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(71) Applicant: PHILIP MORRIS PRODUCTS S.A.

[CH/CH]; Quai Jeanrenaud 3, CH-2000 Neuchâtel (CH).

(72) Inventors: TAURINO, Irene; Quai Jeanrenaud 3,

CH-2000 Neuchâtel (CH). ZINOVIK, Ihor Nikolaevich;

Quai Jeanrenaud 3, CH-2000 Neuchâtel (CH).

(74) Agent: MILLBURN, Julie; Reddie & Grose LLP, The

White Chapel Building, 10 Whitechapel High Street, London Greater London E1 8QS (GB).

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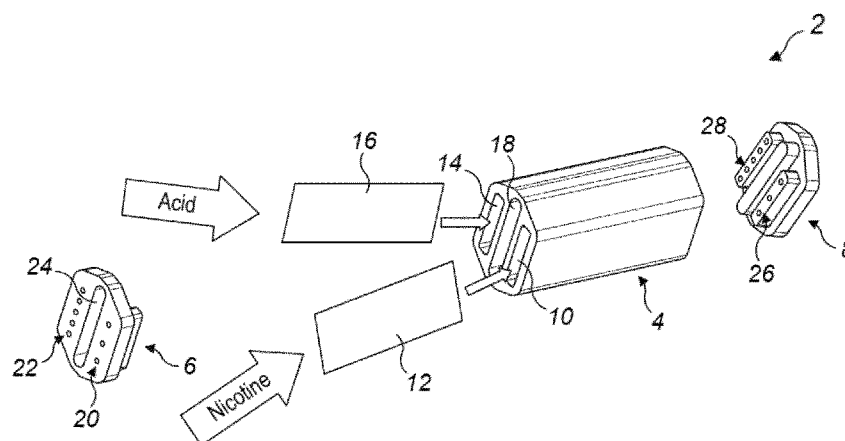


Figure 1

(57) Abstract: A cartridge (2) for use in an aerosol-generating system, the cartridge containing a nicotine source comprising a liquid nicotine formulation, the liquid nicotine formulation comprising glycerine in an amount of at least 10 percent by weight and nicotine, wherein the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is between about 3:2 and about 9:1. An aerosol-generating system (200) comprises: the cartridge (2); and an aerosol-generating device (202) comprising: a housing (206) defining a device cavity (208) configured to receive at least a portion of the cartridge (2); and a heating element for heating the cartridge (2).



CARTRIDGE FOR AN AEROSOL-GENERATING SYSTEM CONTAINING A NICOTINE SOURCE COMPRISING A LIQUID NICOTINE FORMULATION

The invention relates to a liquid nicotine formulation for use in an aerosol-generating system and an aerosol-generating system comprising such a liquid nicotine formulation. In particular, the invention relates to a liquid nicotine formulation for use in an aerosol-generating system for the *in situ* generation of an aerosol of nicotine salt particles and an aerosol-generating system comprising such a liquid nicotine formulation.

Devices for delivering nicotine to a user comprising a nicotine source and a volatile delivery enhancing compound source are known. For example, WO 2008/121610 A1 discloses devices in which nicotine and an acid, such as pyruvic acid, are reacted with one another in the gas phase to form an aerosol of nicotine salt particles that is inhaled by the user.

In devices of this type, the aerosol generated by the reaction of the nicotine and the acid can sometimes be perceived by the user as having a sensorial harshness when inhaled, which may adversely impact the user experience.

It would be desirable to provide a liquid nicotine formulation for use in an aerosol-generating system for the *in situ* generation of an aerosol that, in use, can provide an aerosol with improved perceived sensorial harshness.

It would be particularly desirable to provide a liquid nicotine formulation for use in an aerosol-generating system for the *in situ* generation of an aerosol that, in use, can provide an aerosol with improved perceived sensorial harshness without adversely impacting other properties of the aerosol, such as particle or droplet size and nicotine delivery.

According to the invention there is provided a liquid nicotine formulation for use in an aerosol-generating system, the liquid nicotine formulation comprising glycerine in an amount of at least 10 percent by weight and nicotine, wherein the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is between about 3:2 and about 9:1.

According to the invention there is also provided a cartridge for use in an aerosol-generating system, the cartridge containing a nicotine source comprising a liquid nicotine formulation according to the invention.

According to the invention there is further provided an aerosol-generating system comprising: a cartridge according to the invention; and an aerosol-generating device comprising: a housing defining a device cavity configured to receive at least a portion of the cartridge; and a heating element for heating the cartridge.

When used in an aerosol-generating system, the liquid nicotine formulation according to the invention advantageously allows the generation of an aerosol having an optimal particle or

droplet size for inhalation that provides excellent nicotine delivery with improved perceived sensorial harshness.

As described further below, inclusion in the liquid nicotine formulation according to the invention of glycerine in an amount of at least 10 percent by weight and nicotine, wherein the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is between about 9:1 and about 3:2, has advantageously been found to reduce the perceived sensorial harshness of an aerosol generated by an aerosol-generating system comprising the liquid nicotine formulation compared to an aerosol generated by an aerosol-generating system comprising a liquid nicotine formulation comprising nicotine that does not comprise glycerine. Without wishing to be bound by theory, this improvement in perceived sensorial harshness is believed to be due to coating or enveloping of nicotine by glycerine.

Furthermore, it has surprisingly been found that inclusion in the liquid nicotine formulation according to the invention of glycerine in an amount of at least 10 percent by weight and nicotine, wherein the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is between about 9:1 and about 3:2, does not significantly impact the particle or droplet size of an aerosol generated by an aerosol-generating system comprising the liquid nicotine formulation according to the invention. This is particularly important, since it enables the perceived sensorial harshness of the aerosol generated by an aerosol-generating system comprising the cartridge to be improved through inclusion of glycerine without adversely impacting the delivery of aerosol by inhalation to a user.

It has also surprisingly been found that inclusion in the liquid nicotine formulation according to the invention of glycerine in an amount of at least 10 percent by weight and nicotine, wherein the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is between about 9:1 and about 3:2, can advantageously improve nicotine delivery to a use by an aerosol-generating system comprising the liquid nicotine formulation according to the invention. In particular, it has been found that in the liquid nicotine formulation according to the invention of glycerine in an amount of at least 10 percent by weight and nicotine, wherein the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is between about 9:1 and about 3:2, can enable a greater amount of nicotine to be delivered per puff from a given quantity of nicotine in the liquid nicotine formulation.

As used herein with reference to the invention, the term "liquid nicotine formulation" describes a liquid formulation comprising nicotine or a gel formulation comprising nicotine.

As used herein with reference to the invention, the term "gel formulation" may describe a substantially dilute cross-linked system, which exhibits no flow when in a steady state.

As used herein with reference to the invention, the term "nicotine" describes nicotine, nicotine base or a nicotine salt. In embodiments in which the liquid nicotine formulation comprises

a nicotine base or a nicotine salt, the amounts of nicotine recited herein are the amount of free base nicotine or amount of protonated nicotine, respectively.

Unless stated otherwise, the percentages by weight of glycerine and nicotine in the liquid nicotine formulation recited herein are based on the total weight of the liquid nicotine formulation.

5 The ratio by weight of nicotine to glycerine in the liquid nicotine formulation is between about 3:2 and about 9:1.

Preferably, the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is at least about 9:5. More preferably, the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is at least about 2:1.

10 That is, preferably the weight percent nicotine content of the liquid nicotine formulation is at least about 1.8 times the weight percent glycerine content of the liquid nicotine formulation. More preferably, the weight percent nicotine content of the liquid nicotine formulation is at least about 2 times the weight percent glycerine content of the liquid nicotine formulation.

15 Preferably, the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is less than or equal to about 8:1. More preferably, the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is less than or equal to about 7:1 or less than or equal to about 6:1. Most preferably, the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is less than or equal to about 4:1.

20 That is, preferably the weight percent nicotine content of the liquid nicotine formulation is less than or equal to about 8 times the weight percent glycerine content of the liquid nicotine formulation. More preferably, the weight percent nicotine content of the liquid nicotine formulation is less than or equal to about 7 times the weight percent glycerine content of the liquid nicotine formulation or less than or equal to about 6 times the weight percent glycerine content of the liquid nicotine formulation. Most preferably, the weight percent nicotine content of the liquid nicotine
25 formulation is less than or equal to about 4 times the weight percent glycerine content of the liquid nicotine formulation.

30 The ratio by weight of nicotine to glycerine in the liquid nicotine formulation may be between about 3:2 and about 8:1. For example, the ratio by weight of nicotine to glycerine in the liquid nicotine formulation may be between about 3:2 and about 7:1 or between about 3:2 and about 6:1.

The ratio by weight of nicotine to glycerine in the liquid nicotine formulation may be between about 9:5 and about 9:1. For example, the ratio by weight of nicotine to glycerine in the liquid nicotine formulation may be between about 9:5 and about 8:1, between about 9:5 and about 7:1 or between about 9:5 and about 6:1.

35 The ratio by weight of nicotine to glycerine in the liquid nicotine formulation may be between about 2:1 and about 9:1. For example, the ratio by weight of nicotine to glycerine in the

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liquid nicotine formulation may be between about 2:1 and about 8:1, between about 2:1 and about 7:1 or between about 2:1 and about 6:1.

Preferably, the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is between about 3:2 and about 4:1. More preferably, the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is between about 9:5 and about 4:1. Most preferably, the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is between about 2:1 and about 4:1.

The liquid nicotine formulation may comprise natural nicotine or synthetic nicotine.

The liquid nicotine formulation has a nicotine content of at least about 15 percent by weight.

Preferably, the nicotine content of the liquid nicotine formulation is at least about 60 percent by weight. More preferably, the nicotine content of the liquid nicotine formulation is at least about 65 percent by weight or at least about 70 percent by weight.

Preferably, the nicotine content of the liquid nicotine formulation is less than or equal to about 85 percent by weight. More preferably, the nicotine content of the liquid nicotine formulation is less than or equal to about 80 percent by weight or less than or equal to about 75 percent by weight.

Preferably, the nicotine content of the liquid nicotine formulation is between about 60 percent by weight and about 90 percent by weight. For example, the nicotine content of the liquid nicotine formulation may be between about 60 percent by weight and about 85 percent by weight, between about 60 percent by weight and about 80 percent by weight or between about 60 percent by weight and about 75 percent by weight.

More preferably, the nicotine content of the liquid nicotine formulation is between about 65 percent by weight and about 90 percent by weight or between about 70 percent by weight and about 90 percent by weight. For example, the nicotine content of the liquid nicotine formulation may be between about 65 percent by weight and about 85 percent by weight, between about 65 percent by weight and about 80 percent by weight or between about 65 percent by weight and about 75 percent by weight. For example, the nicotine content of the liquid nicotine formulation may be between about 70 percent by weight and about 85 percent by weight, between about 70 percent by weight and about 80 percent by weight or between about 70 percent by weight and about 75 percent by weight.

Preferably, the liquid nicotine formulation comprises vegetable glycerine.

The liquid nicotine formulation has a glycerine content of at least about 10 percent by weight.

Preferably the glycerine content of the liquid nicotine formulation is at least about 15 percent by weight.

More preferably the glycerine content of the liquid nicotine formulation is at least about 20 percent by weight.

Preferably the glycerine content of the liquid nicotine formulation is less than or equal to about 40 percent by weight.

5 More preferably, the glycerine content of the liquid nicotine formulation is less than or equal to about 35 percent by weight or less than or equal to about 30 percent by weight.

This may advantageously ensure that inclusion of glycerine in the liquid nicotine formulation does not adversely affect *in situ* reaction between nicotine and other reactants during use of an aerosol-generating system comprising the liquid nicotine formulation.

10 Preferably the glycerine content of the liquid nicotine formulation is between about 10 percent by weight and about 40 percent by weight. For example, the glycerine content of the liquid nicotine formulation may be between about 15 percent by weight and about 40 percent by weight or between about 20 percent by weight and about 40 percent by weight.

More preferably, the glycerine content of the liquid nicotine formulation is between about 15
15 10 percent by weight and about 35 percent by weight or between about 10 percent by weight and about 30 percent by weight. For example, glycerine content of the liquid nicotine formulation may be between about 15 percent by weight and about 35 percent by weight or between about 20 percent by weight and about 35 percent by weight. For example, the glycerine content of the liquid nicotine formulation may be between about 15 percent by weight and about 30 percent by
20 weight or between about 20 percent by weight and about 30 percent by weight.

Preferably, the liquid nicotine formulation has a combined glycerine content and nicotine content of at least about 95 percent by weight. More preferably, the liquid nicotine formulation has a combined glycerine content and nicotine content of at least about 97 percent by weight. Most preferably, the liquid nicotine formulation has a combined glycerine content and nicotine
25 content of at least about 99 percent by weight.

The liquid nicotine formulation may comprise one or more flavourants. Suitable flavourants include, but are not limited to, menthol.

Preferably, the liquid nicotine formulation has a flavourant content of less than or equal to about 1 percent by weight.

30 Inclusion of the liquid nicotine formulation according to the invention in a nicotine source of an aerosol-generating system comprising a nicotine source and an acid source for the *in situ* generation of an aerosol of nicotine salt particles has surprisingly been found to be particularly advantageous.

According to the invention there is also provided a cartridge for use in an aerosol-
35 generating system, the cartridge containing a nicotine source comprising a liquid nicotine formulation according to the invention.

According to the invention there is further provided an aerosol-generating system comprising: a cartridge according to the invention; and an aerosol-generating device comprising: a housing defining a device cavity configured to receive at least a portion of the cartridge; and a heating element for heating the cartridge.

5 As used herein with reference to the invention, the terms “proximal”, “distal”, “upstream” and “downstream” describe the relative positions of components, or portions of components, of the cartridge and aerosol-generating system according to the invention.

The aerosol-generating system according to the invention comprises a proximal end through which, in use, an aerosol exits the aerosol-generating system for delivery to a user. The proximal end may also be referred to as the mouth end. In use, a user draws on the proximal
10 end of the aerosol-generating system in order to inhale an aerosol generated by the aerosol-generating system. The aerosol-generating system comprises a distal end opposed to the proximal end.

When a user draws on the proximal end of the aerosol-generating system, air is drawn
15 into the aerosol-generating system, passes through the cartridge and exits the aerosol-generating system at the proximal end thereof. Components, or portions of components, of the aerosol-generating system may be described as being upstream or downstream of one another based on their relative positions between the proximal end and the distal end of the aerosol-generating system.

20 As used herein with reference to the invention, the term “longitudinal” is used to describe the direction between the proximal end and the opposed distal end of the cartridge or aerosol-generating system and the term “transverse” is used to describe the direction perpendicular to the longitudinal direction.

As used herein with reference to the invention, the term “length” is used to describe the
25 maximum longitudinal dimension of components, or portions of components, of the cartridge or aerosol-generating system parallel to the longitudinal axis between the proximal end and the opposed distal end of the cartridge or aerosol-generating system.

As used herein with reference to the invention, the terms “height” and “width” are used to describe the maximum transverse dimensions of components, or portions of components, of the
30 cartridge or aerosol-generating system perpendicular to the longitudinal axis of the cartridge or aerosol-generating system. Where the height and width of components, or portions of components, of the cartridge or aerosol-generating system are not the same, the term “width” is used to refer to the larger of the two transverse dimensions perpendicular to the longitudinal axis of the cartridge or aerosol-generating system.

35 The cartridge may comprise a first compartment containing the nicotine source.

Advantageously, the nicotine source comprises a first carrier material impregnated with the liquid nicotine formulation.

The first carrier material acts as a reservoir for the liquid nicotine formulation.

Advantageously, the first carrier material is chemically inert with respect to the liquid
5 nicotine formulation.

The first carrier material may have any suitable shape and size. For example, the first carrier material may be in the form of a sheet or plug.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention, advantageously the
10 shape and of the first carrier material is similar to the shape and size of the first compartment of the cartridge.

The shape, size, density and porosity of the first carrier material may be chosen to allow the first carrier material to be impregnated with a desired amount of the liquid nicotine formulation.

Advantageously, the nicotine source comprises a first carrier material impregnated with
15 greater than or equal to about 10 microlitres of the liquid nicotine formulation. For example, the nicotine source may comprise a first carrier material impregnated with greater than or equal to about 15 microlitres of the liquid nicotine formulation.

For example, the nicotine source may comprise a first carrier material impregnated with
20 between about 10 microlitres and about 25 microlitres of the liquid nicotine formulation or between about 15 microlitres and about 25 microlitres of the liquid nicotine formulation.

Advantageously, the nicotine source comprises a first carrier material impregnated with
less than or equal to about 25 microlitres of the liquid nicotine formulation. For example, the nicotine source may comprise a first carrier material impregnated with less than or equal to about
20 microlitres of the liquid nicotine formulation.

For example, the nicotine source may comprise a first carrier material impregnated with
25 between about 10 microlitres and about 20 microlitres of the liquid nicotine formulation or between about 15 microlitres and about 20 microlitres of the liquid nicotine formulation.

The nicotine source may comprise a liquid nicotine formulation according to the invention comprising between about 1 milligram and about 40 milligrams of nicotine. For example, the
30 nicotine source may comprise a liquid nicotine formulation according to the invention comprising between about 3 milligram and about 30 milligram of nicotine, between about 6 milligram and about 20 milligram of nicotine or between about 8 milligram and about 18 milligram of nicotine.

The cartridge may comprise: a nicotine source comprising a liquid nicotine formulation according to the invention; and an acid source.

The cartridge may comprise: a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention; and a second compartment comprising an acid source.

5 Inclusion of the liquid nicotine formulation according to the invention in a nicotine source of a cartridge comprising two compartments as defined above has surprisingly been found to be particularly advantageous.

The acid source may comprise an organic acid or an inorganic acid.

Preferably, the acid source comprises an organic acid, more preferably a carboxylic acid, most preferably an alpha-keto or 2-oxo acid or lactic acid.

10 Advantageously, the acid source comprises an acid selected from the group consisting of 3-methyl-2-oxopentanoic acid, pyruvic acid, 2-oxopentanoic acid, 4-methyl-2-oxopentanoic acid, 3-methyl-2-oxobutanoic acid, 2-oxooctanoic acid, lactic acid and combinations thereof. Advantageously, the acid source comprises pyruvic acid or lactic acid. More advantageously, the acid source comprises lactic acid.

15 Advantageously, the acid source comprises a second carrier material impregnated with acid.

The second carrier material acts as a reservoir for the acid.

Advantageously, the second carrier material is chemically inert with respect to the acid.

20 The second carrier material may have any suitable shape and size. For example, the second carrier material may be in the form of a sheet or plug.

In embodiments in which the cartridge comprises a second compartment containing an acid source, advantageously the shape and size of the second carrier material is similar to the shape and size of the second compartment of the cartridge.

25 The shape, size, density and porosity of the second carrier material may be chosen to allow the second carrier material to be impregnated with a desired amount of acid.

Advantageously, the acid source comprises a second carrier material impregnated with greater than or equal to about 10 microlitres of acid. For example, the acid source may comprise a second carrier material impregnated with greater than or equal to about 15 microlitres of acid.

30 For example, the acid source may comprise a second carrier material impregnated with between about 10 microlitres and about 25 microlitres of acid or between about 15 microlitres and about 25 microlitres of acid.

Advantageously, the acid source comprises a second carrier material impregnated with less than or equal to about 25 microlitres of acid. For example, the acid source may comprise a second carrier material impregnated with less than or equal to about 20 microlitres of acid.

For example, the acid source may comprise a second carrier material impregnated with between about 10 microlitres and about 20 microlitres of acid or between about 15 microlitres and about 20 microlitres of acid.

5 In embodiments in which the cartridge comprises an acid source comprising lactic acid, advantageously the acid source comprises a second carrier material impregnated with between about 2 milligrams and about 60 milligrams of lactic acid.

For example, the acid source may comprise a second carrier material impregnated with between about 5 milligrams and about 50 milligrams of lactic acid, between about 8 milligrams and about 40 milligrams of lactic acid or between about 10 milligrams and about 30 milligrams of
10 lactic acid.

In embodiments in which the cartridge comprises a nicotine source comprising a first carrier material impregnated with a liquid nicotine formulation according to the invention and an acid source comprising a second carrier material impregnated with acid, the first carrier material and the second carrier material may be the same or different.

15 The first carrier material and the second carrier material may comprise one or more of glass, cellulose, ceramic, stainless steel, aluminium, polyethylene (PE), polypropylene, polyethylene terephthalate (PET), poly(cyclohexanedimethylene terephthalate) (PCT), polybutylene terephthalate (PBT), polytetrafluoroethylene (PTFE), expanded polytetrafluoroethylene (ePTFE), and BAREX®.

20 Advantageously, the first carrier material and the second carrier material have a density of between about 0.1 grams/cubic centimetre and about 0.3 grams/cubic centimetre.

Advantageously, the first carrier material and the second carrier material have a porosity of between about 15 percent and about 55 percent.

In embodiments in which the cartridge comprises a first compartment containing a nicotine
25 source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, the shape and dimensions of the first compartment of the cartridge may be chosen to allow a desired amount of liquid nicotine formulation to be housed in the cartridge.

In embodiments in which the cartridge comprises a first compartment containing a nicotine
30 source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, the shape and dimensions of the second compartment of the cartridge may be chosen to allow a desired amount of acid to be housed in the cartridge.

The shape and dimensions of the first compartment and the second compartment of the cartridge may be the same or different.

35 In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention, the first compartment

of the cartridge may have a length L_1 of between about 8 millimetres and about 40 millimetres, for example of between about 10 millimetres and about 20 millimetres. The first compartment of the cartridge may have a width W_1 of between about 4 millimetres and about 6 millimetres. The first compartment of the cartridge may have a height H_1 of between about 0.5 millimetres and about 2.5 millimetres.

The first compartment of the cartridge may have any suitable transverse cross-sectional shape. For example, the transverse cross-sectional shape of the first compartment may be circular, semi-circular, elliptical, triangular, square, rectangular or trapezoidal.

In embodiments in which the cartridge comprises a second compartment containing an acid source, the second compartment of the cartridge may have a length L_2 of between about 8 millimetres and about 40 millimetres, for example of between about 10 millimetres and about 20 millimetres. The second compartment of the cartridge may have a width W_2 of between about 4 millimetres and about 6 millimetres. The second compartment of the cartridge may have a height H_2 of between about 0.5 millimetres and about 2.5 millimetres.

The second compartment of the cartridge may have any suitable transverse cross-sectional shape. For example, the transverse cross-sectional shape of the second compartment may be circular, semi-circular, elliptical, triangular, square, rectangular or trapezoidal.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, the ratio of nicotine and acid required to achieve an appropriate reaction stoichiometry may be controlled and balanced through variation of the volume of the first compartment relative to the volume of the second compartment.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention, advantageously, the first compartment comprises a first air inlet and a first air outlet.

The first air outlet of the first compartment of the cartridge is located at the proximal end of the first compartment of the cartridge. The first air inlet of the first compartment of the cartridge is located upstream of the first air outlet of the first compartment of the cartridge.

In embodiments in which the cartridge comprises a second compartment comprising an acid source, advantageously the second compartment comprises a second air inlet and a second air outlet.

The second air outlet of the second compartment of the cartridge is located at the proximal end of the second compartment of the cartridge. The second air inlet of the second compartment of the cartridge is located upstream of the second air outlet of the second compartment of the cartridge.

As used herein with reference to the invention, the term “air inlet” describes one or more apertures through which air may be drawn into a component or portion of a component of the cartridge.

As used herein with reference to the invention, the term “air outlet” describes one or more apertures through which air may be drawn out of a component or portion of a component of the cartridge.

The first air inlet of the first compartment of the cartridge and the second air inlet of the second compartment of the cartridge may each comprise one or more apertures. For example, the first air inlet of the first compartment of the cartridge and the second air inlet of the second compartment of the cartridge may each comprise one, two, three, four, five, six or seven apertures.

The first air inlet of the first compartment of the cartridge and the second air inlet of the second compartment of the cartridge may comprise the same or different numbers of apertures.

Advantageously, the first air inlet of the first compartment of the cartridge and the second air inlet of the second compartment of the cartridge each comprise a plurality of apertures. For example, the first air inlet of the first compartment of the cartridge and the second air inlet of the second compartment of the cartridge may each comprise two, three, four, five, six or seven apertures.

Providing a first compartment having a first air inlet comprising a plurality of apertures and a second compartment having a second air inlet comprising a plurality of apertures may advantageously result in more homogeneous airflow within the first compartment and the second compartment, respectively. In use, this may improve entrainment of nicotine in an air stream drawn through the first compartment and improve entrainment of acid in an air stream drawn through the second compartment.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, the ratio of nicotine and acid required to achieve an appropriate reaction stoichiometry may be controlled and balanced through variation of the volumetric airflow through the first compartment of the cartridge relative to the volumetric airflow through the second compartment of the cartridge. The ratio of the volumetric airflow through the first compartment relative to the volumetric airflow through the second compartment may be controlled through variation of one or more of the number, dimensions and location of the apertures forming the first air inlet of the first compartment of the cartridge relative to the number, dimensions and location of the apertures forming the second air inlet of the second compartment of the cartridge.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, advantageously prior to first use of the cartridge, one or both of the first air inlet of the first compartment and the second air inlet of the second compartment may be sealed by one or more removable or frangible barriers. For example, one or both of the first air inlet of the first compartment and the second air inlet of the second compartment may be sealed by one or more peel-off seals or pierceable seals.

The one or more removable or frangible barriers may be formed from any suitable material. For example, the one or more removable or frangible barriers may be formed from a metal foil or film.

The first air outlet of the first compartment of the cartridge and the second air outlet of the second compartment of the cartridge may each comprise one or more apertures. For example, the first air outlet of the first compartment of the cartridge and the second air outlet of the second compartment of the cartridge may each comprise one, two, three, four, five, six or seven apertures.

The first air outlet of the first compartment of the cartridge and the second air outlet of the second compartment of the cartridge may comprise the same or different numbers of apertures.

Advantageously, the first air outlet of the first compartment of the cartridge and the second air outlet of the second compartment of the cartridge may each comprise a plurality of apertures. For example, the first air outlet of the first compartment of the cartridge and the second air outlet of the second compartment of the cartridge may each comprise two, three, four, five, six or seven apertures. Providing a first compartment having a first air outlet comprising a plurality of apertures and a second compartment having a second air outlet comprising a plurality of apertures may advantageously result in more homogeneous airflow within the first compartment and the second compartment, respectively. In use, this may improve entrainment of nicotine in an air stream drawn through the first compartment and improve entrainment of acid in an air stream drawn through the second compartment.

As described above, in embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, the ratio of nicotine and acid required to achieve an appropriate reaction stoichiometry may be controlled and balanced through variation of the volumetric airflow through the first compartment of the cartridge relative to the volumetric airflow through the second compartment of the cartridge. The ratio of the volumetric airflow through the first compartment relative to the volumetric airflow through the second compartment may be controlled through variation of one or more of the number, dimensions and location of the apertures forming the first air outlet of the first compartment of the cartridge relative to the number,

dimensions and location of the apertures forming the second air outlet of the second compartment of the cartridge.

Advantageously, prior to first use of the cartridge, one or both of the first air outlet of the first compartment and the second air outlet of the second compartment may be sealed by one or more removable or frangible barriers. For example, one or both of the first air outlet of the first compartment and the second air outlet of the second compartment may be sealed by one or more peel-off seals or pierceable seals.

The one or more removable or frangible barriers may be formed from any suitable material. For example, the one or more removable or frangible barriers may be formed from a metal foil or film.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, the first compartment and the second compartment may be arranged in series within the cartridge.

As used herein with reference to the invention, by "series" it is meant that the first compartment and the second compartment are arranged within the cartridge so that in use an air stream drawn through the cartridge passes through one of the first compartment and the second compartment and then passes through the other of the first compartment and the second compartment. Nicotine vapour and glycerine vapour is released from the nicotine source in the first compartment into the air stream drawn through the cartridge and acid vapour is released from the acid source in the second compartment into the air stream drawn through the cartridge. The nicotine vapour reacts with the acid vapour in the gas phase to form an aerosol. As described above, the sensorial harshness of the aerosol is perceived to be lower by a user due to the presence of glycerine within the aerosol.

Where the first compartment and the second compartment are arranged in series within the cartridge, the second compartment may be located downstream of the first compartment so that in use an air stream drawn through the cartridge passes into the first compartment through the first air inlet, through the first compartment and out of the first compartment through the first air outlet and then passes into the second compartment through the second air inlet, through the second compartment and out of the second compartment through the second air outlet. In such embodiments, the nicotine vapour may react with the acid vapour in the second compartment to form an aerosol. In such embodiments the cartridge may further comprise a third compartment downstream of the second compartment and in fluid communication with the second air outlet of the second compartment. The nicotine vapour may react with the acid vapour in the third compartment to form an aerosol.

Alternatively, where the first compartment and the second compartment are arranged in series within the cartridge, the second compartment may be located upstream of the first compartment so that in use an air stream drawn through the cartridge passes into the second compartment through the second air inlet, through the second compartment and out of the second compartment through the second air outlet and then passes into the first compartment through the first air inlet, through the first compartment and out of the first compartment through the first air outlet. In such embodiments, the acid vapour may react with the nicotine vapour in the second compartment to form an aerosol. In such embodiments the cartridge may further comprise a third compartment downstream of the first compartment and in fluid communication with the first air outlet of the first compartment. The acid vapour may react with the nicotine vapour in the third compartment to form an aerosol.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention; and a second compartment comprising an acid source, advantageously the first compartment and the second compartment are arranged in parallel within the cartridge.

As used herein with reference to the invention, by "parallel" it is meant that the first compartment and the second compartment are arranged within the cartridge so that in use a first air stream drawn through the cartridge passes into the first compartment through the first air inlet, downstream through the first compartment and out of the first compartment through the first air outlet and a second air stream drawn through the cartridge passes into the second compartment through the second air inlet, downstream through the second compartment and out of the second compartment through the second air outlet. Nicotine vapour and glycerine vapour is released from the nicotine source in the first compartment into the first air stream drawn through the cartridge and acid vapour is released from the acid source in the second compartment into the second air stream drawn through the cartridge. The nicotine vapour in the first air stream reacts with the acid vapour in the second air stream in the gas phase to form an aerosol. As described above, the sensorial harshness of the aerosol is perceived to be lower by a user due to the presence of glycerine within the aerosol.

In such embodiments the cartridge may further comprise a third compartment downstream of the first compartment and the second compartment and in fluid communication with the first air outlet of the first compartment and the second air outlet of the second compartment. The nicotine vapour in the first air stream may react with the acid vapour in the second air stream in the third compartment to form an aerosol.

In embodiments in which the cartridge further comprises a third compartment, the third compartment may comprise one or more aerosol-modifying agents. For example, the third

compartment may comprise one or more sorbents, one or more flavourants, one or more chemesthetic agents or a combination thereof.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second
5 compartment comprising an acid source, the first compartment and the second compartment may be arranged symmetrically with respect to each other within the cartridge.

Advantageously, the cartridge is an elongate cartridge. In embodiments in which the cartridge is an elongate cartridge, the first compartment and the second compartment of the cartridge may be arranged symmetrically about the longitudinal axis of the cartridge.

10 The cartridge may have any suitable shape. For example, the cartridge may be substantially cylindrical.

The cartridge may have any suitable transverse cross-sectional shape. For example, the transverse cross-sectional shape of the cartridge may be circular, semi-circular, elliptical, triangular, square, rectangular or trapezoidal.

15 The cartridge may have any suitable size.

For example, the cartridge may have a length of between about 5 millimetres and about 50 millimetres. Advantageously, the cartridge may have a length between about 10 millimetres and about 20 millimetres.

For example, the cartridge may have a width of between about 4 millimetres and about
20 10 millimetres and a height of between about 4 millimetres and about 10 millimetres. Advantageously, the cartridge may have a width of between about 6 millimetres and about 8 millimetres and a height of between about 6 millimetres and about 8 millimetres.

The cartridge may comprise a body portion and one or more end caps.

The cartridge may comprise a body portion and a distal end cap.

25 The cartridge may comprise a body portion and a proximal end cap.

The cartridge may comprise a body portion, a distal end cap and a proximal end cap.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention, a second compartment comprising an acid source; and a distal end cap, one or more apertures forming the first air inlet
30 of the first compartment of the cartridge and one or more apertures forming the second air inlet of the second compartment of the cartridge may be provided in the distal end cap.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention, a second compartment comprising an acid source and a proximal end cap, one or more apertures forming the first air
35 outlet of the first compartment of the cartridge and one or more apertures forming the second air outlet of the second compartment of the cartridge may be provided in the proximal end cap.

The cartridge may be formed from any suitable material or combination of materials. Suitable materials include, but are not limited to, aluminium, polyether ether ketone (PEEK), polyimides, such as Kapton®, polyethylene terephthalate (PET), polyethylene (PE), high-density polyethylene (HDPE), polypropylene (PP), polystyrene (PS), fluorinated ethylene propylene (FEP), polytetrafluoroethylene (PTFE), polyoxymethylene (POM), epoxy resins, polyurethane resins, vinyl resins, liquid crystal polymers (LCP) and modified LCPs, such as LCPs with graphite or glass fibres.

In embodiments in which the cartridge comprises a body portion and one or more end caps, the body portion and the one or more end caps may be formed from the same or different materials.

The cartridge may be formed from one or more materials that are nicotine-resistant and acid-resistant.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention, the first compartment of the cartridge may be coated with one or more nicotine-resistant materials.

In embodiments in which the cartridge comprises a second compartment comprising an acid source, the second compartment of the cartridge may be coated with one or more acid-resistant materials.

Examples of suitable nicotine-resistant materials and acid-resistant materials may include, but are not limited to, polyethylene (PE), polypropylene (PP), polystyrene (PS), fluorinated ethylene propylene (FEP), polytetrafluoroethylene (PTFE), epoxy resins, polyurethane resins, vinyl resins and combinations thereof.

Use of one or more nicotine-resistant materials to one or both of form the cartridge and coat the interior of the first compartment of the cartridge may advantageously enhance the shelf life of the cartridge.

Use of one or more acid-resistant materials to one or both of form the cartridge and coat the interior of the second compartment of the cartridge may advantageously enhance the shelf life of the cartridge.

The cartridge may be formed from one or more thermally conductive materials.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention, the first compartment of the cartridge and the second compartment of the cartridge may be coated with one or more thermally conductive materials.

Use of one or more thermally conductive materials to one or both of form the cartridge and coat the interior of the first compartment of the cartridge may advantageously increase heat transfer from a heating element to the nicotine source.

In embodiments in which the cartridge comprises a second compartment containing an acid source, the second compartment of the cartridge may be coated with one or more thermally conductive materials.

5 Use of one or more thermally conductive materials to one or both of form the cartridge and coat the interior of the second compartment of the cartridge may advantageously increase heat transfer from a heating element to the acid source.

Suitable thermally conductive materials include, but are not limited to, metals such as, for example, aluminium, chromium, copper, gold, iron, nickel and silver, alloys, such as brass and steel and combinations thereof.

10 In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, the cartridge may be formed of one or more materials having a low resistivity or a high resistivity depending on whether the first compartment and the second compartment are heated by conduction or induction.

15 The first compartment of the cartridge and the second compartment of the cartridge may be coated with one or more materials having a low resistivity or a high resistivity depending on whether the first compartment and the second compartment are heated by conduction or induction.

The cartridge may be formed by any suitable method. Suitable methods include, but are not limited to, deep drawing, injection moulding, blistering, blow forming and extrusion.

In embodiments in which the cartridge comprises a nicotine source comprising a liquid nicotine formulation according to the invention, the cartridge may be designed to be disposed of once the liquid nicotine formulation is depleted.

25 In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, the cartridge may be designed to be disposed of once the liquid nicotine formulation in the first compartment and the acid in the second compartment are depleted.

The cartridge may be designed to be refillable.

30 The cartridge may comprise a heating element configured to heat the nicotine source.

In embodiments in which the cartridge comprises a nicotine source comprising a liquid nicotine formulation according to the invention and an acid source, the cartridge may comprise a heating element configured to heat the nicotine source and the acid source.

35 In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention, the cartridge may comprise a heating element configured to heat the first compartment.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, the cartridge may comprise a heating element configured to heat the first compartment and the second compartment.

5 In such embodiments, the heating element is advantageously located between the first compartment and the second compartment. That is the first compartment and the second compartment are disposed on either side of the heating element.

The heating element may be an electrical heating element. The heating element may comprise a resistive heating element.

10 In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, advantageously, the heating element is configured to heat the first compartment and the second compartment of the cartridge to a temperature of below about 250 degrees Celsius. Preferably, the heating element is configured to heat the first
15 compartment and the second compartment of the cartridge to a temperature of between about 80 degrees Celsius and about 150 degrees Celsius.

Advantageously, the heating element is configured to heat the first compartment and the second compartment of the cartridge to substantially the same temperature.

As used herein with reference to the invention, by "substantially the same temperature" it
20 is meant that the difference in temperature between the first compartment and the second compartment of the cartridge measured at corresponding locations relative to the heating element is less than about 3°C.

In use, heating the first compartment and the second compartment of the cartridge to a temperature above ambient temperature advantageously enables the vapour concentrations of
25 nicotine in the first compartment of the cartridge and the vapour pressure of acid in the second compartment of the cartridge to be controlled and balanced proportionally to yield an efficient reaction stoichiometry between the nicotine and the acid. Advantageously, this may improve the efficiency of aerosol formation and the consistency of aerosol delivery to a user. Advantageously, it may also reduce the delivery of unreacted nicotine and unreacted acid to a user.

30 Advantageously the cartridge may comprise a cavity for receiving a heating element configured to heat the nicotine source.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention, the cartridge may comprise a cavity for receiving a heating element configured to heat the first compartment.

35 In embodiments in which the cartridge comprises a nicotine source comprising a liquid nicotine formulation according to the invention and an acid source, advantageously the cartridge

may comprise a cavity for receiving a heating element configured to heat the nicotine source and the acid source.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, advantageously the cartridge may comprise a cavity for receiving a heating element configured to heat the first compartment and the second compartment. In such embodiments, the cavity is advantageously located between the first compartment and the second compartment. That is the first compartment and the second compartment are disposed on either side of the cavity.

Advantageously, the cavity extends from the distal end of the cartridge at least part way along the length of the cartridge.

Advantageously, the cavity extends along the longitudinal axis of the cartridge.

The cavity may extend from the distal end of the cartridge to the proximal end of the cartridge. In such embodiments, the cavity has an open distal end and an open proximal end.

The cavity may extend from the distal end of the cartridge part way along the length of the cartridge. In such embodiments, the cavity has an open distal end and a closed proximal end.

The cavity may be enclosed along its length.

The cavity may be at least partially open along its length. This may advantageously facilitate insertion of a heating element into the cavity.

Advantageously the cartridge may comprise a susceptor for inductively heating the nicotine source.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention, the cartridge may comprise a susceptor for inductively heating the first compartment.

In embodiments in which the cartridge comprises a nicotine source comprising a liquid nicotine formulation according to the invention and an acid source, advantageously the cartridge may comprise a susceptor for inductively heating the nicotine source and the acid source.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, advantageously, the cartridge may comprise a susceptor for inductively heating the first compartment and the second compartment. In such embodiments, the susceptor is advantageously located between the first compartment and the second compartment. That is the first compartment and the second compartment are disposed on either side of the susceptor.

According to the invention there is further provided an aerosol-generating system comprising: a cartridge according to the invention; and an aerosol-generating device comprising:

a housing defining a device cavity configured to receive at least a portion of the cartridge; and a heating element for heating the cartridge.

The aerosol-generating system may advantageously comprise a consumable cartridge according to the invention and a reusable aerosol-generating device comprising a housing
5 defining a device cavity configured to receive at least a portion of the cartridge and a heating element for heating the cartridge.

The heating element may be an electrical heating element. The heating element may comprise a resistive heating element.

The heating element may be an inductive heating element. The inductive heating element
10 may comprise an inductor coil. In such embodiments, the inductive heating element may advantageously circumscribe at least a portion of the device cavity of the aerosol-generating device.

In such embodiments, during use, the inductive heating element generates an alternating magnetic field to generate eddy currents and hysteresis losses in a susceptor in the cartridge,
15 causing the susceptor to heat up, thereby heating the cartridge. For example, during use, in embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, the inductive heating element generates an alternating magnetic field to generate eddy currents and hysteresis losses in a susceptor in the cartridge, causing the
20 susceptor to heat up, thereby heating the first compartment and the second compartment of the cartridge.

The heating element may be located within the device cavity of the aerosol-generating device.

Advantageously, the heating element may be located within the device cavity of the
25 aerosol-generating device and the cartridge may comprise a cavity for receiving the heating element as described above. In use, the heating element is received within cavity of the cartridge and heats the cartridge. For example, in use, in embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, the heating
30 element is received within cavity of the cartridge and heats the first compartment and the second compartment of the cartridge.

In such embodiments, the heating element of the aerosol-generating device may advantageously be an elongate heating element in the form of a heating element blade having a width that is greater than the thickness thereof and the cavity of the cartridge may be configured
35 as an elongate slot.

The heating element may circumscribe at least a portion of the device cavity.

In such embodiments, the heating element may be arranged to circumscribe at least a portion of the cartridge when at least a portion of the cartridge is received within the device cavity.

Advantageously, in embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, the heating element may be an inductor coil and the cartridge may comprise a susceptor for inductively heating the first compartment and the second compartment of the cartridge as described above.

Advantageously, the heating element is configured to heat the first compartment and the second compartment of the cartridge to a temperature of below about 250 degrees Celsius. Preferably, the heating element is configured to heat the first compartment and the second compartment of the cartridge to a temperature of between about 80 degrees Celsius and about 150 degrees Celsius.

Advantageously, the heating element is configured to heat the first compartment and the second compartment of the cartridge to substantially the same temperature.

As used herein with reference to the invention, by "substantially the same temperature" it is meant that the difference in temperature between the first compartment and the second compartment of the cartridge measured at corresponding locations relative to the heating element is less than about 3 degrees Celsius.

In use, heating the first compartment and the second compartment of the cartridge to a temperature above ambient temperature advantageously enables the vapour concentrations of the nicotine in the first compartment of the cartridge and the vapour pressure of the acid in the second compartment of the cartridge to be controlled and balanced proportionally to yield an efficient reaction stoichiometry between the nicotine and the acid. Advantageously, this may improve the efficiency of the aerosol formation and the consistency of the aerosol delivery to a user. Advantageously, it may also reduce the delivery of unreacted nicotine and unreacted acid to a user.

The aerosol-generating system may further comprise a power supply for supplying power to the heating element and a controller configured to control a supply of power from the power supply to the heating element.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source, the aerosol-generating device may comprise one or more temperature sensors configured to sense the temperature of the heating element and the temperature of the first compartment and the second compartment of the cartridge. In such embodiments, the controller may be configured to control a supply of power to the heating element based on the sensed temperature.

The aerosol-generating system may further comprise a mouthpiece.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second compartment comprising an acid source,, nicotine vapour released from the nicotine source in
5 the first compartment of the cartridge and acid vapour released from the acid source in the second compartment of the cartridge may react with one another in the gas phase in the mouthpiece to form an aerosol.

The mouthpiece may be configured for engagement with the cartridge.

In embodiments in which the mouthpiece is configured for engagement with the cartridge,
10 the combination of the cartridge and the mouthpiece may simulate the shape and dimensions of a combustible smoking article, such as a cigarette, a cigar, or a cigarillo. Advantageously, in such embodiments the combination of the cartridge and the mouthpiece may simulate the shape and dimensions of a cigarette.

The mouthpiece may be configured for engagement with the housing of the aerosol-
15 generating device.

The mouthpiece may be designed to be disposed of once the liquid nicotine formulation of the nicotine source of the cartridge is depleted.

In embodiments in which the cartridge comprises a first compartment containing a nicotine source comprising a liquid nicotine formulation according to the invention and a second
20 compartment comprising an acid source, the mouthpiece may be designed to be disposed of once the nicotine in the first compartment and the acid in the second compartment are depleted.

The mouthpiece may be designed to be reusable. In embodiments in which the mouthpiece is designed to be reusable, the mouthpiece may advantageously be configured to be removably attached to the cartridge or the housing of the aerosol-generating device.

For the avoidance of doubt, features described above in relation to one aspect of the
25 invention may also be applicable to other aspects of the invention. In particular, features described above in relation to the liquid nicotine formulation of the invention may also relate, where appropriate, to the cartridge of the invention, and *vice versa* and features described above in relation to the cartridge of the invention may also relate, where appropriate, to the aerosol-
30 generating system of the invention, and *vice versa*.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a cartridge according to an embodiment of the invention;

Figure 2 shows an aerosol-generating system according to an embodiment of the
35 invention; and

Figures 3A-C show the: percentage by volume of droplets having a particle size below 5 microns (Figure 3A); transmittance (Figure 3B) and; average amount of nicotine delivered per puff for aerosols generated by an aerosol-generating system according to the invention and a comparative aerosol-generating system not according to the invention.

5 Figure 1 shows a schematic illustration of an elongate cartridge 2 according to an embodiment of the invention for use in an aerosol-generating system for generating an aerosol comprising nicotine lactate salt particles.

10 The cartridge 2 has a length of about 15 millimetres, a width of about 7 millimetres and a height of about 5.2 millimetres. The cartridge 2 comprises an elongate body 4, a distal end cap 6 and a proximal end cap 8.

The body 4 has a length of about 13 millimetres, a width of about 7 millimetres and a height of about 5.2 millimetres. The distal end cap 6 and the proximal end cap 8 have a length of about 2 millimetres, a width of about 7 millimetres and a height of about 5.2 millimetres.

15 The cartridge 2 comprises an elongate first compartment 10 that extends from the proximal end of the body 4 to the distal end of the body 4. The first compartment 10 contains a nicotine source comprising a first carrier material 12 impregnated with 18 microlitres of a liquid nicotine formulation according to the invention having a glycerine content of about 32 percent by weight and a nicotine content of about 68 percent by weight. The ratio by weight of nicotine to glycerine in the liquid nicotine formulation is about 2.1.

20 The cartridge 2 comprises an elongate second compartment 14 that extends from the proximal end of the body 4 to the distal end of the body 4. The second compartment 14 contains a lactic acid source comprising a second carrier material 16 impregnated with about 18 microlitres of lactic acid.

The first compartment 10 and the second compartment 14 are arranged in parallel.

25 The cartridge 2 further comprises a cavity 18 for receiving a heating element configured to heat the first compartment 10 and the second compartment 14. The cavity 18 is located between the first compartment 10 and the second compartment 14 and extends from the proximal end of the body 4 to the distal end of the body 4. The cavity 18 is of substantially stadium shaped transverse cross-section and has a width of about 6.3 millimetres and a height of about
30 1 millimetre.

The distal end cap 6 comprises a first air inlet 20 comprising a row of three spaced apart apertures and a second air inlet 22 comprising a row of five spaced apart apertures. Each of the apertures forming the first air inlet 20 and the second air inlet 22 is of substantially circular transverse cross-section and has a diameter of about 0.3 millimetres.

The distal end cap 6 further comprises a third inlet 24 located between the first air inlet 20 and the second air inlet 22. The third inlet 24 is of substantially stadium shaped transverse cross-section and has a width of about 6.3 millimetres and a height of about 1 millimetre.

The proximal end cap 8 comprises a first air outlet 26 comprising a row of three spaced apart apertures and a second air outlet 28 comprising a row of five spaced apart apertures. Each of the apertures forming the first air outlet 26 and the second air outlet 28 is of substantially circular transverse cross-section and has a diameter of about 0.3 millimetres.

As shown in Figure 1, to form the cartridge 2, the proximal end cap 8 is inserted into the proximal end of the body 4 such that the first air outlet 26 is aligned with the first compartment 10 and the second air outlet 28 is aligned with the second compartment 14.

The first carrier material 12 impregnated with the liquid nicotine formulation is inserted into the first compartment 10 and the second carrier material 16 impregnated with the lactic acid is inserted into the second compartment 14.

The distal end cap 6 is then inserted into the distal end of the body 4 such that the first air inlet 20 is aligned with the first compartment 10, the second air inlet 22 is aligned with the second compartment 14 and the third inlet 24 is aligned with the cavity 18.

The first compartment 10 and the second compartment 14 are substantially the same shape and size. The first compartment 10 and the second compartment 14 are of substantially rectangular transverse cross-section and have a length of about 11 millimetres, a width of about 4.3 millimetres and a height of about 1 millimetres.

The first carrier material 12 and the second carrier material 16 comprise a non-woven sheet of PET/PBT and are substantially the same shape and size. The shape and size of the first carrier material 12 and the second carrier material 16 is similar to the shape and size of the first compartment 10 and the second compartment 14 of the cartridge 2, respectively.

The first air inlet 20 is in fluid communication with the first air outlet 26 so that a first air stream may pass into the cartridge 2 through the first air inlet 20, through the first compartment 10 and out of the cartridge 2 through the first air outlet 26. The second air inlet 22 is in fluid communication with the second air outlet 28 so that a second air stream may pass into the cartridge 2 through the second air inlet 22, through the second compartment 14 and out of the cartridge 2 through the second air outlet 28.

Prior to first use of the cartridge 2, the first air inlet 20 and the second air inlet 22 may be sealed by a removable peel-off seal or a pierceable seal (not shown) applied to the external face of the distal end cap 6. Similarly, prior to first use of the cartridge 2, the first air outlet 26 and the second air outlet 28 may be sealed by a removable peel-off seal or a pierceable seal (not shown) applied to the external face of the proximal end cap 8.

Figure 2 shows a schematic illustration of an aerosol-generating system 200 according to an embodiment of the invention for generating an aerosol comprising nicotine lactate salt particles.

The aerosol-generating system comprises an aerosol-generating device 202, a cartridge 2 according to the embodiment of the invention shown in Figure 1 and a mouthpiece 204.

The aerosol-generating device 202 comprises a housing 206 defining a device cavity 208 configured to receive the cartridge 2 and a heating element (not shown) configured to heat both the first compartment 10 and the second compartment 14 of the cartridge 2.

The heating element is a single elongate electric heating element. The heating element is positioned within the device cavity 208 of the aerosol-generating device 202 and extends along the longitudinal axis of the device cavity 208. The aerosol-generating device 202 further comprises a power supply and a controller (not shown) for controlling a supply of power from the power supply to the heating element.

As the cartridge 2 is inserted into the device cavity 208 of the aerosol-generating device 202, the heating element passes through the third inlet 24 of the distal end cap 106 of the cartridge 2 and is received in the cavity 18 located between the first compartment 10 and the second compartment 14 of the cartridge 2. During use, the controller of the aerosol-generating device 202 controls the supply of power from the power supply aerosol-generating device 202 to the heating element to heat the first compartment 10 and the second compartment 14 of the cartridge 2 to substantially the same temperature of about 115°C.

Once the cartridge 2 has been inserted into the device cavity 208 of the aerosol-generating device 202, the distal end of the mouthpiece 204 is connected to the proximal end of the housing 206 of the aerosol-generating device 202.

In use, a user draws on the proximal end of the mouthpiece 204 to draw a first air stream through the first compartment 10 of the cartridge 2 and a second air stream through the second compartment 14 of the cartridge 2. As the first air stream is drawn through the first compartment 10 of the cartridge 2, nicotine and glycerine vapour is released from the first carrier material 12 into the first air stream. As the second air stream is drawn through the second compartment 14 of the cartridge 2, lactic acid vapour is released from the second carrier material 16 into the second air stream.

The nicotine vapour in the first air stream and the lactic acid vapour in the second air stream react with one another in the gas phase in the mouthpiece 204 to form an aerosol of nicotine lactate salt particles, which is delivered to the user through the proximal end of the mouthpiece 204. As described above, the sensorial harshness of the aerosol is perceived to be lower by the user due to the presence of the glycerine within the aerosol.

In an alternative embodiment (not shown), the distal end of the mouthpiece 204 may be configured for engagement with the proximal end of the cartridge 2 rather than the proximal end of the housing 206 of the aerosol-generating device 202.

5 In the aerosol-generating system according to invention shown in Figure 2, the aerosol-generating device 202 comprises a heating element within the device cavity 208 and the cartridge 2 comprises a cavity 18 for receiving the heating element. In an alternative embodiment (not shown), rather than a cavity for receiving a heating element configured to heat the first compartment and the second compartment, the cartridge may comprise a heating element located between the first compartment and the second compartment. In this alternative
10 embodiment, the aerosol-generating device may be configured to supply power to the heating element of the cartridge by means of one or more connection points of the heating element at the distal end of the cartridge.

In the aerosol-generating system according to invention shown in Figure 2, the aerosol-generating device 202 comprises an electric heating element within the device cavity 208 and the
15 cartridge 2 comprises a cavity 18 for receiving the heating element. In an alternative embodiment (not shown), the aerosol-generating device 202 may comprise an inductive heating element circumscribing the device cavity 208 and the cartridge 2 may comprise a susceptor positioned within the cavity 18. In this alternative embodiment, during use the controller of the aerosol-generating device 202 controls the supply of power from the power supply of the aerosol-
20 generating device 202 to the inductive heating element to heat the susceptor within the cavity 18 of the cartridge 2. Once heated, the susceptor heats the first compartment 10 and the second compartment 14 of the cartridge 2.

Example

25 Figures 3A-C show the: percentage by volume of droplets having a particle size below 5 microns (Figure 3A); transmittance (Figure 3B) and; average amount of nicotine delivered per puff for aerosols generated by an aerosol-generating system according to the invention and a comparative aerosol-generating system not according to the invention.

The aerosol-generating system according to the invention comprises a cartridge according
30 to the invention comprising: a first compartment containing a nicotine source, the nicotine source comprising a first carrier material impregnated with 18 microlitres of a liquid nicotine formulation according to the invention comprising 5 microlitres (6.3 milligrams) of glycerine and 13 microlitres (13.13 milligrams) of nicotine; and a second compartment containing an acid source, the acid source comprising a second carrier material impregnated with 18 microlitres of lactic acid.

35 The comparative aerosol-generating system according to the invention comprises a cartridge not according to the invention comprising: a first compartment containing a nicotine

source, the nicotine source comprising a first carrier material impregnated with 13 microlitres (13.13 milligrams) of nicotine; and a second compartment containing an acid source, the acid source comprising a second carrier material impregnated with 18 microlitres of lactic acid.

All features of the aerosol-generating system according to the invention and the comparative aerosol-generating system according to the invention are identical except for the liquid nicotine formulation of the nicotine source.

The aerosols generated by the aerosol-generating systems under a Health Canada smoking regime (12 puffs of 2 seconds each with a puff volume of 55 millilitres and a puff interval of 30 seconds) are collected and the percentage by volume of droplets having a particle size below 5 microns (Figure 3A), transmittance (Figure 3B) and average amount of nicotine delivered per puff measured using standard techniques. During the tests, the cartridges of the aerosol-generating systems are heated by a heating element controlled to provide a steady state temperature of 115°C. A pre-heating period of 1 minute is carried out prior to commencement of the puffs to enable the steady state temperature to be reached.

The results shown in Figures 3A-C are the average of 4 tests. In Figures 3A-3C, the results for the aerosol-generating system according to the invention are shown by the left-hand bars and the results for the comparative aerosol-generating system not according to the invention are shown by the right-hand bars.

The perceived sensorial harshness of the aerosol generated by the aerosol-generating system according to the invention and the aerosol generated by the aerosol-generating system not according to the invention is also assessed.

The sensorial harshness of the aerosol generated by the aerosol-generating system according to the invention is advantageously perceived to be lower than that of the aerosol generated by the aerosol-generating system not according to the invention.

As shown in Figures 3A and 3B, the percentage by volume of droplets having a particle size below 5 microns (Figure 3A) and transmittance, which is a measure of the total number of droplets per puff, (Figure 3B) of the aerosol generated by the aerosol-generating system according to the invention are the same as those of the aerosol generated by the aerosol-generating system not according to the invention.

As shown in Figure 3C, the nicotine delivery per puff for the aerosol generated by the aerosol-generating system according to the invention is advantageously higher than that of the aerosol generated by the aerosol-generating system not according to the invention.

CLAIMS

1. A cartridge for use in an aerosol-generating system, the cartridge containing a nicotine source comprising a liquid nicotine formulation, the liquid nicotine formulation comprising
5 glycerine in an amount of at least 10 percent by weight and nicotine, wherein the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is between about 3:2 and about 9:1.
2. A cartridge according to claim 1 wherein the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is at least about 9:5.
10
3. A cartridge according to claim 1 or 2 wherein the ratio by weight of nicotine to glycerine in the liquid nicotine formulation is less than or equal to about 8:1.
4. A cartridge according to any one of claims 1 to 3 wherein the ratio by weight of nicotine to
15 glycerine in the liquid nicotine formulation is between about 2:1 and about 4:1.
5. A cartridge according to any one of claims 1 to 4 wherein the nicotine content of the liquid nicotine formulation is between about 60 percent by weight and about 90 percent by weight.
- 20 6. A cartridge according to any one of claims 1 to 5 wherein the glycerine content of the liquid nicotine formulation is between about 10 percent by weight and about 30 percent by weight.
7. A cartridge according to any one of claims 1 to 6 wherein the nicotine content of the liquid nicotine formulation is at least about 70 percent by weight.
25
8. A cartridge according to any one of claims 1 to 7 wherein the combined glycerine content and nicotine content of the liquid nicotine formulation is at least about 95 percent by weight.
9. A cartridge according to any one of claims 1 to 8 wherein the liquid nicotine formulation
30 comprises one or more flavourants.
10. A cartridge according to any one of claims 1 to 9 wherein the nicotine source comprises a first carrier material impregnated with the liquid nicotine formulation.
- 35 11. A cartridge according to claim 10 wherein the first carrier material is impregnated with between about 10 microlitres and about 25 microlitres of the liquid nicotine formulation.

12. A cartridge according to any one of claims 1 to 11 further comprising an acid source.
13. A cartridge according to claim 12 wherein the acid source comprises a second carrier
5 material impregnated with acid.
14. A cartridge according to claim 13 wherein the second carrier material is impregnated with
between about 10 microlitres and about 25 microlitres of acid.
- 10 15. An aerosol-generating system comprising:
a cartridge according to any one of claims 1 to 14; and
an aerosol-generating device comprising:
a housing defining a device cavity configured to receive at least a portion of the
cartridge; and
15 a heating element for heating the cartridge.

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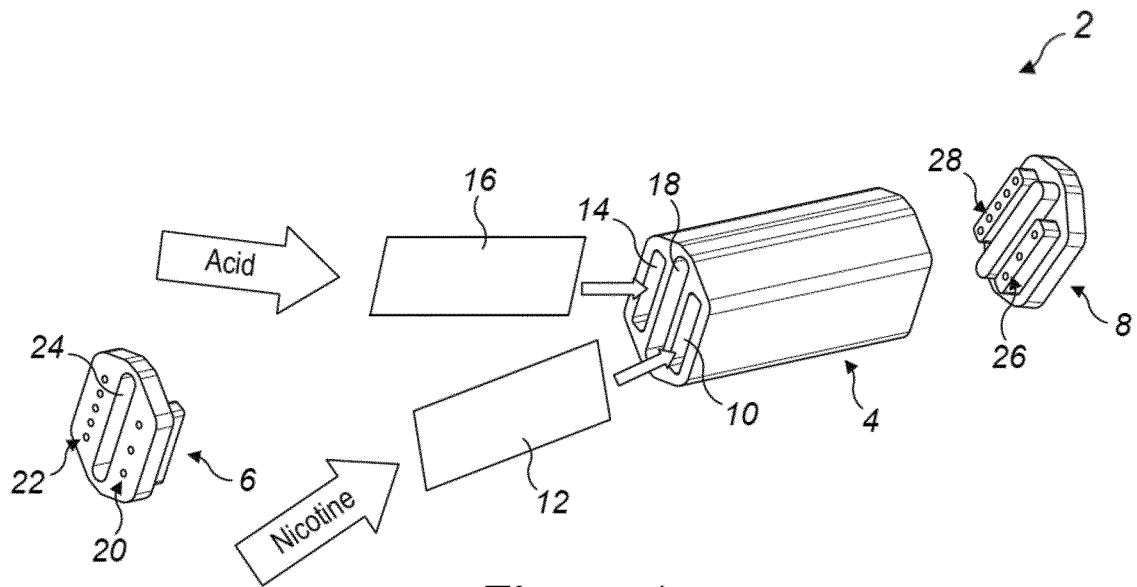


Figure 1

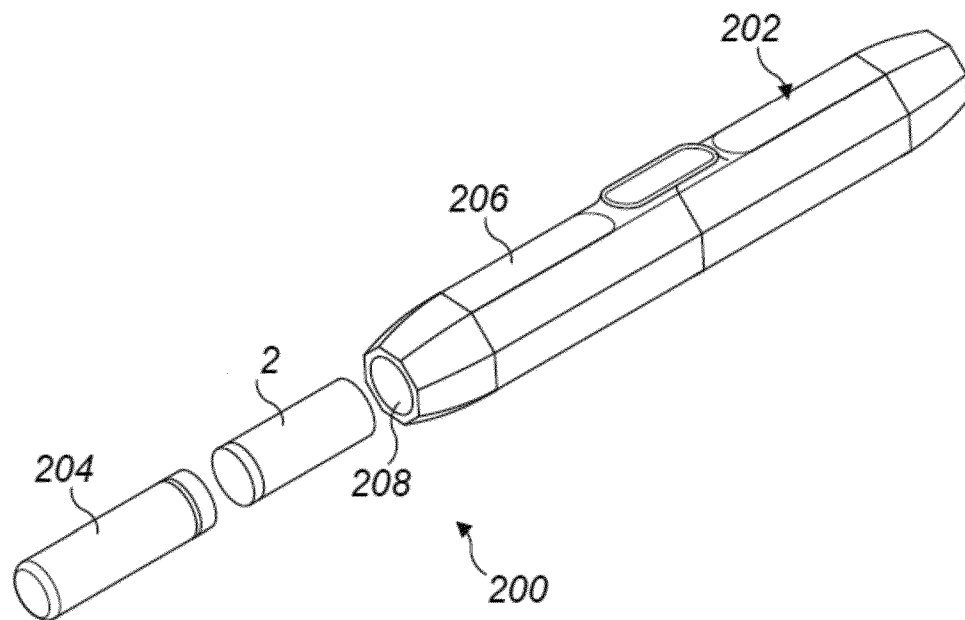


Figure 2

- 2/2 -

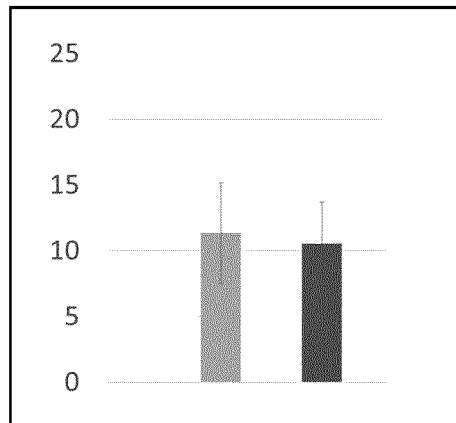


Figure 3A

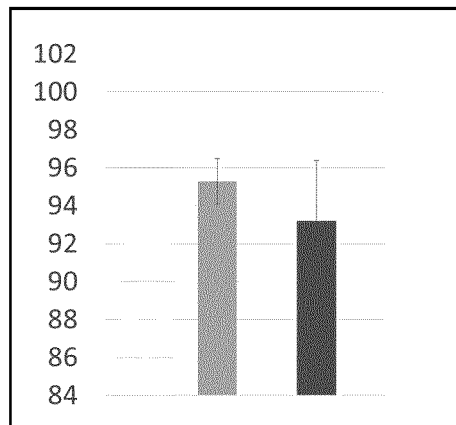


Figure 3B

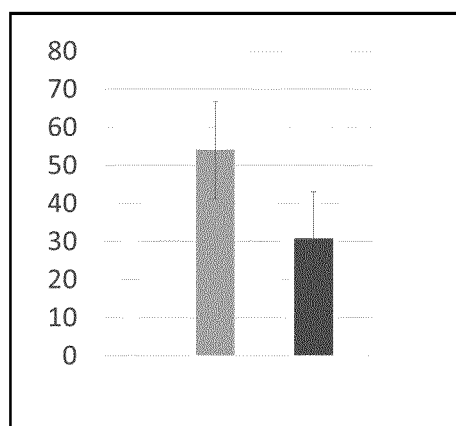


Figure 3C

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/067492

A. CLASSIFICATION OF SUBJECT MATTER
INV. A24B15/16 A24F47/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A24B A61K A61M A24F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2018/140001 A1 (GABBAY EYAL [US]) 24 May 2018 (2018-05-24) paragraph [0013] - paragraph [0017]; table 1 paragraph [0037] - paragraph [0038] paragraph [0002]	1-15
A	WO 2017/108991 A1 (PHILIP MORRIS PRODUCTS SA [CH]) 29 June 2017 (2017-06-29) claims	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

13 September 2019

Date of mailing of the international search report

19/09/2019

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Leprêtre, François

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2019/067492

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2018140001	A1	24-05-2018	NONE

WO 2017108991	A1	29-06-2017	CA 3005512 A1 29-06-2017
			CN 108289511 A 17-07-2018
			EP 3393283 A1 31-10-2018
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			WO 2017108991 A1 29-06-2017
