumable. The consumable may be configured for engagement with a main body. When the consumable is engaged with the main body, the combination of the consumable and the main body may form a smoking substitute system such as a closed smoking substitute system. For example, the consumable may comprise components of the system that are disposable, and the main body may comprise non-disposable or non-consumable components (e.g. power supply, controller, sensor, etc.) that facilitate the generation and/or delivery of aerosol by the consumable. In such an embodiment, a nicotine source (e.g. nicotine-infused air-permeable substrate) may be replenished by replacing a used consumable with an unused consumable.

[0039] 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 only the foamed polymer reservoir may be replaced when depleted, rather than the whole smoking substitute apparatus.

[0040] In light of this, it should be appreciated that some of the features described herein as being part of the smoking substitute apparatus may alternatively form part of a main body for engagement with the smoking substitute apparatus. This may be the case in particular when the smoking substitute apparatus is in the form of a consumable.

[0041] Where the smoking substitute apparatus is in the form of a consumable, the main body and the consumable may be configured to be physically coupled together. For example, the consumable may be at least partially received in a recess of the main body, such that there is an interference fit between the main body and the consumable. Alternatively, the main body and the consumable may be physically coupled together by screwing one onto the other, or through a bayonet fitting, or the like.

[0042] 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.

[0043] The smoking substitute apparatus may comprise a reservoir configured to store an aerosol precursor. The aerosol precursor may be formulated so as to produce a non-visible or substantially non-visible vapour. The aerosol precursor may consist substantially of nicotine or a nicotine compound. The aerosol precursor may further comprise a flavourant. Alternatively, the aerosol precursor may be substantially flavourless. That is, the aerosol precursor may not contain any deliberately added additional flavourant. A flavourant may be provided as a separate flavourant aerosol precursor, such that the aerosol precursor and flavourant aerosol precursor may be separately vaporised to form an aerosol comprising both the aerosol precursor and the flavourant aerosol precursor.

[0044] The reservoir configured to store the aerosol precursor and/or the flavourant aerosol precursor consists of an air-permeable substrate impregnated with the aerosol precursor and/or the flavourant aerosol precursor. The substrate material is a foamed polymer which will allow for airflow to pass through the substrate at a given pressure drop value, so as to provide a comfortable 'draw' sensation for the user. The substrate may be, for example, a sintered polyethylene or a PET foam.

[0045] The substrate may be impregnated with nicotine via immersion in a liquid containing nicotine and a volatile carrier (for example a solution of nicotine in ethanol). The substrate may be immersed to evenly soak the substrate. Once removed and left to dry or baked in an oven, the carrier may be evaporated and the nicotine may be left evenly spread throughout the substrate.

[0046] The aerosol precursor and/or the flavourant aerosol precursor may be formulated to form a vapour when heated air is drawn through the reservoir. The reservoir may comprise a monolithic substrate. The reservoir may consist of a plurality of substrates, each arranged to allow air to be drawn therethrough, and each comprising one or both of an aerosol precursor and the flavourant aerosol precursor. The aerosol precursor and/or the flavourant aerosol precursor may be provided in spatially coterminous or spatially distinct regions of the reservoir.

[0047] The smoking substitute apparatus may comprise one or more passages for fluid (e.g. air) flow therethrough. Where more than one passage is present, one or more of the passages may be distinct, such that there is no intersection between the passages. One or more of the passages may comprise junctions or openings therebetween such that fluid within the passages can mix within the smoking substitute apparatus.

[0048] One or more of the passages may comprise one or more valves to control fluid flow. The valve may be,

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

[0049] The passages may extend through (at least a portion of) the smoking substitute apparatus, between openings that may define an inlet and an outlet of a passage. Each inlet and outlet may be in fluid communication with only one passage, or a subset of the passages, or all the passages in the smoking substitute apparatus. The outlet or outlets may be at a mouthpiece of the smoking substitute apparatus. In this respect, a user may draw fluid (e.g. air) into and through a passage by inhaling at the outlet (i.e. using the mouthpiece).

[0050] One or more of the fluid passages comprises a heater for heating the fluid (i.e. air) passing through the passage. The heater is arranged upstream of a reservoir formed from an air permeable substrate such that air warmed by the heater is drawn through the reservoir to enable or increase nicotine or flavourant vapourisation and subsequent entrainment in the air-flow. The heater to heat the air may comprise one or more meshes arranged within the fluid passage. The heater to heat the air may comprise one or more thermally conductive elements to conduct heat from a heater to the air passage or to increase the heat transfer between the heater and the air.

[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 the smoking substitute apparatus is engaged with the main body). The power source may be a battery (e.g. a rechargeable battery). A connector in the form of e.g. a USB port may be provided for recharging this battery.

[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 of the main body may be configured to transfer electrical power from the power source to a heater of the consumable via the electrical interface of the consumable.

[0053] The electrical interface of the smoking substitute apparatus may also be used to identify the smoking substitute apparatus (in the form of a consumable) from a list of known types. For example, the consumable may

have a certain concentration of nicotine and the electrical interface may be used to identify this. The electrical interface may additionally or alternatively be used to identify when a consumable is connected to the main body.

5 **[0054]** Again, where the smoking substitute apparatus is in the form of a consumable, the main body may comprise an identification means, which may, for example, be in the form of an RFID reader, a barcode or QR code reader. This identification means may be able to identify
10 a characteristic (e.g. a type) of a consumable engaged with the main body. In this respect, the consumable may include any one or more of an RFID chip, a barcode or QR code, or memory within which is an identifier and which can be interrogated via the identification means.

15 **[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(s) 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
20 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.

25 **[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®
30 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(s) of the consumable and/or smoking substitute apparatus in response to a puff detection by the sensor. The control may be in the form of activation of the heater(s) in response to a detected puff. That is, the smoking substitute apparatus
45 may be configured to be activated when a puff is detected by the puff sensor. When the smoking substitute apparatus is in the form of a consumable, the puff sensor may be provided in the consumable or alternatively may be provided in the main body. Where multiple independent passages are provided within the smoking substitute apparatus, each of the passages may have a puff sensor.

[0058] The term "flavourant" is used to describe a compound or combination of compounds that provide flavour and/or aroma. For example, the flavourant may be configured to interact with a sensory receptor of a user (such as an olfactory or taste receptor). The flavourant may include one or more volatile substances.

[0059] The flavourant may be provided in solid or liquid form. The flavourant may be natural or synthetic. For example, the flavourant may include menthol, liquorice, chocolate, fruit flavour (including e.g. citrus, cherry etc.), vanilla, spice (e.g. ginger, cinnamon) and tobacco flavour. The flavourant may be evenly dispersed or may be provided in isolated locations and/or varying concentrations.

[0060] The air-permeable substrate may comprise plant material. The plant material may comprise least one plant material selected from the list including *Amaranthus dubius*, *Arctostaphylos uva-ursi* (Bearberry), *Argemone mexicana*, *Amica*, *Artemisia vulgaris*, Yellow Tees, *Galea zacatechichi*, *Canavalia maritima* (Baybean), *Cecropia mexicana* (Guamura), *Cestrum nocturnum*, *Cynoglossum virginianum* (wild comfrey), *Cytisus scoparius*, *Damiana*, *Entada rheedii*, *Eschscholzia californica* (California Poppy), *Fittonia albivenis*, *Hippobroma longiflora*, *Humulus japonica* (Japanese Hops), *Humulus lupulus* (Hops), *Lactuca virosa* (Lettuce Opium), *Laggera alata*, *Leonotis leonurus*, *Leonurus cardiaca* (Motherwort), *Leonurus sibiricus* (Honeyweed), *Lobelia cardinalis*, *Lobelia inflata* (Indian-tobacco), *Lobelia siphilitica*, *Nepeta cataria* (Catnip), *Nicotiana species* (Tobacco), *Nymphaea alba* (White Lily), *Nymphaea caerulea* (Blue Lily), Opium poppy, *Passiflora incarnata* (Passionflower), *Pedicularis densiflora* (Indian Warrior), *Pedicularis groenlandica* (Elephant's Head), *Salvia divinorum*, *Salvia dorrii* (Tobacco Sage), *Salvia species* (Sage), *Scutellaria galericulata*, *Scutellaria lateriflora*, *Scutellaria nana*, *Scutellaria species* (Skullcap), *Sida acuta* (Wireweed), *Sida rhombifolia*, *Silene capensis*, *Syzygium aromaticum* (Clove), *Tagetes lucida* (Mexican Tarragon), *Tarhonanthus camphoratus*, *Tumera diffusa* (Damiana), *Verbascum* (Mullein), *Zamia latifolia* (Maconha Brava) together with any combinations, functional equivalents to, and/or synthetic alternatives of the foregoing.

[0061] In some embodiments, the plant material is tobacco. Any type of tobacco may be used. This includes, but is not limited to, flue-cured tobacco, burley tobacco, Maryland Tobacco, dark-air cured tobacco, oriental tobacco, dark-fired tobacco, perique tobacco and rustica tobacco. This also includes blends of the above mentioned tobaccos.

[0062] Any suitable parts of the tobacco plant may be used. This includes leaves, stems, roots, bark, seeds and flowers.

[0063] The tobacco may comprise one or more of leaf tobacco, stem tobacco, tobacco powder, tobacco dust, tobacco derivatives, expanded tobacco, homogenised tobacco, shredded tobacco, extruded tobacco, cut rag tobacco and/or reconstituted tobacco (e.g. slurry recon or paper recon).

[0064] The air-permeable substrate may comprise a gathered sheet of homogenised (e.g. paper/slurry recon) tobacco or gathered shreds/strips formed from such a sheet.

[0065] In some embodiments, the sheet used to form

the aerosol-forming substrate has a grammage greater than or equal to 100 g/m², e.g. greater than or equal to 110 g/m² such as greater than or equal to 120 g/m².

[0066] The sheet may have a grammage of less than or equal to 300 g/m² e.g. less than or equal to 250 g/m² or less than or equal to 200 g/m².

[0067] The sheet may have a grammage of between 120 and 190 g/m².

[0068] The air-permeable substrate may comprise at least 50 wt% plant material, e.g. at least 60 wt% plant material e.g. around 65 wt% plant material. The air-permeable substrate may comprise 80 wt% or less plant material e.g. 75 or 70 wt% or less plant material.

[0069] The air-permeable substrate may comprise one or more additives selected from flavourants, fillers and binders.

[0070] Typically, the air-permeable substrate does not comprise a humectant. Humectants may be provided in heat not burn (HNB) tobacco charges. In such cases, humectants are provided as vapour generators, the generated vapour being used to help carry volatile active compounds and to increase visible vapour. Accordingly, it is preferred that the air-permeable substrate does not comprise one or more humectants such as polyhydric alcohols (e.g. propylene glycol (PG), triethylene glycol, 1,2-butane diol and vegetable glycerine (VG)) and their esters (e.g. glycerol mono-, di- or tri-acetate). If such humectants are present in the air-permeable substrate, they may be present at a low level, such as less than 0.5 wt%, more preferably less than 0.1 wt%.

[0071] Suitable binders are known in the art and may act to bind together the components forming the air-permeable substrate. Binders may comprise starches and/or cellulosic binders such as methyl cellulose, ethyl cellulose, hydroxypropyl cellulose, hydroxyethyl cellulose and methyl cellulose, gums such as xanthan, guar, arabic and/or locust bean gum, organic acids and their salts such as alginic acid/ sodium alginate, agar and pectins.

[0072] Preferably the binder content is 5 to 10 wt% of the air-permeable substrate e.g. around 6 to 8 wt%.

[0073] Suitable fillers are known in the art and may act to strengthen the air-permeable substrate. Fillers may comprise fibrous (non-tobacco) fillers such as cellulose fibres, lignocellulose fibres (e.g. wood fibres), jute fibres and combinations thereof.

[0074] Preferably, the filler content is 5 to 10 wt% of the aerosol-forming substrate e.g. around 6 to 9 wt%.

[0075] The air-permeable substrate may comprise an aqueous and/or non-aqueous solvent. In some embodiments, the air-permeable substrate has a water content of between 4 and 10 wt% e.g. between 6-9 wt% such as between 7-9 wt%. Such low moisture content in the air-permeable substrate typically has the effect that, when the air-permeable substrate is exposed to heated air, there would typically not be produced a substantial visible vapour. It is to be noted that in one embodiment it is possible to use as the air-permeable substrate a low

moisture tobacco material with its natural nicotine content. The natural nicotine content then meets the requirements of the active agent.

[0076] The air-permeable substrate may be at least partly circumscribed by a wrapping layer e.g. a paper wrapping layer. The wrapping layer may overlie an inner foil layer or may comprise a paper/foil laminate (with the foil innermost).

[0077] The plant material may comprise cannabis plant material including *Cannabis sativa*, *Cannabis indica* and *Cannabis ruderalis*. The plant material may comprise *Echinacea purpurea*, *Echinacea angustifolia*, *Acmella oleracea*, *Helichrysum umbraculigerum*, or *Radula marginata*. This also includes blends of the above mentioned plant material.

[0078] In some embodiments, the cannabinoid-containing plant material is cannabis. The plant may be a traditional strain, or may be a strain bred or other modified (e.g. genetically) to produce certain levels of some cannabinoids compounds, e.g. low levels of THC or high levels of THC.

[0079] Any suitable parts of the cannabinoid-containing plant may be used. Thus the cannabinoid-containing plant material may comprise leaves, stems, roots, bark, seeds, buds and flowers (which may be cured).

[0080] 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

[0081] So that the invention may be understood, and so that further aspects and features thereof may be appreciated, embodiments illustrating the principles of the invention will now be discussed in further detail with reference to the accompanying figures, in which:

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

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

Figure 3 is a schematic longitudinal cross sectional view of a smoking substitute apparatus of the first embodiment;

Figure 4 is a schematic longitudinal cross sectional view of a heater of the smoking substitute apparatus of the first embodiment;

Figure 5 is a schematic longitudinal cross sectional view of a heater of the smoking substitute apparatus of the first embodiment;

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

Figure 7 is a schematic longitudinal cross sectional view of a heater of the smoking substitute apparatus of the first embodiment, in which the meshes are independently controllable;

Figure 8 is a schematic longitudinal cross sectional view of a heater of the smoking substitute apparatus of the first embodiment;

Figure 9A is a schematic longitudinal cross sectional view of a heater of the smoking substitute apparatus of the first embodiment; and

Figure 9B is a schematic top-down view of a heater of the smoking substitute apparatus of the first embodiment.

Detailed Description of the Invention

[0082] Further background to the present invention and further aspects and embodiments of the present invention will now be discussed with reference to the accompanying figures. Further aspects and embodiments will be apparent to those skilled in the art. The contents of all documents mentioned in this text are incorporated herein by reference in their entirety.

[0083] Figures 1 and 2 illustrate a smoking substitute system in the form of an e-cigarette system 110. The system 110 comprises a main body 120 of the system 110, and a smoking substitute apparatus in the form of an e-cigarette consumable (or "pod") 150. In the illustrated embodiment the consumable 150 (sometimes referred to herein as a smoking substitute apparatus) is removable from the main body 120, so as to be a replaceable component of the system 110. The e-cigarette system 110 is a closed system in the sense that it is not intended that the consumable should be refillable with e-liquid by a user.

[0084] As is apparent from Figures 1 and 2, the consumable 150 is configured to engage the main body 120. Figure 1 shows the main body 120 and the consumable 150 in an engaged state, whilst Figure 2 shows the main body 120 and the consumable 150 in a disengaged state. When engaged, a portion of the consumable 150 is received in a cavity of corresponding shape in the main body 120 and is retained in the engaged position by way of a snap-engagement mechanism. In other embodiments, the main body 120 and consumable 150 may be engaged by screwing one into (or onto) the other, or through a bayonet fitting, or by way of an interference fit. In the illustrated embodiment, the consumable 150 is a "single-use" consumable 150. The term "single-use" does not necessarily mean the consumable is designed to be disposed of after a single smoking session. Rather,

it defines that the consumable 150 is not designed to be refilled, and is instead disposed of and replaced after usage.

[0085] The power source of the main body 120 may be in the form of a battery (e.g. a rechargeable battery such as a lithium ion battery). The main body 120 may comprise a connector in the form of e.g. a USB port for recharging this battery. The main body 120 may also comprise a controller that controls the supply of power from the power source to the main body electrical contacts (and thus to the heater 164). That is, the controller may be configured to control a voltage applied across the main body electrical contacts, and thus the voltage applied across the heater 164. In this way, the heater 164 may only be heated under certain conditions (e.g. during a puff and/or only when the system is in an active state). In this respect, the main body 120 may include a puff sensor (not shown) that is configured to detect a puff (i.e. inhalation). The puff sensor may be operatively connected to the controller so as to be able to provide a signal, to the controller, which is indicative of a puff state (i.e. puffing or not puffing). The puff sensor may, for example, be in the form of a pressure sensor or an acoustic sensor.

[0086] Although not shown, the main body 120 and consumable 150 may comprise a further interface which may, for example, be in the form of an RFID reader, a barcode or QR code reader. This interface may be able to identify a characteristic (e.g. a type) of a consumable 150 engaged with the main body 120. In this respect, the consumable 150 may include any one or more of an RFID chip, a barcode or QR code, or memory within which is an identifier and which can be interrogated via the interface.

[0087] The system 110 is configured to vaporise an aerosol precursor, which in the illustrated embodiment is a nicotine-based liquid impregnated into a substrate 160. The nicotine-impregnated substrate 160 may be referred to as an aerosol generator. When air is drawn through or over the nicotine-impregnated substrate 160, the nicotine is vaporised and entrained in the airflow to thereby be delivered to a user. The vapour or aerosol produced by the aerosol generator is less visible than that produced by a conventional e-liquid from an e-cigarette when exhaled by a user. Preferably, the vapour or aerosol generated by the aerosol generator is invisible or substantially invisible when exhaled by a user.

[0088] A substrate 160 may be impregnated with nicotine by immersion in a solution of nicotine in a volatile carrier solvent (e.g. ethanol) such that the substrate 160 is evenly soaked. The substrate 160 can then be removed and left to dry or baked in an oven, meaning that the carrier is evaporated and the nicotine is left evenly spread throughout the substrate.

[0089] The nicotine-impregnated substrate 160 may be provided within a consumable 150. In such an embodiment, when the supply of nicotine in the nicotine-impregnated substrate 160 is depleted, the consumable

150 may be replaced. In other embodiments, the nicotine-impregnated substrate 160 itself may be a consumable component of the system 110. For example, the nicotine-impregnated substrate may be locatable within and removable from the system 110.

[0090] Further details are now set out relating to the air-permeable substrate and its impregnation with nicotine.

[0091] Suitable materials and methods for manufacturing air permeable substrates are disclosed, for example, in US4800903, US4284089, US4813437, and US5167242, the entire contents of which are incorporated herein by reference.

[0092] US4800903 discloses that preferred materials for a polymeric plug are olefinic polymers, and preferably polyethylene or polypropylene, most preferably high density polyethylene. Use of high density polyethylene is preferred over, for example, amorphous polyethylene, since it provides a balance between ease of manufacturing and capacity for reversible nicotine absorption.

[0093] Meanwhile, some polymers are considered to be inherently unsuitable for use as an air permeable substrate. For example, some polymeric substances such as polystyrene and polycarbonate are dissolved by nicotine, rendering them unsuitable for forming a nicotine impregnated substrate. Furthermore, polymers containing halogens or nitrogen or sulphur are undesirable since they can produce noxious fumes.

[0094] To improve user satisfaction, it may be preferable to use an air permeable substrate that provides an equivalent resistance to draw to that of a conventional cigarette. For example, US4284089 discloses that a non-combustible cigarette with a draw resistance approximating that of a conventional cigarette would permit about 35 millilitres of air to be drawn through it during a 2 second period.

[0095] A substrate may be impregnated with nicotine by a variety of methods. For example, US4800903 indicates that liquid nicotine, nicotine vapour or a solution of nicotine may be used, and suggests that a solution of nicotine in supercritical liquid carbon dioxide may advantageously be used to impregnate the substrate. Alternatively, the substrate may be impregnated with nicotine via immersion in a liquid containing nicotine and a volatile carrier (for example a solution of nicotine in ethanol). The substrate is immersed to evenly soak the substrate. Once the substrate is removed from the liquid it can be left to dry or baked in an oven, evaporating away the carrier so that the nicotine is left evenly distributed throughout the substrate.

[0096] US5167242 discloses that a polyethylene plug can be charged or loaded with a mixture of nicotine, menthol and ethanol in a weight ratio (nicotine:menthol:ethanol) of about 10:1:120 or 10:1:160. The menthol and nicotine are sequentially added to the ethanol in a mixing vessel to produce a solution. Meanwhile, the plugs are placed in a vacuum dryer, which is partially evacuated to create a lower internal pressure than that of the mixing

vessel, allowing the nicotine/ethanol/methanol solution to be sucked into the vacuum dryer. The plugs remain immersed in the solution within the vacuum dryer for 10 minutes, after which the temperature is raised and the vacuum pump is started to evaporate the ethanol. The vacuum dryer is then filled with nitrogen, and a nitrogen atmosphere is maintained for the remainder of the packaging procedure to prevent oxygen contamination of the nicotine.

[0097] In alternative embodiments, the air-permeable substrate may be formed in a different manner. For example, the air-permeable substrate may be formed from tobacco. The tobacco may be leaf tobacco, tobacco derivatives, expanded tobacco, shredded tobacco, reconstituted tobacco or tobacco substitutes. Preferably the tobacco has a relatively low moisture content, for example less than 10wt% moisture. A typical minimum moisture content for the tobacco is not less than 4wt% moisture. Such low moisture content tobacco, when exposed to heated air, would typically not produce a substantial vapour. Accordingly, such an air-permeable substrate may be loaded with nicotine, as described above.

[0098] Where the air-permeable substrate is formed for example of tobacco, nicotine may be applied to the air-permeable substrate by mixing and/or dissolving the active agent in a suitable carrier liquid such as a solvent (e.g. water, ethanol, PG, glycerine, macrogol, castor oil, paraffin, (and derivatives thereof)).

[0099] The air is typically heated to a suitable temperature. This temperature may be at least 30°C. This is in order to promote vaporisation of the active ingredient. The temperature is typically not greater than 80°C, or typically not greater than 70°C. This is in order to promote user comfort. It may also reduce or prevent the degradation of the air-permeable substrate and/or the active ingredient (nicotine).

[0100] Figure 3 shows a schematic longitudinal cross-sectional view of the aerosol generator which forms part of the smoking substitute system shown in Figures 1 and 2. In Figure 3, the nicotine-impregnated substrate 160 is arranged within a passage 170. The passage 170 extends between an aerosol generator inlet 172 and an aerosol generator outlet 174 at opposing ends of the consumable 150. In this respect, the passage 170 comprises an upstream end at the end of the consumable 150 that engages with the main body 120, and a downstream end at an opposing end of the consumable 150 that comprises a mouthpiece 154 of the system 110.

[0101] When the consumable 150 is received in the cavity of the main body 120 as shown in Figure 3, a plurality of device air inlets 176 are formed at the boundary between the casing of the consumable and the casing of the main body. The device air inlets 176 are in fluid communication with the aerosol generator inlet 172 through an inlet flow channel 178 formed in the cavity of the main body which is of corresponding shape to receive a part of the consumable 150. Air from outside of the system 110 can therefore be drawn into the passage 170 through

the device air inlets 176 and the inlet flow channels 178.

[0102] When the consumable 150 is engaged with the main body 120, a user can inhale (i.e. take a puff) via the mouthpiece 154 so as to draw air through the passage 170, and so as to form an airflow (indicated by the dashed arrows in Figure 3) in a direction from the aerosol generator inlet 172 to the aerosol generator outlet 174. Air is thereby drawn through and/or around the nicotine-impregnated substrate 160, such that nicotine from the nicotine-impregnated substrate 160 can be entrained in the airflow. The nicotine-impregnated substrate 160 is arranged to extend across a cross-section of at least a portion of the passage 170, such that substantially all of the air drawn through the passage 170 passes through at least a part of the reservoir 160. The resistance to drawing air through the consumable 150 may be configured by altering the air permeability of the nicotine-impregnated substrate, or by the provision of one or more bypass passages separate from the passage 170 (not illustrated).

[0103] In this embodiment, a heater 164 is arranged upstream of the nicotine-impregnated substrate 160 along the passageway 170. The heater 164 is operable to heat air passing through the passageway 170 to enable or enhance nicotine entrainment. The heater 164 may be located in a passage in the base unit 120 (not illustrated), with the base unit passageway being in fluid communication with the passageway 170 of the consumable 150. In further embodiments, the heater 164 may be located externally of the passageway 170 but placed in thermal communication with the airflow via thermally conductive elements which extend into or across the passageway 170 (not illustrated).

[0104] The heater 164 comprises an electrically heatable mesh located in the airflow stream. The mesh may be formed of a material that is heatable by resistive heating using an electrical current. For example, the mesh may be a woven net of wire, or punched or lasered metal sheet arranged to be electrically connected at either side or end. Suitable wires may be, for example, 0.0125 mm in diameter, while a suitable metal sheet may have a thickness of between 0.1 and 0.3 mm. A mesh 164 according to the present invention may have a variety of different hole shapes formed in the mesh, including, for example, circular, hexagonal, triangular, rectangular, elliptical, or square. The mesh 164 may be formed from, for example, nichrome, stainless steel, titanium or another protectively coated metal. A current used to heat the heater 164 may be, for example, between 0.5 A and 2.0 A. The heater 164 may have a resistance of between 0.6 Ω and 6.0 Ω . The heater may be operable to heat to between 200°C and 400°C.

[0105] In alternative embodiments (not illustrated), the heater 164 may be a heating plate or heating coil arranged in or around the periphery of the air passage 170. In this way, the heater 164 may surround and define a part of the air passage 170.

[0106] Figures 4-9 show exemplary arrangements for

the mesh heater 164. The heater may comprise a single flat sheet mesh 164a (Figure 4). The heater may comprise multiple sheets 164b with common connections (Figure 5), multiple sheets 164c spaced apart and connected in series (Figure 6), multiple sheets 164d spaced apart and connected in parallel (Figure 7), or multiple sets of sheets 164e connected in series within a set, and in parallel between sets (Figure 8). The spacing between the multiple sheets may be, for example, between 0.5 mm and 5 mm. One or more sheets may be arranged in a shape that extends along the passageway 170, such as a cylindrical arrangement 164f (Figure 9A - side view, 9B - top view), or helical arrangement (not illustrated). The mesh may extend across the full cross-section of the passageway 170, or a part thereof.

[0107] The smoking substitute apparatus 150 may be configurable to heat only a subset of the mesh sheets 164. For example, a user of the smoking substitute apparatus 150 may select a number or proportion of the sheets 164 to heat according to their desired heating level. Additionally or alternatively, the smoking substitute apparatus 150 may comprise means for detecting whether one or more of the meshes 164 has become damaged such that it no longer conducts electricity, or no longer satisfactorily generates heat by resistive heating, and can thereby vary the power supplied to the remaining meshes accordingly. This may be required in particular where the heater 164 is provided as a part of the base unit 120 of the smoking substitute system 110, since it provides a redundancy for long-term deterioration of the heater 164.

[0108] When the consumable 150 is engaged with the main body 120, electrical contacts 156 make contact with corresponding electrical contacts (not shown) of the main body 120. The main body electrical contacts are electrically connectable to a power source (not shown) of the main body 120, such that (in the engaged position) the heater 164 is electrically connectable to the power source. In this way, power can be supplied by the main body 120 to the heater 164 in order to heat the heater 164.

[0109] The passageway 170 may comprise one or more one-way valves 166. The one or more valves are provided to prevent, substantially prevent or reduce airflow from a downstream to upstream direction along the passageway 170. In Figure 3, two valves 166 are located immediately upstream and immediately downstream, respectively, of the nicotine-impregnated substrate 160. In some embodiments, only one valve 166 may be provided. In further embodiments, a valve 166 may be located upstream of the heater 164. In still further embodiments, the valves may be omitted.

[0110] 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.

[0111] 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.

[0112] 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.

[0113] Any section headings used herein are for organizational purposes only and are not to be construed as limiting the subject matter described.

[0114] 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.

[0115] 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%.

[0116] The words "preferred" and "preferably" are used herein refer to embodiments of the invention that may provide certain benefits under some circumstances. It is to be appreciated, however, that other embodiments may also be preferred under the same or different circumstances. The recitation of one or more preferred embodiments therefore does not mean or imply that other embodiments are not useful, and is not intended to exclude other embodiments from the scope of the disclosure, or from the scope of the claims.

Claims

1. A smoking substitute system (110) comprising:

an air passage (170);
a reservoir (160) formed from an air-permeable substrate and arranged in the air passage (170) such that substantially all of the air drawn

- through the passage (170) is drawn through the reservoir (160), the air-permeable substrate being loaded with substantially pure nicotine; and a heater (164) arranged in the air passage (170) and upstream of the reservoir (160), the heater (164) being operable to heat air passing through the air passage (170).
2. A smoking substitute system (110) according to claim 1, wherein:
the heater (164) for heating the air in the air passage (170) comprises an electrically heatable mesh.
 3. A smoking substitute system (110) according to claim 2, wherein:
the electrically heatable mesh is formed as a sheet and the sheet is configured in a helical arrangement extending along the passage (170).
 4. A smoking substitute system (110) according to any one of claims 2 or 3, wherein:
the heater (164) for heating the air in the air passage (170) comprises a plurality of meshes having a common electrical connection.
 5. A smoking substitute system (110) according to any one of claims 2 to 4, wherein:
the heater (164) for heating the air in the air passage (170) comprises a plurality of meshes connected in series.
 6. A smoking substitute system (110) according to any one of claims 2 to 5, wherein:
the heater (164) for heating the air in the air passage (170) comprises a plurality of meshes connected in parallel.
 7. A smoking substitute system (110) according to any one of claims 2 to 6, wherein
the heater (164) for heating the air in the air passage (170) comprises a plurality of meshes which are independently operable.
 8. A smoking substitute system (110) according to any preceding claim, wherein:
the heater (164) for heating the air in the air passage (170) comprises an electrically heatable heating coil.
 9. A smoking substitute system (110) according to any preceding claim, wherein:
the heater (164) for heating the air in the air passage (170) comprises an electrically heatable heating plate.
 10. A smoking substitute system (110) according to claim 9, wherein:
the heating plate surrounds and defines a part of the air passage (170).
 11. A smoking substitute system (110) according to any preceding claim, wherein:
the heater (164) for heating the air in the air passage (170) is heatable by resistive heating using an electrical current.
 12. A smoking substitute system (110) according to any preceding claim, wherein:
one or more one-way valves (166) arranged along the air passage (170) and configured to allow air to flow along the air passage (170) in an upstream to downstream direction.
 13. A kit of parts for a smoking substitute system (110) according to any one of claims 1 to 12, comprising:
a base unit (120), and
a smoking substitute apparatus (150) removably engageable with the base unit (120); wherein:
the base unit (120) comprises a base unit air passage, said base unit air passage comprising the heater (164); and wherein:
the smoking substitute apparatus (150) is a cartridge configured for engagement with the base unit (120), the cartridge comprising a cartridge air passage in fluid communication with the base unit air passage to collectively form the air passage (170) of the smoking substitute system (110), said cartridge air passage comprising the reservoir (160).
 14. A kit of parts for a smoking substitute system (110) according to any one of claims 1 to 12, comprising:
a base unit (120), and
a smoking substitute apparatus (150) removably engageable with the base unit (120); wherein:
the smoking substitute apparatus (150) is a cartridge configured for engagement with the base unit (120), the cartridge comprising at least the portion of the air passage (170) that comprises the heater (164) and the reservoir (160) of the smoking substitute system (110).
 15. A method of using a smoking substitute system (110) according to any one of claims 1 to 12 to generate an aerosol.

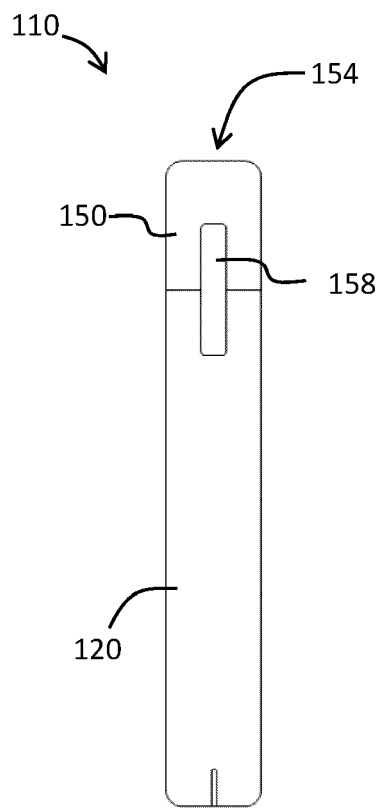


FIG. 1

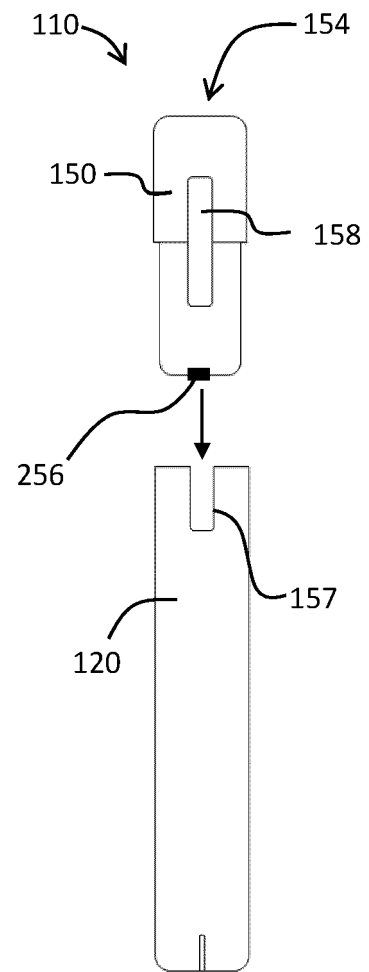
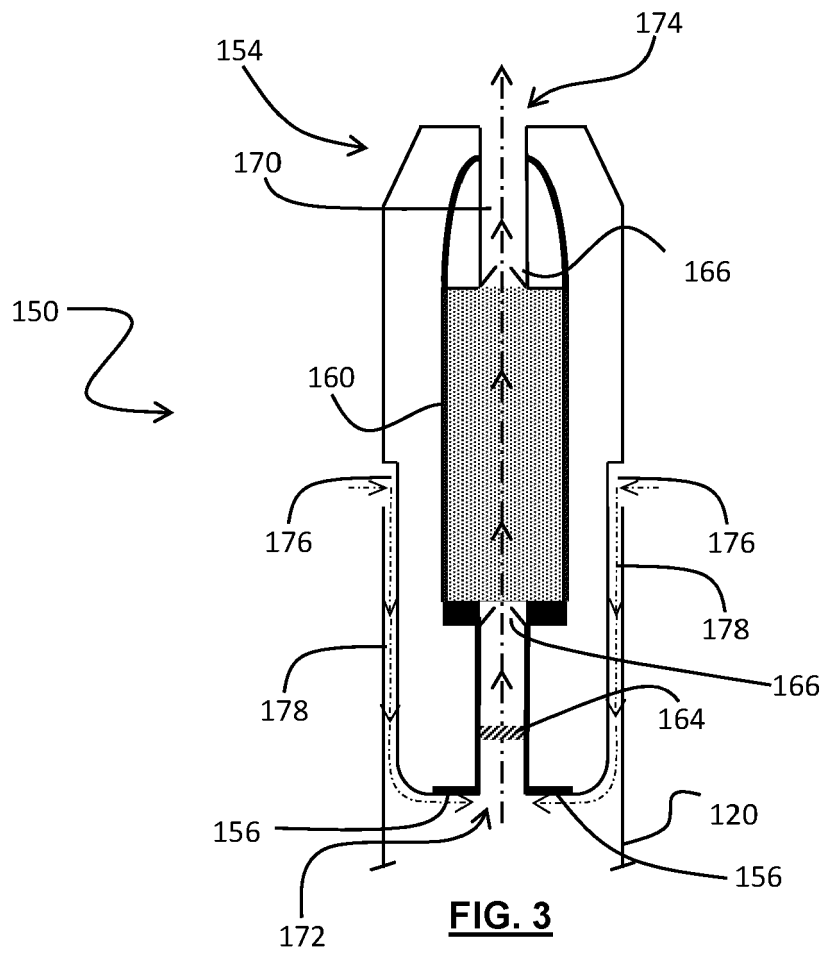


FIG. 2



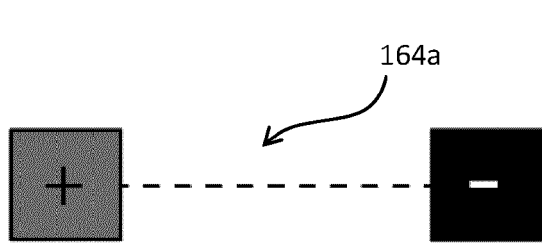


FIG. 4

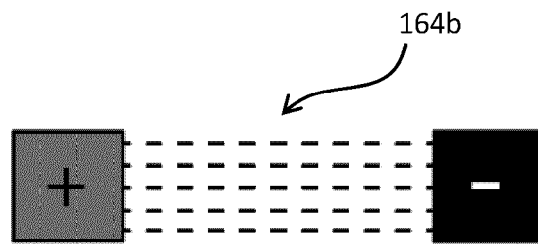


FIG. 5

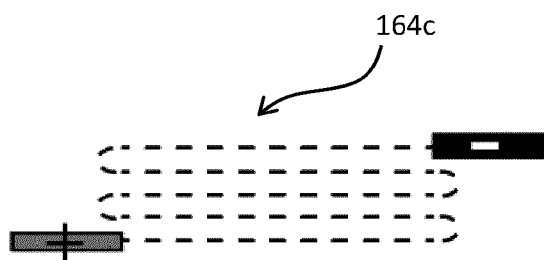


FIG. 6

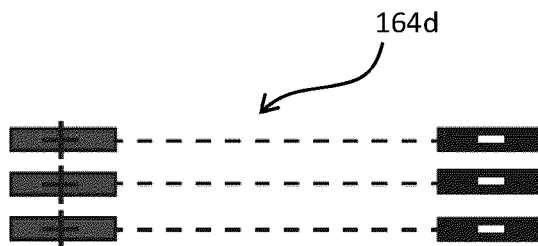


FIG. 7

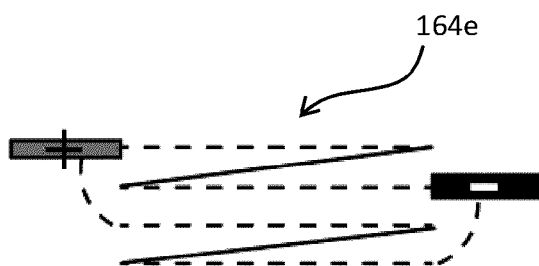


FIG. 8

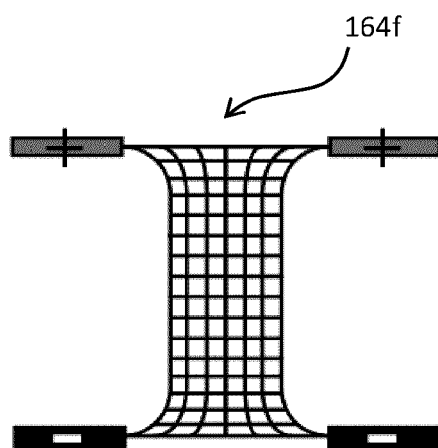


FIG. 9A

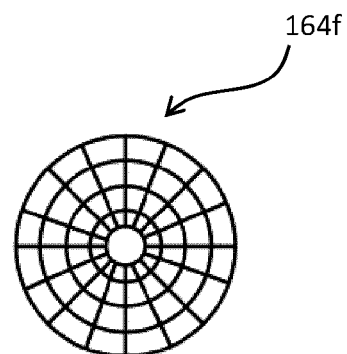


FIG. 9B



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