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(54) LIQUID FORMULATION OF AN ELECTRONIC VAPOR DEVICE

FLÜSSIGKEITSFORMULIERUNG EINER ELEKTRONISCHEN DAMPFVORRICHTUNG

FORMULATION LIQUIDE D'UN DISPOSITIF À VAPEUR ÉLECTRONIQUE

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(73) Proprietor: **Philip Morris Products S.A.**
2000 Neuchâtel (CH)

(72) Inventors:
- **LI, San**
  Midlothian, Virginia 23114 (US)
- **SMITH, Barry S.**
  Hopewell, Virginia 23860 (US)
- **KOBAL, Gerd**
  Sandy Hook, Virginia 23153 (US)

(74) Representative: **Reddie & Grose LLP**
The White Chapel Building
10 Whitechapel High Street
London E1 8QS (GB)

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Description

[0001] The present invention relates to a liquid formulation for e-vaping devices.

[0002] Electronic vaping devices (or e-vaping devices) are used to vaporize a liquid material into a vapor in order for a user (an adult electronic vaper or adult vaper) to inhale the vapor. E-vaping devices typically include a heater which vaporizes liquid material to produce a vapor. An e-vaping device may include several e-vaping elements including a power source, a cartridge or e-vaping tank including the heater and a reservoir capable of holding the liquid material.

[0003] A tobacco-based smoking article typically produces a vapor known to create a familiar sensory experience for adult smokers, including a low to moderate harshness response in the throat and a perceived warmth in the chest. The preferred levels of harshness in the throat and perceived warmth in the chest may differ amongst adult smokers. Users of e-vaping devices (adult vapers) typically prefer vaping a device that does not generate too much harshness but that is sufficient to produce a pleasant or familiar experience.

[0004] Liquid formulations for e-vaping devices comprising nicotine and one or more aerosol formers, such as propylene glycol, are widely available.

[0005] CN 101 473 999 A discloses a liquid formulation for an e-vaping device with a health orientation namely preventing and curing decayed teeth. The formulation comprises tobacco leaf extract, 40-50% w/v propylene glycol, 10-15% w/v water, tobacco flavor, stabilizer, thickener, xylitol, L-arabinose and sodium fluoride solution.

[0006] CN 101 461 565 discloses a health-care electronic cigarette liquid for medical use, which comprises: tobacco leaf extract, 40-50% w/v propylene glycol, 10-15% w/v pure water, tobacco flavor, stabilizer, thickener and a medicament.

[0007] The invention is defined in the appended independent claims, to which reference should now be made. Optional features of the invention are defined in dependent claims. Aspects, embodiments or examples falling outside the scope of the appended independent claims are not part of the invention, and are merely included for illustrative or explanatory purposes. According to the present invention there is provided a liquid formulation for an e-vaping device, the liquid formulation comprising: a vapor former including propylene glycol, water and substantially no amount of glycerol, wherein a concentration of propylene glycol in the vapor former is 80 percent by weight and a concentration of water in the vapor former is 20 percent by weight; nicotine, wherein a concentration of nicotine in the liquid formulation is equal to or lower than 1.5 percent by weight; and one or more acids, wherein the liquid formulation is configured to form a vapor having a particulate phase and a gas phase when heated in the e-vaping device.

[0008] The liquid formulation is configured to form a vapor having a gas phase upon operation of the e-vaping device.

[0009] The liquid formulation includes one or more acids. The acid is operative upon the vapor so as to reduce an amount of nicotine content in the gas phase of the vapor.

[0010] The vapor former including propylene glycol and substantially no glycerol or glycerin provides nicotine delivery, has a higher wicking rate and capillary efficiency in the cartomizer, evaporates easier, and generates a vapor that is less visible than a vapor formed by a vapor former including both propylene glycol and glycerol/glycerin. The above advantages may be due, among other reasons, to the fact that propylene glycol is substantially less viscous than glycerol and has a lower boiling point than glycerol. In addition, less battery power is required to generate a vapor when the vapor former includes propylene glycol and substantially no glycerol/glycerin. As a result, the performance of the e-vaping device is improved in terms of vapor formation efficiency and battery power usage.

[0011] As a result of higher evaporation of the vapor, vapor phase nicotine, which is the concentration of nicotine in the vapor phase of the vapor generated during vaping of the e-vaping device, is substantially increased compared to a lower evaporation rate of the vapor. As a result of the higher vapor phase nicotine, the perception in the chest of a user typically increases. As another result of the higher vapor phase nicotine, a lower nicotine level may be used in the vapor precursor or liquid formulation of the e-vaping device. For example, a nicotine level of substantially 1.5 percent, and nicotine levels that are lower than about 1.5 percent, may be used. For example, nicotine levels of about 0.5 percent, about 1 percent and about 1.5 percent may be used.

[0012] In addition, as the propylene glycol concentration in the vapor former increases, the visibility of the vapor exhaled by the user decreases. When the vapor former includes propylene glycol and substantially no glycerol, the vapor exhaled by the user is substantially invisible. Accordingly, a vapor precursor or liquid formulation including a vapor former having propylene glycol and substantially no glycerol/glycerin provides the ability for the user to vape without generating a noticeable amount of vapor.

[0013] The concentration of acids may be substantially 3.5 percent.

[0014] In one embodiment, the liquid formulation may include an acid having a boiling point of at least about 100 degrees Celsius and configured to volatilize when heated by a heater in the e-vaping device. The liquid formulation is configured to form a vapor having a particulate phase and a gas phase when heated by the heater in the e-vaping device, the particulate phase containing protonated nicotine and the gas phase containing unprotonated nicotine, and the vapor has a majority amount of the protonated nicotine and a minority amount of the unprotonated nicotine. In one embodiment, the acid is operative upon the vapor so as to reduce the amount of perceived throat harshness by a user in comparison to the vapor being formed upon operation of the e-vaping device without the acid.

[0015] In one embodiment, the acid is selected to have a liquid to vapor transfer efficiency of about 50 percent or greater and in an amount sufficient to reduce the nicotine gas phase component compared to the nicotine gas phase component of an e-vaping device having a vapor precursor or liquid formulation that does not include the acid. For example, the reduction may be of substantially 70 percent or greater.

[0016] In one embodiment, the acidic compound that is part of the vapor precursor or liquid formulation may include at least one of pyruvic acid, formic acid, oxalic acid, glycolic acid, acetic acid, isovaleric acid, valeric acid, propionic acid, octanoic acid, lactic acid, sorbic acid, malic acid, tartaric acid, succinic acid, citric acid, benzoic acid, oleic acid, aconitic acid, butyric acid, cinnamic acid, decanoic acid, 3,7-dimethyl-6-octenoic acid, 1-glutamic acid, heptanoic acid, hexanoic acid, 3-hexenoic acid, trans-2-hexenoic acid, isobutyric acid, lauric acid, 2-methylbutyric acid, 2-methylvaleric acid, myristic acid, nonanoic acid, palmitic acid, 4-pentenoic acid, phenylacetic acid, 3-phenylpropionic acid, hydrochloric acid, phosphoric acid and sulfuric acid.

[0017] In one embodiment, the acidic compound consists of a mixture of pyruvic acid, lactic acid, benzoic acid and acetic acid.

[0018] The liquid formulation includes water. Water can be included in an amount ranging from about 5 percent by weight based on the weight of the liquid formulation to about 40 percent by weight based on the weight of the liquid formulation. For example, water may be included at about 20 percent by weight based on the weight of the liquid formulation.

[0019] Features of any of the aspects and embodiments of the present invention described herein may be combined with one or more of the other aspects and embodiments of the present invention.

[0020] The above and other features and advantages of example embodiments will become more apparent by describing in detail, example embodiments with reference to the attached drawings. The accompanying drawings are intended to depict example embodiments and should not be interpreted to limit the intended scope of the claims. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted.

Fig. 1 is a side view of an e-vaping device, according to an example embodiment;
Fig. 2 is a cross-sectional view of an e-vaping device, according to an example embodiment;
Fig. 3 is a cross-sectional view of another example embodiment of an e-vaping device; and
Fig. 4 is a cross-sectional view of an e-vaping device according to an example embodiment.

[0021] Some detailed example embodiments are disclosed herein. However, specific structural and functional details disclosed herein are merely representative for purposes of describing example embodiments. Example embodiments may, however, be embodied in many alternate forms and should not be construed as limited to only the embodiments set forth herein.

[0022] Accordingly, while example embodiments are capable of various modifications and alternative forms, embodiments thereof are shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that there is no intent to limit example embodiments to the particular forms disclosed, but to the contrary, example embodiments are to cover all modifications, equivalents, and alternatives falling within the scope of example embodiments. Like numbers refer to like elements throughout the description of the figures.

[0023] It should be understood that when an element or layer is referred to as being "on," "connected to," "coupled to," or "covering" another element or layer, it may be directly on, connected to, coupled to, or covering the other element or layer, or intervening elements or layers may be present. In contrast, when an element is referred to as being "directly on," "directly connected to," or "directly coupled to" another element or layer, there are no intervening elements or layers present. Like numbers refer to like elements throughout the specification.

[0024] It should be understood that, although the terms first, second, third, etc. may be used herein to describe various elements, components, regions, layers or sections, these elements, components, regions, layers, or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer, or section from another region, layer, or section. Thus, a first element, component, region, layer, or section discussed below could be termed a second element, component, region, layer, or section without departing from the teachings of example embodiments.

[0025] Spatially relative terms (for example, "beneath," "below," "lower," "above," "upper," and the like) may be used herein for ease of description to describe one element or feature's relationship to another element or feature as illustrated in the figures. It should be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as "below" or "beneath" other elements or features would then be oriented "above" the other elements or features. Thus, the term "below" may encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

[0026] The terminology used herein is for the purpose of describing various embodiments only and is not intended to

be limiting of example embodiments. As used herein, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "includes," "including," "comprises," and "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, or groups thereof.

[0027] Example embodiments are described herein with reference to cross-sectional illustrations that are schematic illustrations of idealized embodiments (and intermediate structures) of example embodiments. As such, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and tolerances, are to be expected. Thus, example embodiments should not be construed as limited to the shapes of regions illustrated herein but are to include deviations in shapes that result, for example, from manufacturing. Thus, the regions illustrated in the figures are schematic in nature and their shapes are not intended to illustrate the actual shape of a region of a device and are not intended to limit the scope of example embodiments.

[0028] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which example embodiments belong. It will be further understood that terms, including those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0029] When the terms "about" or "substantially" are used in this specification in connection with a numerical value, it is intended that the associated numerical value include a tolerance of ± 10 percent around the stated numerical value. Moreover, when reference is made to percentages in this specification, it is intended that those percentages are based on weight, that is, weight percentages. The expression "up to" includes amounts of zero to the expressed upper limit and all values therebetween. When ranges are specified, the range includes all values therebetween such as increments of 0.1 percent.

[0030] In one embodiment, an e-vaping device includes a liquid supply reservoir containing a liquid formulation. The liquid formulation is delivered to a heater of the e-vaping device where the liquid formulation is heated and volatilized to form a vapor upon operation of the e-vaping device. In an example embodiment, the liquid formulation includes a mixture of molecular nicotine (unprotonated and uncharged) and an acid, which protonates nearly all of the molecular nicotine in the liquid formulation, so that upon heating of the liquid formulation by a heater in the e-vaping device, a vapor having a majority amount of protonated nicotine and a minority amount of unprotonated nicotine is produced, whereby only a minor portion of all the vaporized nicotine typically remains in the gas phase of the vapor. The fraction of nicotine in the gas phase may contribute to perceptions of throat harshness or other perceived off-tastes. Reducing the proportional level of nicotine in the gas phase may improve the perceived subjective deficits associated with nicotine in the gas phase. For example, a proportion of nicotine in the gas phase of the vaporized nicotine may be substantially 1.5 percent, substantially 1 percent or less of the total nicotine delivered.

[0031] As used herein, the term "vapor former" describes any suitable known compound or mixture of compounds that, in use, facilitates formation of a vapor and that is substantially resistant to thermal degradation at the operating temperature of the vapor-generating device. Suitable vapor-formers consist of various compositions of polyhydric alcohols such as propylene glycol. In one embodiment, the vapor is propylene glycol.

[0032] The liquid formulation may optionally include one or more flavorants in an amount ranging from about 0.01 percent to about 15 percent by weight (for example, about 1 percent to about 12 percent, about 2 percent to about 10 percent, or about 5 percent to about 8 percent). The flavorant can be a natural flavorant or an artificial flavorant. In one embodiment, the flavorant is one of tobacco flavor, menthol, wintergreen, peppermint, herb flavors, fruit flavors, nut flavors, liquor flavors, and combinations thereof.

[0033] The following examples describe the taste and perception differences between i) formulations that include a mixture of propylene glycol and glycerol, and ii) formulations that include propylene glycol but do not include glycerol. The amount of nicotine in the various formulations may be between about 0.5 percent and about 1.5 percent. For example, nicotine levels of about 0.5 percent, about 1 percent, about 1.5 percent, about 2 percent, about 2.5 percent and about 3 percent may be used. The following examples of e-vaping devices are discussed:

COMPARATIVE EXAMPLE 1: A first comparative liquid formulation solution includes about 40 percent propylene glycol (PG), about 60 percent glycerol (Gly), about 15 percent water and about 1.5 percent nicotine by weight (NBW) with substantially no acid.

[0034] COMPARATIVE EXAMPLE 2: A second comparative liquid formulation solution includes about 40 percent propylene glycol, about 60 percent glycerol, about 15 percent water, about 1.5 percent nicotine by weight (NBW) and about 2 percent of menthol as a flavorant, with substantially no acid.

[0035] EXAMPLE 1: A first example embodiment of a liquid formulation solution includes about 80 percent propylene glycol, substantially no glycerol, about 20 percent water and about 1.5 percent nicotine by weight (NBW) with substantially no acid.

[0036] EXAMPLE 2: A second example embodiment of a liquid formulation solution includes about 80 percent propylene

glycol, substantially no glycerol, about 20 percent water and about 1.5 percent nicotine by weight (NBW) with substantially no acid. The liquid formulation also includes substantially 2 percent menthol by weight.

[0037] Comparing Examples 1 and 2 to Examples 3 and 4, as described in Table 1 below, shows that the removal of glycerol substantially increased the overall enjoyment (overall "liking") of the e-vaping device.

[0038] Table 1 describes the reaction of a panel of eight users (adult vapers) who performed a taste-test for the examples described above. The users were asked to score the overall enjoyment, or liking, of the e-vaping device, on a scale of 1 to 7. The users were asked to rank the "Flavor Liking or Menthol Perception" to provide an evaluation of their liking of the flavorant, and in the case where the flavorant is menthol, of their perception of the menthol in the e-vaping device. The users were also asked to rank the impact of the e-vaping device for each one of the comparative examples and the example embodiments, the strength being perceived in the chest of the user. For example, the strength of the e-vaping device may be the perception of a strong nicotine taste in the chest of the users. The users also ranked the harshness of the e-vaping devices based on the various liquid compositions, the harshness being perceived in one or both of the mouth and the throat of the user. For example, the harshness may be the perception of a burning sensation in one or both of the mouth and the throat of the user during use of the e-vaping device, the burning sensation being due to the combination of propylene glycol and glycerol.

Table 1: Overall Enjoyment Score of Various E-Vaping Devices

Expert Panel (Scale of 1-7)	Comparative Example 1 (40/60 PG/Gly, 15 percent Water, 1.5 percent NBW)	Comparative Example 2 (40/60 PG/Gly, 15 percent Water, 1.5 percent NBW, 2 percent Menthol)	Example Embodiment 1 (80/20 PG/Water, 1.5 percent NBW, flavorant)	Example Embodiment 2 (40/20 PG/ Water, 1.5 percent NBW, 2 percent Menthol)
Flavor linking or Menthol Perception	3.81	3.88	4.00	4.63
Impact	3.69	3.5	4.00	4.06
Harshness	3.56	3.00	3.25	3.06
Overall Liking	3.5	3.5	3.75	3.88

[0039] Based on the results described on Table 1, Example Embodiments 1 and 2 yield greater average scores of 3.75 and 3.88 on a scale of 1-7 compared to Comparative Examples 1 and 2, which yield average scores of 3.5 each. Thus, the expert panel of users concluded that e-vaping devices having liquid formulations that include a mixture of propylene glycol, water and nicotine, without including glycerin/glycerol have a more positive perception of the flavor and a better sensation of impact in the chest, harshness in one or both of the mouth and the throat, of the user.

[0040] The following experiments also discuss the taste and perception differences among formulations that include a mixture of propylene glycol and glycerol as well as formulations that do not include glycerol. The amount of nicotine in the various formulations is about 1.5 percent, and the amount of water is about 15 percent. In the experiments, nicotine measurements per puff of an e-vaping device by a user have been taken with respect to a relative concentration of propylene glycol and glycerol.

[0041] The examples of e-vaping devices are discussed below with respect to Table 2:

Table 2: Nicotine amount per puff with respect to liquid formulation

Percentage PG-Glycerol	**Puff 1-20 (milligrams of nicotine/puff)**	**Puff 21-40 (milligrams of nicotine/puff)**	**Puff 41-60 (milligrams of nicotine/puff)**	**Puff 61-80 (milligrams of nicotine/puff)**
0-100	0.053	0.045	0.040	0.026
20-80	0.060	0.052	0.044	0.023
40-60	0.066	0.057	0.048	0.030
60-40	0.071	0.061	0.055	0.028
80-20	0.075	0.065	0.058	0.038
100-0	0.088	0.077	0.061	0.022

[0042] Based on the results described in Table 2, and for the same e-vaping conditions, that is, a same battery power output, cartomizer configuration and nicotine and water content in the liquid formulation, the vapor mass and nicotine in the vapor generated per puff (milligrams of nicotine/puff) are different with different propylene glycol to glycerol ratios in the liquid formulation of the e-vaping device. Accordingly, as propylene glycol fraction in the liquid formulation increases, the inhaled vapor produces more strength or impact in the chest of the user, as evidenced by the increasing amount of nicotine per puff. The increasing amount of nicotine per puff is proportional to an increase in the concentration of propylene glycol in the liquid formulation.

[0043] This effect may be due, among other reasons, to the fact that propylene glycol is substantially less viscous than glycerol. As a result, liquid formulations with increased propylene glycol typically have a higher wicking rate and capillary efficiency. Propylene glycol also has a lower boiling point than glycerol. As a result, generation of the vapor is easier for liquid formulations that have increased propylene glycol. In addition, less battery power is required to generate a vapor when the vapor former includes propylene glycol and substantially no glycerol because of the easier generation of vapor. As a result of the above and of the increased fluid properties of propylene glycol, the performance of the e-vaping device is improved in terms of vapor formation efficiency and battery power usage when more propylene glycol is provided in the liquid formulation.

[0044] In examples, as the propylene glycol concentration in the vapor former increases, the visibility of the exhaled vapor decreases. When the vapor former includes propylene glycol and substantially no glycerol, the vapor exhaled by a user is substantially invisible. Accordingly, a liquid formulation including a vapor former having propylene glycol and substantially no glycerol provides the ability for the user to vape without generating vapor. For example, a liquid formulation having substantially 80 percent propylene glycol, substantially 20 percent water and substantially no glycerol may provide the above advantages.

[0045] According to at least one example, an acid can be added to the vapor precursor, the acid having the effect of reducing the production of gas phase nicotine with typically minimal sensory and operational impact on the e-vaping device.

[0046] In another example, the acid is added within an acceptable sensorial amount according to a sensory impact associated with the acid. For example, to some users, acetic acid, when added at certain levels, may impart a "vinegar" sensorial response. Accordingly, in one embodiment, the acetic acid content may be limited to levels below where such sensory impact arises. Other acids can also be used in combination with the acetic (or other) acid in a similar manner so as to establish an acid complex wherein the desired level of acid functionality is achieved (with multiple acids), but with each acid being included at a level below where noticeable or objectionable sensory impact may arise.

[0047] According to at least one example, the acid has a boiling point of at least about 100 degrees Celsius, and may be included in the liquid formulation in an amount sufficient to adjust the pH of the liquid formulation in the range of about 3 to about 8.

[0048] In one example, the acid is included in an amount sufficient to reduce the amount of nicotine gas phase component by about 30 percent by weight or greater, preferably about 60 percent to about 70 percent by weight, more preferably, about 70 percent by weight or greater, and most preferably about 85 percent by weight or greater, of the level of nicotine gas phase component produced without the acid.

[0049] In one example, the acid is operative upon the vapor generated from the liquid formulation upon operation of the e-vaping device so as to reduce the amount of perceived throat harshness in comparison to the vapor formed without the acid.

[0050] According to at least one example, the acid included in the liquid formulation includes one or more of pyruvic acid, formic acid, oxalic acid, glycolic acid, acetic acid, isovaleric acid, valeric acid, propionic acid, octanoic acid, lactic acid, levulinic acid, sorbic acid, malic acid, tartaric acid, succinic acid, citric acid, benzoic acid, oleic acid, aconitic acid, butyric acid, cinnamic acid, decanoic acid, 3,7-dimethyl-6-octenoic acid, 1-glutamic acid, heptanoic acid, hexanoic acid, 3-hexenoic acid, trans-2-hexenoic acid, isobutyric acid, lauric acid, 2-methylbutyric acid, 2-methylvaleric acid, myristic acid, nonanoic acid, palmitic acid, 4-pentenoic acid, phenylacetic acid, 3-phenylpropionic acid, hydrochloric acid, phosphoric acid, sulfuric acid, and combinations thereof. The acid also may be incorporated in the form of a salt.

[0051] Fig. 1 is a side view of an e-vaping device, according to a first example. In Fig. 1, the liquid formulation forms a vapor when vaporized in an e-vaping device 60 such as, for example, an e-vaping device, as shown in Fig. 1. The e-vaping device 60 comprises a replaceable cartridge (or first section) 70 and a reusable fixture (or second section) 72, which are coupled together at a threaded joint 74 or by other connecting structure such as one or more of a snug-fit, snap-fit, detent, clamp, clasp, or the like.

[0052] Fig. 3 is a cross-sectional view of another example of an e-vaping device. As shown in Fig. 3, the first section 70 can house a mouth-end insert 20, a capillary vapor generator including a capillary tube 18, a heater 19 to heat at least a portion of the capillary tube 18, a liquid supply reservoir 14, and optionally a valve 40. Alternatively, as shown in Fig. 4, the first section 70 can house a mouth-end insert 20, a heater 319, a flexible, filamentary wick 328 and a liquid supply reservoir 314 as discussed in further detail below.

[0053] The second section 72 can house a power supply 12 (shown in Figs. 2, 3 and 4), a control circuitry 11, and

optionally a puff sensor 16 (shown in Figs. 2 and 4). The threaded portion 74 of the second section 72 can be connected to a battery charger, when not connected to the first section 70, to charge the battery or power supply 12.

[0054] Fig. 2 is a cross-sectional view of an e-vaping device according to another example. As shown in Fig. 2, the e-vaping device 60 can also include a middle section (third section) 73, which can house the liquid supply reservoir 14, the heater 19 and the valve 40. The middle section 73 can be configured to be fitted with a threaded joint 74' at an upstream end of the first section 70 and a threaded joint 74 at a downstream end of the second section 72. In this example, the first section 70 houses the mouth-end insert 20, while the second section 72 houses the power supply 12 and the control circuitry 11.

[0055] In one example, the first section 70, the second section 72 and the optional third section 73 include an outer cylindrical housing 22 extending in a longitudinal direction along the length of the e-vaping device 60. Moreover, in one example, the middle section 73 is disposable and one or both of the first section 70 and the second section 72 are reusable. The sections 70, 72, 73 can be attached by threaded connections or connectors whereby the middle section 73 can be replaced when the liquid supply reservoir 14 is used up. In another example, the first section 70 can also be replaceable so as to avoid the need for cleaning one or both of the capillary tube 18 and the heater 19.

[0056] In one example, the first section 70 and the second section 72 may be integrally formed without threaded connections to form a disposable e-vaping device.

[0057] As shown in Fig. 2, the outer cylindrical housing 22 can include a cutout or depression 102 which allows a user to manually apply pressure to the liquid supply reservoir 14. In one example, the outer cylindrical housing 22 is one or both of flexible and compressible along the length thereof and fully or partially covers the liquid supply reservoir 14. The cutout or depression 102 can extend partially about the circumference of the outer cylindrical housing 22. Thus, the outer cylindrical housing 22 can be formed of or include a variety of materials including plastics, rubber and combinations thereof. In one example, the outer cylindrical housing 22 is formed of or includes silicone. The outer cylindrical housing 22 can be any suitable color. The outer cylindrical housing 22 can include graphics or other indicia printed thereon. Moreover, the liquid supply reservoir 14 is compressible such that when pressure is applied to the liquid supply reservoir, liquid is pumped from the liquid supply reservoir 14 to the capillary tube 18. A pressure activated switch 44 can be positioned beneath the liquid supply reservoir 14. When pressure is applied to the liquid supply reservoir 14 to pump liquid, the switch is also pressed and a heater 19 is activated. The heater 19 can be a portion of the capillary tube 18. By applying manual pressure to the pressure switch, the power supply 12 is activated and an electric current heats the liquid in the capillary tube 18 via electrical contacts so as to volatilize the liquid.

[0058] In the example illustrated in Fig. 2, the liquid supply reservoir 14 is a tubular, elongated body formed of or including an elastomeric material so as to be one or both of flexible and compressible when squeezed. In one example, the elastomeric material can be one of silicone, plastic, rubber, latex, and combinations thereof.

[0059] In one example, the compressible liquid supply reservoir 14 has an outlet 17 in fluid communication with a capillary tube 18 so that when squeezed, the liquid supply reservoir 14 can deliver a volume of liquid material to the capillary tube 18. Contemporaneously to delivering liquid to the capillary, the power supply 12 is activated upon the application of the manual pressure on the pressure switch, and the capillary tube 18 is heated to form a heated section wherein the liquid material is volatilized. Upon discharge from the heated capillary tube 18, the volatilized material expands, mixes with air and forms a vapor.

[0060] In one example, the liquid supply reservoir 14 extends longitudinally within the outer cylindrical housing 22 of the first section 70 (shown in Figs. 3 and 4) or the middle section 73 (shown in Fig. 2). Moreover, the liquid supply reservoir 14 contains a liquid formulation that is configured to be volatilized when heated and to form a vapor when discharged from the capillary tube 18.

[0061] In the examples illustrated in Figs. 2 and 3, the capillary tube 18 includes an inlet end 62 in fluid communication with the outlet 17 of the liquid supply reservoir 14, and an outlet end 63 configured to expel volatilized liquid material from the capillary tube 18. In one example, as shown in Figs. 2 and 3, the liquid supply reservoir 14 may include a valve 40.

[0062] As shown in Fig. 2, the valve 40 can be a check valve configured to maintain the liquid material within the liquid supply reservoir and to open when the liquid supply reservoir 14 is squeezed and pressure is applied to the reservoir 14. In one example, the check valve 40 opens when a critical, minimum pressure is reached so as to avoid inadvertent dispensing of liquid material from the liquid supply reservoir 14 or activating the heater 19. In one example, the critical pressure needed to open the check valve 40 is essentially equal to or slightly less than the pressure required to apply a pressure switch 44 to activate the heater 19. In one example, the pressure required to press the pressure switch 44 is high enough such that accidental heating is avoided. Such arrangement avoids activation of the heater 19 in the absence of liquid being pumped through the capillary.

[0063] Advantageously, the use of a check valve 40 aids in limiting the amount of liquid that is drawn back from the capillary tube upon release of pressure upon the liquid supply reservoir 14, the switch 44, or both, if manually pumped so as to avoid air uptake into the liquid supply reservoir 14. Presence of air degrades pumping performance of the liquid supply reservoir 14 and can degrade the liquid formulation.

[0064] Once pressure upon the liquid supply reservoir 14 is relieved, the valve 40 closes. The heated capillary tube

18 discharges any liquid remaining downstream of the valve 40.

[0065] Optionally, a critical flow orifice 41 is located downstream of the check valve 40 to establish a maximum flow rate of liquid to the capillary tube 18.

[0066] As shown in Fig. 3, in other examples, the valve 40 can be a two-way valve and the liquid supply reservoir 14 can be pressurized. For example, the liquid supply reservoir 14 can be pressurized using a pressurization arrangement 405 configured to apply constant pressure to the liquid supply reservoir 14. For example, pressure can be applied to the liquid supply reservoir 14 using an internal or external spring and plate arrangement which constantly applies pressure to the liquid supply reservoir 14. Alternatively, the liquid supply reservoir 14 can be compressible and positioned between two plates that are connected by springs or the liquid supply reservoir 14 could be compressible and positioned between the outer housing and a plate that are connected by a spring so that the plate applies pressure to the liquid supply reservoir 14.

[0067] In one example, the capillary tube 18 of Figs. 2 and 3 has an internal diameter of about 0.01 millimetres to about 10 millimetres, preferably about 0.05 millimetres to about 1 millimetre, and more preferably about 0.05 millimetres to about 0.4 millimetres. Capillary tubes of smaller diameter provide more efficient heat transfer to the fluid because, with the shorter distance to the center of the fluid, less energy and time is required to vaporize the liquid.

[0068] In one example, the capillary tube 18 may have a length of about 5 millimetres to about 72 millimetres, more preferably about 10 millimetres to about 60 millimetres or about 20 millimetres to about 50 millimetres. In one example, the capillary tube 18 is substantially straight. In other examples, the capillary tube 18 is coiled or includes one or more bends therein to conserve space, accommodate a long capillary tube, or both.

[0069] In some examples, the capillary tube 18 is formed of or includes a conductive material, and thus acts as its own heater 19 by passing current through the tube. The capillary tube 18 may be any electrically conductive material capable of being resistively heated, while retaining the necessary structural integrity at the operating temperatures experienced by the capillary tube 18, and which is non-reactive with the liquid material. Suitable materials for forming the capillary tube 18 are one or more of stainless steel, copper, copper alloys, porous ceramic materials coated with film resistive material, Inconel® available from Special Metals Corporation, which is a nickel-chromium alloy, nichrome, which is also a nickel-chromium alloy, and combinations thereof.

[0070] In one example, the capillary tube 18 is a stainless steel capillary tube 18, which serves as a heater 19 via electrical leads 26 attached thereto for passage of direct or alternating current along a length of the capillary tube 18. Thus, the stainless steel capillary tube 18 is heated by resistance heating. The stainless steel capillary tube 18 may be circular in cross section and may be formed of or include tubing suitable for use as a hypodermic needle of various gauges. For example, the capillary tube 18 may comprise a 32 gauge needle having an internal diameter of about 0.11 millimetres and a 26 gauge needle having an internal diameter of about 0.26 millimetres.

[0071] In another example, the capillary tube 18 may be a non-metallic tube such as, for example, a glass tube. In such an example, the heater 19 is formed of or includes a conductive material capable of being resistively heated, such as, for example, stainless steel, nichrome or platinum wire, arranged along the glass tube. When the heater arranged along the glass tube is heated, liquid material in the capillary tube 18 is heated to a temperature sufficient to at least partially volatilize liquid material in the capillary tube 18.

[0072] In one example, at least two electrical leads 26 (Fig. 2) are bonded to a metallic capillary tube 18. In an example, the at least two electrical leads 26 are coupled to the capillary tube 18. In one example, one electrical lead 26 is coupled to a first, upstream portion 101 of the capillary tube 18 and a second electrical lead 26 is coupled to a downstream, end portion 102 of the capillary tube 18, as shown in Figs. 2 and 3.

[0073] In operation, once the capillary tube 18 of Figs. 2 and 3 is heated, the liquid material contained within a heated portion of the capillary tube 18 is volatilized and ejected out of the outlet 63 where the liquid material expands and mixes with air and forms a vapor in a mixing chamber 240.

[0074] As discussed above and illustrated in Fig. 4, the liquid formulation can also be used in an e-vaping device including a heater zone having at least one heater 319 and a filamentary wick 328. The first section 70 includes an outer tube (or casing) 22 extending in a longitudinal direction and an inner tube (or chimney) 362 coaxially positioned within the outer tube 22. In one example, a nose portion 361 of an upstream gasket (or seal) 320 is fitted into an upstream end portion 365 of the inner tube 362, while at the same time, an outer perimeter 367 of the gasket 320 provides a liquid-tight seal with an interior surface 397 of the outer casing 22. The upstream gasket 320 also includes a central, longitudinal air passage 315, which opens into an interior of the inner tube 362 that defines a central channel 321. A transverse channel 333 at an upstream portion of the gasket 320 intersects and communicates with the central, longitudinal air passage 315 of the gasket 320. This channel 333 assures communication between the central, longitudinal air passage 315 and a space 335 defined between the gasket 320 and a threaded connection 74.

[0075] In one example, a nose portion 393 of a downstream gasket 310 is fitted into a downstream end portion 381 of the inner tube 362. An outer perimeter 382 of the gasket 310 provides a substantially liquid-tight seal with an interior surface 397 of the outer casing 22. The downstream gasket 310 includes a central channel 384 disposed between the central passage 321 of the inner tube 362 and the mouth-end insert 20.

[0076] In this example, the liquid supply reservoir 314 is contained in an annulus between an inner tube 362 and an outer casing 22 and between the upstream gasket 320 and the downstream gasket 310. Thus, the liquid supply reservoir 314 at least partially surrounds the central air passage 321. The liquid supply reservoir 314 comprises a liquid material and optionally a liquid storage medium (not shown) configured to store the liquid material therein.

[0077] The inner tube 362 has a central air passage 321 extending therethrough and that houses the heater 319. The heater 319 is in contact with the filamentary wick 328, which preferably extends between opposing sections of the liquid supply reservoir 314 so as to deliver the liquid formulation from the liquid supply reservoir to the heater 319.

[0078] In one example, the e-vaping device 60 described herein also includes at least one air inlet 440. As shown in Fig. 4, the at least one air inlet 440 can be located upstream of the heater 319.

[0079] In the examples illustrated in Figs. 2 and 3, the at least one air inlet 440 is preferably arranged downstream of the capillary tube 18 so as to minimize drawing air along the capillary tube and thereby avoid cooling of the capillary tube 18 during heating cycles.

[0080] In the examples, the at least one air inlet 440 includes one or two air inlets. Alternatively, there may be three, four, five or more air inlets. Altering the size and number of air inlets 440 can also aid in establishing the resistance to draw of the e-vaping device 60.

[0081] The power supply 12 of the examplescan include a battery or power supply 12 arranged in the e-vaping device 60. The power supply 12 is configured to apply voltage across the heater 19 associated with the capillary tube 18, as shown in Figs. 2 and 3, or the heater 319 associated with the wick 328, as shown in Fig. 4. Thus, the heater 19 or 319 volatilizes liquid material according to a power cycle of either a predetermined time period, such as a 2 to 10 second period.

[0082] In one example, the electrical contacts or connection between the heater 19, 319 and the electrical leads 26 are substantially conductive and temperature resistant while the heater 19, 319 is substantially resistive so that heat generation occurs primarily along the heater 19 and not at the contacts.

[0083] The battery 12 can be a lithium-ion battery or one of its variants, for example a lithium-ion polymer battery. Alternatively, the battery may be a nickel-metal hydride battery, a nickel cadmium battery, a lithium-manganese battery, a lithium-cobalt battery or a fuel cell. In that case, preferably, the e-vaping device 60 is usable by a smoker until the energy in the power supply is depleted. Alternatively, the power supply 12 may be rechargeable and include circuitry allowing the battery to be chargeable by an external charging device. In that case, preferably the circuitry, when charged, provides power for a pre-determined number of puffs, after which the circuitry must be re-connected to an external charging device.

[0084] In one example, the e-vaping device 60 also includes control circuitry which can be on a printed circuit board 11 (shown in Figs. 2, 3 and 4). The control circuitry 11 can also include a heater activation light 27 that is configured to glow when the heater 19, 319 is activated. In one example, the heater activation light 27 comprises at least one LED and is at an upstream end 28 (shown in Fig. 1) of the e-vaping device 60 so that the heater activation light 27 illuminates a cap which takes on the appearance of a burning coal during use. Moreover, the heater activation light 27 can be configured to be visible to the adult vaper. In addition, the heater activation light 27 can be utilized for smoking article system diagnostics. The light 27 can also be configured such that the adult vaper can activate, deactivate, or activate and deactivate the light 27 when desired, such that the light 27 would not activate during vaping if desired.

[0085] The time-period of the electric current supply to the heater 19 may be pre-set depending on the amount of liquid desired to be vaporized. The control circuitry 11 can be programmable and can include an application specific integrated circuit (ASIC). In other examples, the control circuitry 11 can include a microprocessor programmed to carry out functions such as heating the capillary tubes, operating the valves, or both.

[0086] As shown in Figs. 2, 3 and 4, the e-vaping device 60 further includes a mouth-end insert 20 having at least two off-axis, preferably diverging outlets 21. In one example, the mouth-end insert 20 includes at least two diverging outlets 21 (for example, 3, 4, 5, 6 to 8 outlets or more). In one example, the outlets 21 of the mouth-end insert 20 are located at ends of off-axis passages 23 and are angled outwardly in relation to the longitudinal direction of the e-vaping device 60 (i.e., divergently). As used herein, the term "off-axis" denotes at an angle to the longitudinal direction of the e-vaping device. Also preferably, the mouth-end insert (or flow guide) 20 includes outlets uniformly distributed around the mouth-end insert 20 so as to substantially uniformly distribute vapor in a user's mouth during use.

[0087] In addition, the outlets 21 and off-axis passages 23 are arranged such that droplets of unvaporized liquid material carried in the vapor impact at least one of interior surfaces of the mouth-end insert 20 and interior surfaces of the off-axis passages 23 such that the droplets are removed or broken apart.

[0088] In one example, one or more of the outlets 21 may have a diameter of about 0.015 inch to about 0.090 inch (for example, about 0.020 inch to about 0.040 inch or about 0.028 inch to about 0.038 inch). The size of the outlets 21 and off-axis passages 23 along with the number of outlets 21 can be selected to adjust the resistance to draw (RTD) of the e-vaping device 60, if desired.

[0089] In one example, the e-vaping device 60 is about the same size as a tobacco-based smoking article. In some examples, the e-vaping device 60 can be about 80 millimetres to about 110 millimetres long, preferably about 80 millimetres to about 100 millimetres long and about 7 millimetres to about 10 millimetres in diameter. For example, in one

example, the e-vaping device is about 84 millimetres long and has a diameter of about 7.8 millimetres.

[0090] The outer cylindrical housing 22 of the e-vaping device 60 may be formed of or include any suitable material or combination of materials. In one example, the outer cylindrical housing 22 is formed at least partially of metal and is part of the electrical circuit.

[0091] In one example, the liquid formulation may include one of more acids from pyruvic acid, formic acid, oxalic acid, acetic acid, isovaleric acid, valeric acid, propionic acid, octanoic acid, lactic acid, levulinic acid, sorbic acid, malic acid, tartaric acid, succinic acid, citric acid, benzoic acid, oleic acid, aconitic acid, butyric acid, cinnamic acid, decanoic acid, 3,7-diemthyl-6-octenoic acid, 1-glutamic acid, heptanoic acid, hexanoic acid, 3-hexenoic acid, trans-2-hexenoic acid, isobutyric acid, lauric acid, 2-methylbutyric acid, 2-methylvaleric acid, myristic acid, nonanoic acid, palmitic acid, 4-pentenoic acid, phenylacetic acid, 3-phenylpropionic acid, hydrochloric acid, phosphoric acid, sulfuric acid and combinations thereof. The acid also may be incorporated into the liquid formulation in the form of a salt. In one example, the salt form of the acid is selected such that the addition of the acid does not have significant adverse effects on one or both of the vapor transfer efficiency and the reaction of the corresponding free acid form with nicotine.

[0092] The acids included in the liquid formulation can have a boiling point of at least about 100 degrees Celsius. For example, the acids may have a boiling point ranging from about 100 degrees Celsius to about 300 degrees Celsius or from about 150 degrees Celsius to about 250 degrees Celsius (for example, about 160 degrees Celsius to about 240 degrees Celsius, about 170 degrees Celsius to about 230 degrees Celsius, about 180 degrees Celsius to about 220 degrees Celsius or about 190 degrees Celsius to about 210 degrees Celsius). By including acids having a boiling point within this range, the acid may volatilize when heated by heater elements of e-vaping devices as previously described. In one example utilizing a heater coil and a wick, the heater coil may reach an operating temperature at or about 300 degrees Celsius.

[0093] In one example, the acid is included in the liquid formulation in an amount sufficient to reduce the pH of the liquid formulation in the range of about 3 to about 8. In the examples, the acid is included in the liquid formulation in an amount sufficient to adjust the pH of the liquid formulation in the range of about 3 to about 5. In some other examples, the acid is included in the liquid formulation in an amount sufficient to adjust the pH of the liquid formulation in the range of about 7 to about 8. Moreover, the acid may be condensable at ambient temperature (except for HCl and other acids which are gases at ambient temperature).

Claims

1. A liquid formulation for an e-vaping device, the liquid formulation comprising:

   a vapor former including propylene glycol, water and substantially no amount of glycerol, wherein a concentration of propylene glycol in the vapor former is 80 percent by weight and a concentration of water in the vapor former is 20 percent by weight;
   nicotine, wherein a concentration of nicotine in the liquid formulation is equal to or lower than 1.5 percent by weight; and
   one or more acids,
   wherein the liquid formulation is configured to form a vapor having a particulate phase and a gas phase when heated in the e-vaping device.

2. The liquid formulation of claim 1, wherein a concentration of nicotine in the liquid formulation is 1.5 percent by weight.

3. The liquid formulation of claim 1 wherein a concentration of nicotine in the liquid formulation is 1 percent by weight or 0.5 percent by weight.

4. The liquid formulation of any preceding claim, wherein vapor particles formed from the vapor former have a larger average diameter than vapor particles formed from a different vapor former that includes glycerol.

5. The liquid formulation of claim 4, wherein an evaporation rate of the vapor particles formed from the vapor former is greater than an evaporation rate of vapor particles formed from the different vapor former including glycerol.

6. The liquid formulation of any preceding claim, wherein the liquid formulation is in the form of a solution.

7. The liquid formulation of any preceding claim, further comprising an acidic compound that includes at least one of pyruvic acid, formic acid, oxalic acid, glycolic acid, acetic acid, isovaleric acid, valeric acid, propionic acid, octanoic acid, lactic acid, sorbic acid, malic acid, tartaric acid, succinic acid, citric acid, benzoic acid, oleic acid, aconitic acid,

butyric acid, cinnamic acid, decanoic acid, 3,7-dimethyl-6-octenoic acid, 1-glutamic acid, heptanoic acid, hexanoic acid, 3-hexenoic acid, trans-2-hexenoic acid, isobutyric acid, lauric acid, 2-methylbutyric acid, 2-methylvaleric acid, myristic acid, nonanoic acid, palmitic acid, 4-pentenoic acid, phenylacetic acid, 3-phenylpropionic acid, hydrochloric acid, phosphoric acid and sulfuric acid.

8. The liquid formulation of any preceding claim, further comprising nicotine bitartrate.

Patentansprüche

1. Flüssige Formulierung für eine E-Dampfvorrichtung, wobei die flüssige Formulierung umfasst:

   Einen Dampfbildner, der Propylenglykol, Wasser und im Wesentlichen keine Menge an Glycerin umfasst, wobei eine Konzentration an Propylenglykol in dem Dampfbildner 80 Gew.-% und eine Konzentration an Wasser in dem Dampfbildner 20 Gew.-% beträgt;
   Nikotin, wobei eine Konzentration von Nikotin in der flüssigen Formulierung gleich oder weniger als 1,5 Gew.-% beträgt; und eine oder mehreren Säuren,
   wobei die flüssige Formulierung so konfiguriert ist, dass diese einen Dampf mit einer teilchenförmigen Phase und einer Gasphase bildet, wenn sie in der e-Dampfvorrichtung erhitzt wird.

2. Flüssige Formulierung nach Anspruch 1, wobei eine Konzentration von Nikotin in der flüssigen Formulierung 1,5 Gew.-% beträgt.

3. Flüssige Formulierung nach Anspruch 1, wobei eine Konzentration von Nikotin in der flüssigen Formulierung 1 Gew.-% oder 0,5 Gew.-% beträgt.

4. Flüssige Formulierung nach einem der vorhergehenden Ansprüche, wobei die von dem Dampfbildner gebildeten Dampfteilchen einen größeren mittleren Durchmesser als die von einem anderen Dampfbildner gebildeten Dampfteilchen aufweisen, der Glycerin enthält.

5. Flüssige Formulierung nach Anspruch 4, wobei eine Verdampfungsrate der Dampfteilchen, die von dem Dampfbildner gebildet werden, größer ist als eine Verdampfungsrate der Dampfteilchen, die von dem anderen Dampfbildner einschließlich Glycerin gebildet werden.

6. Flüssige Formulierung nach einem beliebigen der vorhergehenden Ansprüche, wobei die flüssige Formulierung in Form einer Lösung vorliegt.

7. Die flüssige Formulierung nach einem beliebigen der vorangehenden Ansprüche umfasst ferner eine saure Verbindung, die mindestens eines der folgenden Elemente umfasst: Brenztraubensäure, Ameisensäure, Oxalsäure, Glycolsäure, Ethansäure, Isovaleriansäure, Valeriansäure, Propansäure, Octansäure, Milchsäure, Sorbinsäure, Apfelsäure, Weinsäure, Bernsteinsäure, Zitronensäure, Benzoesäure, Ölsäure, Aconitsäure, Butylsäure, Zimtsäure, Decansäure, 3,7-Dimethyl-6-Octensäure, 1-Glutaminsäure, Heptansäure, Hexansäure, 3-Hexensäure, trans-2-Hexensäure, Isobuttersäure, Laurinsäure, 2-Methylbutylsäure, 2 Methylvaleriansäure, Myristinsäure, Nonansäure, Palmitinsäure, 4-Pentensäure, Phenylessigsäure, 3-Phenylpropionsäure, Chlorwasserstoffsäure, Phosphorsäure und Schwefelsäure.

8. Flüssige Formulierung nach einem beliebigen der vorhergehenden Ansprüche, die ferner Nikotinbitartrat umfasst.

Revendications

1. Formulation liquide pour un dispositif d'e-vapotage, la formulation liquide comprenant :

   un agent de formation de vapeur comportant du propylène glycol, de l'eau et sensiblement aucune quantité de glycérol, dans laquelle une concentration de propylène glycol dans l'agent de formation de vapeur est de 80 pour cent en poids et une concentration d'eau dans l'agent de formation de vapeur est de 20 pour cent en poids ; de la nicotine, dans laquelle une concentration de nicotine dans la formulation liquide est égale ou inférieure à environ 1,5 pour cent en poids ; et

un ou plusieurs acides,
dans laquelle la formulation liquide est configurée pour former une vapeur ayant une phase particulaire et une phase gazeuse lorsqu'elle est chauffée dans le dispositif d'e-vapotage.

2. Formulation liquide selon la revendication 1, dans laquelle la concentration de nicotine dans la formulation liquide est de 1,5 pour cent en poids.

3. Formulation liquide selon la revendication 1, dans laquelle la concentration de nicotine dans la formulation liquide est de 1 pour cent en poids ou de 0,5 pour cent en poids.

4. Formulation liquide selon l'une quelconque des revendications précédentes, dans laquelle les particules de vapeur formées à partir de l'agent de formation de vapeur ont un diamètre moyen plus grand que les particules de vapeur formées à partir d'un agent de formation de vapeur différent qui comporte du glycérol.

5. Formulation liquide selon la revendication 4, dans laquelle un taux d'évaporation des particules de vapeur formées à partir de l'agent de formation de vapeur est supérieur à un taux d'évaporation des particules de vapeur formées à partir de l'agent de formation de vapeur différent comportant du glycérol.

6. Formulation liquide selon l'une quelconque des revendications précédentes, dans laquelle la formulation liquide est sous la forme d'une solution.

7. Formulation liquide selon l'une quelconque des revendications précédentes, comprenant en outre un composé acide qui comporte au moins l'un parmi acide pyruvique, acide formique, acide oxalique, acide glycolique, acide acétique, acide isovalérique, acide valérique, acide propionique, acide octanoïque, acide lactique, acide sorbique, acide malique, acide tartrique, acide succinique, acide citrique, acide benzoïque, acide oléique, acide aconitique, acide butyrique, acide cinnamique, acide décanoïque, acide 3,7-diméthyl-6-octénoïque, acide 1-glutamique, acide heptanoïque, acide hexanoïque, acide 3-hexénoïque, acide trans-2-hexénoïque, acide isobutyrique, acide laurique, acide 2-méthylbutyrique, acide 2-méthylvalérique, acide myristique, acide nonanoïque, acide palmitique, acide 4-penténoïque, acide phénylacétique, acide 3-phénylpropionique, acide chlorhydrique, acide phosphorique et acide sulfurique.

8. Formulation liquide selon l'une quelconque des revendications précédentes, comprenant en outre du bitartrate de nicotine.

FIG. 1

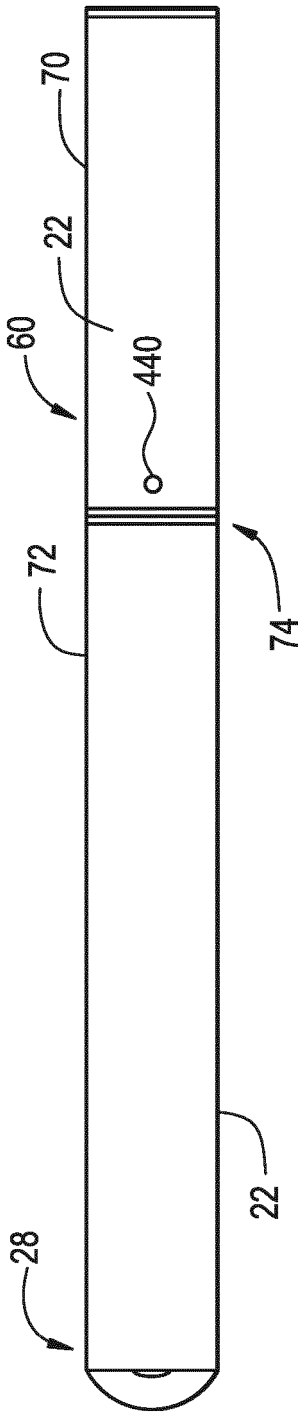
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FIG. 2

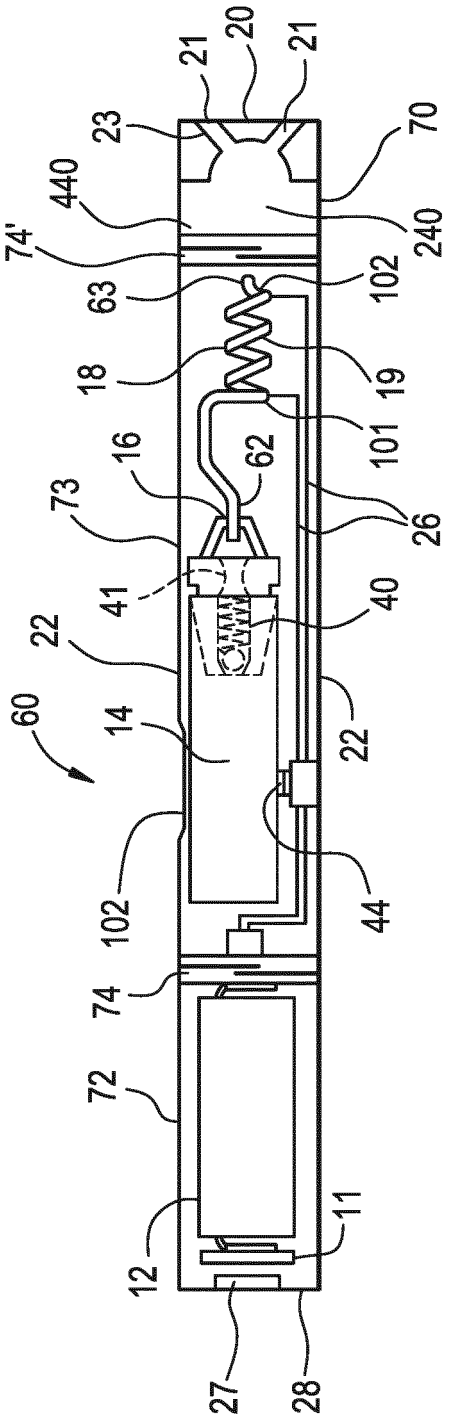
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FIG. 3

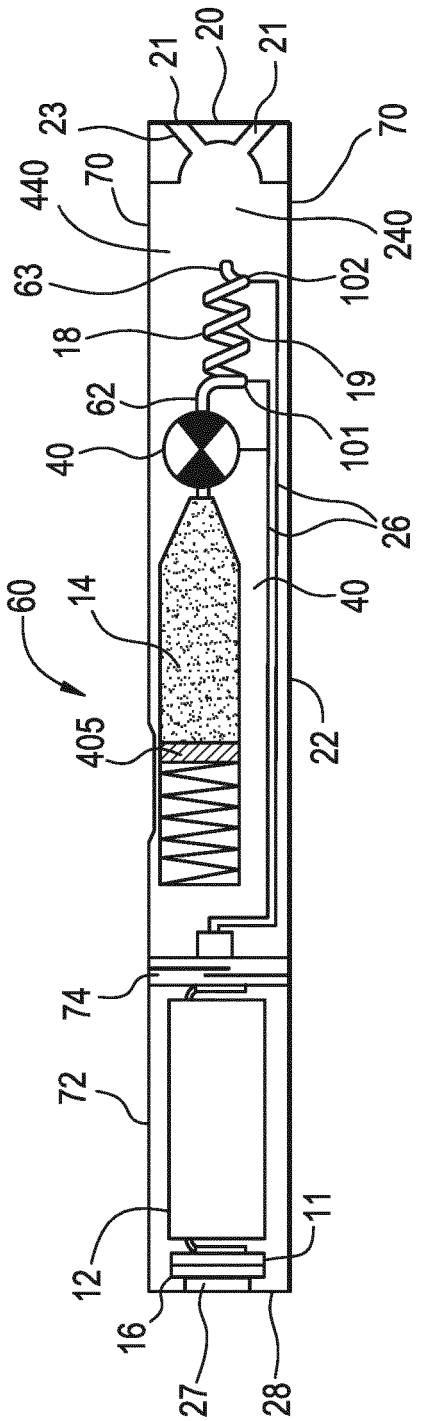
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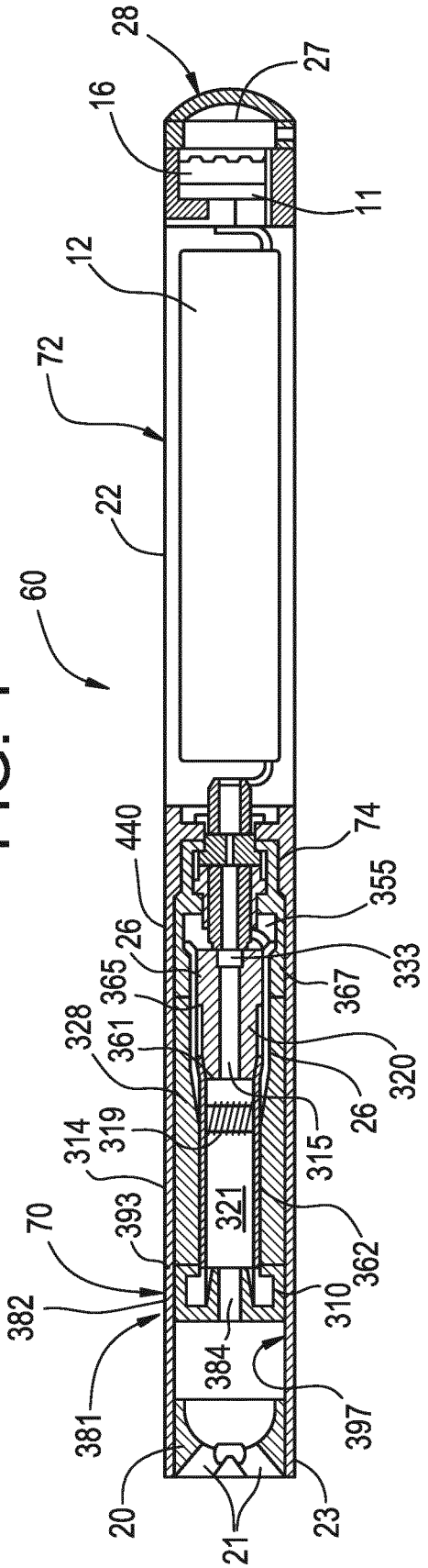
FIG. 4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REFERENCES CITED IN THE DESCRIPTION

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- CN 101461565 **[0006]**