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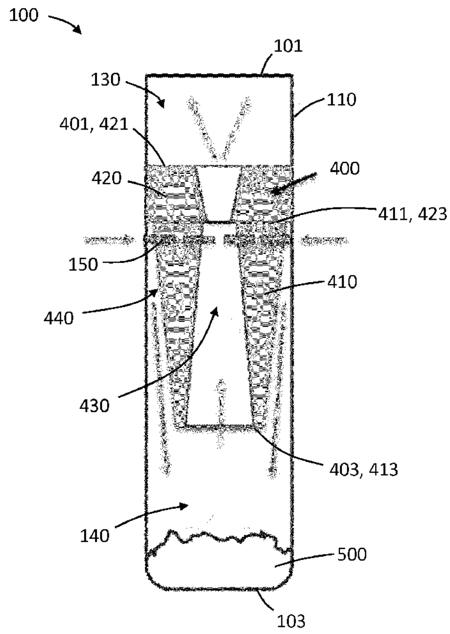

FIG. 3

(57) Abstract: A cartridge (100) for use with an aerosol generating device (200) includes a housing (110) defining a closed end (103), an open end (101), and an aperture (150) between the closed end and the open end. The cartridge further comprises a composition (500) comprising nicotine disposed in the housing in proximity to the closed end. The cartridge also includes a flow control apparatus (400) disposed in the housing. The flow control apparatus includes a proximal end (401), a distal end (403), and an internal airflow passageway (430) between the distal end and the proximal end. A seal is formed between seal between an exterior of the flow control apparatus and an interior of the housing. The seal is between the open end of the housing and the aperture of the housing. A channel (440) is defined, at least in part, by the interior of the housing. The channel is in communication with the aperture and directs air from the aperture towards the composition comprising nicotine. Preferably, the channel extends less than fully around the housing. The channel may be formed between the flow control apparatus and the housing.

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CARTRIDGE FOR USE WITH AEROSOL GENERATING DEVICE

The present disclosure relates to cartridges for use with an aerosol generating device. The cartridge comprises a composition, for example a composition containing nicotine, and an airflow path that permits aerosol generated from the composition, when heated by the aerosol generating device, to be efficiently delivered to a user. The cartridge has a mouth end for insertion into a user's mouth and a distal end that may be received by an aerosol generating device having a heating element configured to heat the distal end of the cartridge. The composition is disposed in the cartridge in proximity to the distal end. When heated by the heating element of the aerosol generating device, aerosol may be produced by the composition, which may be inhaled by a user by drawing on the mouth end of the cartridge.

Cartridges comprising nicotine for use with aerosol generating articles are known. Often the cartridges comprise a liquid composition, such as an e-liquid, that is heated by a coiled electrically resistive filament. To avoid accidental leakage of the liquid composition, a good deal of care is taken to manufacture the cartridges.

Use of alternative forms of compositions comprising nicotine, such as gels, may reduce potential leakage concerns, but may require different heating schemes and different airflow schemes to allow aerosol generated from the heated composition to be efficiently delivered to a user.

It would be desirable to provide a cartridge for use in an aerosol generating device where the cartridge contains a composition that exhibits little to no leakage of the composition.

It would also be desirable to provide a cartridge that contains a composition and includes a flow control system that efficiently delivers aerosol generated from the composition when the composition is heated by the aerosol generating device. Preferably, the composition comprises nicotine. Preferably, the composition is a gel composition.

In various aspects of the present invention there is provided a cartridge for use with an aerosol generating device. The cartridge includes a housing defining a closed end, an open end, and an aperture between the closed end and the open end. The cartridge further comprises a composition disposed in the housing in proximity to the closed end. Preferably, the composition comprises nicotine. Preferably, the composition is a gel. The cartridge also includes a flow control apparatus disposed in the housing. The flow control apparatus includes a proximal end, a distal end, and an internal airflow passageway between the distal end and the proximal end. A seal is formed between an exterior of the flow control apparatus and an interior of the housing. The seal is between the open end of the housing and the aperture of the housing. A channel is defined between a portion of the exterior of the flow control apparatus and the interior of the housing. The channel is in communication with the aperture and directs air from the aperture towards the composition.

In some embodiments, the channel may extend substantially around the interior of the housing. In some embodiments, the channel may extend less than fully around the interior of the housing. The channel is defined between the flow control apparatus and the housing. In some embodiments, the channel may be formed, at least in part, by the interior of the housing. In some embodiments, the channel may be formed, at least in part, by the exterior of the flow control apparatus. In some embodiments, the channel may be formed, at least in part, by the interior of the housing and the exterior of the flow control apparatus.

Various aspects or embodiments of the cartridges for use with aerosol generating devices described herein may provide one or more advantages relative to currently available or previously described cartridges for aerosol generating devices. For example, the airflow management, including the flow control apparatus and channel of the cartridge provides for efficient transfer of aerosol generated from the composition to a user. Furthermore, if the composition comprises a gel, the composition is less likely to leak form the cartridge than a liquid composition.

The cartridge includes a mouth end for insertion into a user's mouth and a distal end that may be received by an aerosol generating device having a heating element configured to heat the distal end of the cartridge. The composition is disposed in proximity to the distal end of the cartridge. The aerosol generating device may heat the composition in the cartridge to generate an aerosol, which may be inhaled by a user by drawing on the mouth end of the cartridge. For example, where the composition comprises nicotine, the aerosol generating device may heat the composition in the cartridge to generate an aerosol comprising nicotine, which may be inhaled by a user by drawing on the mouth end of the cartridge.

The cartridge, or portions of the cartridge, containing the composition may be single-use cartridges or multi-use cartridges. In some embodiments, portions of the cartridges are re-usable, and portions are disposable after a single use. For example, the cartridges may include a mouthpiece that may be re-usable and a single use portion that contains the composition. In embodiments comprising both reusable portions and single use portions, the reusable portions may be removable from the single use portions.

The cartridge includes a housing. The housing may comprise a single part or multiple parts. The housing defines an open end and a closed end. The composition is disposed in proximity to the closed end. The open end of the housing may be inserted into a user's mouth. The user may draw on the open end to cause aerosol from the composition in the housing to be inhaled by the user. The housing defines at least one aperture between the open end and the closed end. The at least one aperture defines at least one air inlet, such that when the user draws on the open end of the housing, air enters the cartridge through the aperture. The user may draw on the open end of the cartridge to draw air into the cartridge through the aperture. The channel directs air from the aperture towards the closed end of the cartridge. Air drawn into the cartridge through the aperture may flow along the channel of the cartridge towards the composition at the closed end, then through the internal airflow passageway of the flow control apparatus from the distal end to the proximal end and out of the cartridge at the open end for inhalation by the user.

By spacing the aperture from the closed end of the housing, the aperture is separated from the composition, reducing the likelihood of leakage of the composition through the aperture. Furthermore, by providing a channel for airflow from the aperture to the composition, formed between the interior of the housing and an exterior portion of the flow control apparatus, airflow from the aperture may be directed towards the composition and the flow control apparatus may act as a further obstacle between the composition and the aperture to further reduce the likelihood of leakage of the composition through the aperture. In addition, the internal airflow passageway of the flow control apparatus provides air and vapour generated from the composition with a pathway to be drawn out of the housing through the open end. The pathway provided by the airflow passageway of the flow control apparatus may have an airflow cross section that is defined or varied along the length of the passageway to improve the flow of aerosol generated from the composition from the closed end of the housing to the open end of the housing.

The cartridge includes a flow control apparatus. The housing and the flow control apparatus, or portions thereof, may be formed as a single part or separate parts. The flow control apparatus may be formed as a single part or separate parts. The flow control apparatus is disposed in the housing and has a proximal end, a distal end, and an internal airflow passageway between the distal end and the proximal end. The proximal end is closer to the open end of the housing than the distal end.

The internal airflow passageway of the flow control apparatus has an airflow cross section between the proximal end and the distal end.

For purposes of the present disclosure, “airflow cross-section” is a cross sectional area of a passageway through which air is able to flow.

For purposes of the present disclosure, “cross-sectional area” is a maximum transverse cross sectional area of the cartridge or a portion or a part of the cartridge.

In some embodiments, the airflow cross section of the airflow passageway may be substantially constant from the distal end to the proximal end. The airflow passageway may have any suitable inner diameter. For example, the inner diameter of the airflow passageway may be between about 1 mm to about 5 mm, such as about 2 mm. The airflow passageway typically has an airflow cross section that is smaller than the airflow cross section within the housing around the distal end of the flow control apparatus. As such, the flow control apparatus presents a constricted airflow cross section for accelerating air entering the airflow passageway at the distal end.

In some embodiments, the airflow cross section of the airflow passageway may vary from the distal end to the proximal end. For example, the airflow cross section at the distal end of the airflow passageway may be greater than the airflow cross section at the proximal end of the airflow passageway. Where the airflow cross section of the airflow passageway is greater at the distal end than at the proximal end, the diameter of the airflow passageway at the proximal end may be between about 0.5 mm to about 3 mm, such as about 1 mm, and the diameter of the airflow passageway at the distal end may be between about 1 mm to about 5 mm, such as about 2 mm.

The flow control apparatus may have any suitable length. For example, the flow control apparatus may have a length from about 3 mm to about 50 mm, such as from about 4 mm to about 30 mm, such as about 25 mm.

The internal airflow passageway of the flow control apparatus may be configured to accelerate air as it flows from the distal end towards the proximal end.

The internal airflow passageway of the flow control apparatus may have one or more portions arranged between the distal end and the proximal end that are adapted to control the flow of air through the airflow passageway from the distal end to the proximal end.

The airflow passageway of the flow control apparatus may comprise a first portion between the proximal end and the distal end that is configured to accelerate air as it flows from the distal end towards the proximal end of the flow control apparatus. The first portion of the airflow passageway may be configured in any suitable manner to accelerate air as it flows through the airflow passageway from the distal end towards the proximal end of the airflow passageway. For example, the first portion of the airflow passageway may include guides defining a constricted airflow cross section, which force air to accelerate substantially in the axial direction from the distal end towards the proximal end.

The airflow passageway may comprise a first portion between the proximal end and the distal end, wherein the airflow passageway has an airflow cross section at the distal end of the airflow passageway greater than an airflow cross section at the first portion of the airflow passageway.

In some embodiments, the airflow cross section of the first portion of the airflow passageway may constrict from a location closer to the distal end of the flow control apparatus to a location closer to the proximal end of the flow control apparatus to cause the air to accelerate as it flows from the distal end towards the proximal end. In other words, the airflow cross section of the first portion may constrict from the distal end of the first portion to the proximal end of the first portion. The airflow passageway may comprise a first portion between the proximal end and the distal end, wherein the first portion has a cross-sectional area that decreases from the distal end towards the proximal end. Thus, the distal end of the first portion of the airflow passageway (the location closer to the distal end of the flow control apparatus) may have an inner diameter greater than the proximal end of the first portion (the location closer to the proximal end of the flow control apparatus).

In some embodiments, the airflow cross section of the first portion of the airflow passageway may be substantially constant from the distal end of the first portion to the proximal end of the first portion. In such embodiments, the substantially constant airflow cross section of the first portion of the airflow passageway may be smaller than the airflow cross section at the distal end of the airflow passageway.

For purposes of the present disclosure, “diameter” or “width” is a maximum transverse dimension of the cartridge or a portion or a part of the cartridge. By way of example, the “diameter” may be a diameter of an object having a circular transverse cross section or may be a width of an objection having rectangular transverse cross section.

For purposes of the present disclosure, an airflow cross section that is “constricted” from a first location to a second location means that the airflow cross section reduces in diameter from the first location to the second location.

Where the airflow cross section of the first portion of the airflow passageway is constricted from the distal end to the proximal end, the constriction of the airflow cross section typically comprises a reduction in the diameter of the airflow passageway from the distal end of the first portion to the proximal end of the first portion. The constriction of the airflow cross section from the distal end to the proximal end may be continuous. For example, the reduction in the diameter of the airflow passageway may be linear from the distal end to the proximal end of the first portion. The constriction may be uniform or non-uniform. For example, the rate of constriction of the airflow cross section may increase from the distal end to the proximal end of the first portion. The constriction of the airflow cross section may be stepped. In other words, the airflow cross section may constrict in discrete increments or steps from the distal end to the proximal end. In some embodiments, the constriction is linear and uniform around the circumference of the airflow passageway from the distal end to the proximal end of the first portion.

The first portion (the air accelerating portion) of the airflow passageway may have any suitable shape. An inner surface of the flow control apparatus defining the first portion (the air accelerating portion) of the airflow passageway may have a frustoconical shape.

The proximal end of the first portion of the airflow passageway may have any suitable inner diameter. For example, the inner diameter of the proximal end of the first portion of the airflow passageway may be between about 0.5 mm to about 3 mm, such as about 1 mm.

The distal end of the first portion of the airflow passageway may have any suitable inner diameter. For example, the inner diameter of the distal end of the first portion of the airflow passageway may be between about 1 mm to about 5 mm, such as about 2 mm.

The ratio of the diameter of the proximal end of the first portion of the airflow passageway to the diameter of the distal end of the first portion of the airflow passageway may be any suitable ratio. For example, the ratio may be between about 1:4 and about 3:4, or between about 2:5 and about 3:5, or may be about 1:2.

The first portion of the airflow passageway may have any suitable length. In other words, the distance between the proximal end and the distal end of the first portion of the airflow passageway may be any suitable distance. For example, the length of the first portion of the airflow passageway may be from about 3 mm to about 15 mm, such as from about 4 mm to about 7 mm, or about 5.5 mm.

The internal airflow passageway of the flow control apparatus may optionally comprise a second portion closer to the proximal end of the flow control apparatus than the first portion. In other words, the second portion may be arranged downstream of the first portion. The second portion of the airflow passageway may be configured to decelerate air flowing from the distal end towards the proximal end of the flow control apparatus. The airflow cross section of the second portion of the airflow passageway may expand from a location closer to the distal end of the flow control apparatus to a location closer to the proximal end of the flow control apparatus to cause the air to decelerate as it flows from the distal end towards the proximal end. In other words, the second portion of the airflow passageway may comprise a distal end and a proximal end and the airflow cross section of the second portion may expand from the distal end to the proximal end. The airflow passageway may comprise a second portion closer to the proximal end than the first portion, wherein the cross-sectional area of the second portion of the airflow passageway increases from the distal end towards the proximal end. Thus, the location closer to the proximal end may have an inner diameter greater than the location closer to the distal end.

For purposes of the present disclosure, an airflow cross section that is “expanded” from a first location to a second location means that the airflow cross section increases in diameter from the first location to the second location.

The expansion of the airflow cross section from the distal end of the second portion of the airflow passageway to the proximal end of the airflow passageway may be continuous. The expansion may be uniform or non-uniform. For example, the expansion may be stepped. For example, the expansion may be linear. For example, the rate of expansion of the airflow cross section may increase from the distal end to the proximal end of the first portion. In some embodiments, the expansion is continuous and uniform from the location closer to the distal end to the location closer to the proximal end.

The second portion (the air decelerating portion) of the airflow passageway may have any suitable shape. An inner surface of the flow control apparatus defining the second portion (the air decelerating portion) of the airflow passageway may have a frustoconical shape.

The proximal end of the second portion of the airflow passageway may have any suitable inner diameter. For example, the inner diameter of the proximal end may be between about 2 mm to about 6 mm, such as between about 3 mm to about 5.5 mm, such as about 5 mm.

The distal end of the second portion of the airflow passageway may have any suitable inner diameter. In some embodiments, the distal end of the second portion may have the same diameter as the distal end of the first portion. For example, the inner diameter of the distal end of the second portion may be between about 0.5 mm to about 3 mm, such as about 1 mm. In some embodiments, the distal end of the second portion may have a different diameter to the proximal end of the first portion. For example, the inner diameter of the distal end may be between about 1 mm to about 6 mm, such as between about 2 mm to about 5 mm, such as about 4.2 mm.

The second portion of the airflow passageway, if present, may have any suitable length. For example, the second portion of the airflow passageway may have a length from about 0.2 mm to about 20 mm, such as from about 1 mm to about 10 mm, such as between about 3 mm and about 7 mm, such as about 4.5 mm.

In some embodiments, the internal airflow passageway of the flow control apparatus may optionally comprise a third portion closer to the distal end of the flow control apparatus than the first portion. In other words, the third portion may be arranged upstream of the first portion.

The third portion may comprise a chamber having a substantially constant inner diameter along its length, relative to the first and optional second portions. The third portion may provide a chamber to enable cooling of the air, vapour and aerosol before it reaches the air accelerating portion. The third portion may also provide additional control of the resistance to draw (RTD) of the flow control apparatus.

The third portion may have a substantially constant inner diameter of between about 2 mm and about 6 mm, such as about 5 mm or in particular about 4.8 mm or about 5.09 mm. The third portion may have a distal end closer to the distal end of the flow control apparatus and a proximal end closer to the proximal end of the flow control apparatus. In some embodiments, the third portion may be slightly tapered from the distal end to the proximal end. For example, the inner diameter at the distal end of the third portion may be about 5.1 mm and the distal portion at the proximal end of the third portion may be about 4.8 mm. A slight taper of the inner diameter from the distal end to the proximal end may facilitate manufacture of the flow control apparatus.

The third portion of the airflow passageway may have any suitable length. For example, the third portion of the airflow passageway may have a length of between about 1 mm and about 50 mm, such as between about 5 mm and about 30 mm or about 15 mm.

In some embodiments, the airflow passageway of the flow control apparatus is defined by a first portion only. In some embodiments, the airflow passageway of the flow control apparatus comprises a first portion and a second portion closer to the proximal end of the flow control apparatus than the first portion (*i.e.* downstream of the first portion). In some embodiments, the airflow passageway of the flow control apparatus comprises a first portion, a second portion closer to the proximal end of the flow control apparatus than the first portion (*i.e.* downstream of the first portion) and a third portion closer to the distal end of the flow control apparatus than the first portion (*i.e.* upstream of the first portion).

The cartridge comprises a seal between an exterior of the flow control apparatus and an interior of the housing. If the housing and the flow control apparatus, or portions thereof, are formed from the same part, the seal may be formed by the integration of the components into the single part. If the housing and the flow control apparatus are formed from separate parts, the seal may be formed by, for example, an interference fit of the flow control apparatus in the housing. In particular, the seal may be formed by an interference fit between a proximal portion of the exterior of the flow control apparatus and an interior of the housing. A gasket, such as an o-ring, between the housing and the flow control apparatus may be employed to form the seal or assist in forming the seal. The seal is located between the open end of the housing and the at least one aperture.

In some embodiments, the flow control apparatus is removably secured to the housing. For example, the flow control apparatus may be received in the housing by interference fit, threaded engagement, or the like, such that the flow control apparatus may be securely inserted and removed from the housing without damaging the housing or the flow control apparatus. Secure insertion of the flow control apparatus in the housing may produce a seal between the flow control apparatus and the housing.

The cartridge comprises at least one channel in communication with an aperture of the housing. The channel is formed, at least in part, by the housing. The channel directs air from the aperture towards the closed end of the cartridge. The channel directs air from the aperture towards the composition. In some embodiments, the channel is formed between an exterior surface of the flow control apparatus and an interior surface of the housing.

The cartridge may comprise more than one channel. In some embodiments, the cartridge comprises from about 2 to about 20 channels between the outer surface of the flow control apparatus and the inner surface of the housing. For example, the cartridge may comprise from about 5 to about 15 channels, such as from about 10 to 12 channels.

Preferably, each channel is in communication with at least one aperture through the housing. However, the cartridge may comprise one or more channels that are not in direct communication with an aperture.

The aperture may be positioned at any suitable location of the housing. In some embodiments, the housing may comprise more than one aperture. For example, the housing may comprise from about 2 to about 20 apertures. The number of apertures may be equal to the number of channels. If the number of apertures is equal to the number of channels, each aperture may correspond to a separate channel. If the housing comprises more than one aperture, the apertures may be arranged in any suitable manner. Preferably, the apertures are circumferentially disposed around the housing. The apertures may be disposed circumferentially around the housing, and the apertures may be spaced from the closed end of the housing by the same distance.

The channels may comprise sidewalls. Preferably, the sidewalls extend the length of the channel.

In some embodiments, the sidewalls extend between an exterior of the flow control apparatus and the interior of the housing. The sidewalls may extend from the exterior of the flow control apparatus, the interior of the housing, or the exterior of the flow control apparatus and the interior of the housing. The sidewalls may be formed from the same part as the exterior of the flow control apparatus or the interior of the housing.

The channels may have any suitable width. For example, a channel may extend fully around the interior of the housing. The channel extends less than fully around the housing, such as less than about 90% around the housing, less than about 70% around the housing, or less than about 50% around the housing. In some embodiments, the channel extends at least about 2% around the housing, such as at least about 5% around the housing.

The channels may have a distal end spaced from the closed end of the housing. The distal end of the channels may be at the distal end of the flow control apparatus. The distal end of a channel may be any suitable distance from the closed end of the housing. For example, the distal end of the channel may be from about 2 mm to about 20 mm from the closed end of the housing, such as from about 7 mm to about 17 mm from the closed end of the housing, or about 15 mm from the closed end of the housing.

Where a channel has sidewalls, the channel may have a width defined by the distance between the side walls. The channels may have any suitable width. For example, the width of the channels may vary from about 0.5 to about 2 mm, such as from about 0.75 mm to about 1.5 mm, such as about 1.5 mm.

A channel may have a depth defined from the inner surface of the housing to the outer surface of the flow control apparatus. The channels may have any suitable depth. The depth of the channel may be constant along the length of the channel. The depth of the channel may vary along the length of the channel. In some embodiments, the depth of the channel increases from a location in proximity to the aperture to a distal end of the channel, which is the end of the channel closest to the closed end of the housing. For example, the outer surface of the flow control apparatus defining the channel may be inwardly tapered from the location in proximity to the aperture to the distal end of the channel. This may facilitate manufacture of at least one of the flow control apparatus and the housing.

Regardless of whether the depth of the channel is constant or varies along the length of the channel, the channel may have a depth from about 0.3 mm to about 1.5 mm, such as from about 0.5 mm to about 1 mm, or about 0.75 mm.

The distal end of the flow control apparatus may be positioned a suitable distance from the closed end of the housing such that aerosol generated from the composition may be entrained in air than enters the aperture, flows through the channel and through the internal passageway of the flow control apparatus to a user for inhalation when the user draws on the cartridge. Preferably, at least 5% of the air that flows through the cartridge contacts the composition. More preferably, at least 25% of the air that flows through the cartridge contacts the composition.

In some embodiments, the distal end of the flow control apparatus is positioned from the closed end of the housing a distance from about 2 mm to about 20 mm, such as from about 7 mm to about 17 mm, or about 15 mm.

The cartridge may have any suitable overall dimensions and shape. The cartridge may have a size and shape similar to Philip Morris International's HEETS® or Heatstick® articles, for use in Philip Morris International's iQOS™ aerosol generating device system. Preferably, the cartridge is generally cylindrical. The cartridge may have an outer diameter, for example, from about 5 mm to about 15 mm, such as from about 5 mm to about 10 mm, or from about 7 mm to about 8 mm. The cartridge may have a length, for example, from about 10 mm to about 60 mm, such as from about 50 mm to about 15 mm, such as about 20 mm or about 45 mm.

The cartridges may have any suitable resistance to draw (RTD) and may vary depending on the length and dimensions of the channels, the size of the apertures, the dimensions of the most constricted cross section of the internal passageway, and the like. In many embodiments the RTD of the cartridges is between about 50 and about 140 mm H_2O, between about 60 and about 120 mm H_2O, or about 90 mm H_2O. The RTD of the cartridge refers to the static pressure difference between the one or more apertures and the mouth end of the cartridge when it is traversed by an airflow under steady conditions in which the volumetric flow is 17.5 millilitres per second at the mouth end. The RTD of a specimen can be measured using an appropriately modified method from the method set out in ISO Standard 6565:2002.

The cartridges may be formed from any suitable one or more material. For example, the flow control apparatus may be formed of any suitable one or more materials. For example, the flow control apparatus may be formed from a plastic material, a metal material, a cellulosic material, such as cellulose acetate, paper, cardboard or combinations thereof. The housing may be formed from any suitable one or more materials. For example, the housing, or a portion thereof, may be formed from a metal material, a plastic material, cardboard, or combinations thereof. When the housing is formed by cardboard, the apertures may be formed in the cardboard by laser cuts. When the closed end of the housing is formed by cardboard, the end may be closed by folding the cardboard, placing an end cap on a cardboard tube, pinching and folding the cardboard, or the like.

In some embodiments, the cartridge comprises a mouthpiece. The mouthpiece may comprise the flow control apparatus, or a portion thereof, and may form at least a proximal portion of the housing of the cartridge. The mouthpiece may connect with the housing, or a distal portion of the housing, in any suitable manner, such as through interference fit, threaded engagement, or the like.

The composition may be placed in the housing in proximity to the closed end prior to final assembly of the cartridge. The flow control apparatus, or a part comprising the proximal portion of the housing, which may contain the flow control apparatus, may be connected to the housing or the portion of the housing comprising the closed end.

Once fully assembled, the cartridge defines an airflow path through which air flows when a user draws on the mouth end of the cartridge. When the user draws on the mouth end of the cartridge, air enters the cartridge through an aperture in the housing, which then flows through the channel towards the closed end of the housing where it may entrain aerosol generated by heating of the composition. The air with entrained aerosol may then flow through the internal passageway of the flow control apparatus and through the open mouth end of the housing for inhalation by the user.

The cartridge may comprise any suitable composition. The composition may comprise any suitable components in any suitable concentrations.

The cartridge may comprise a composition that does not comprise nicotine (*i.e.* a nicotine-free composition).

The cartridge may comprise any suitable nicotine-free composition.

The cartridge may comprise a composition comprising nicotine (*i.e.* a nicotine-containing composition).

The cartridge may comprise any suitable nicotine-containing composition . The nicotine–containing composition may comprise any suitable concentration of nicotine. For example, the composition may comprise about 0.2 % by weight to about 5 % by weight nicotine, such as from about 1% by weight to about 2% by weight nicotine.

The composition may comprise an aerosol former, such as glycerol. The composition may comprise any suitable concentration of the aerosol former. For example, the composition may comprise about 60% by weight to about 95% by weight of glycerol, such as from about 80% to about 90% by weight glycerol.

The composition may comprise a gelling agent, such as alginate, gellan, guar, or combinations thereof. The composition may comprise any suitable concentration of a gelling agent. For example, the composition may comprise about 0.5% by weight to about 10% by weight gelling agent, such as from about 1% by weight to about 3% by weight gelling agent.

The composition may comprise water. The composition may comprise any suitable concentration of water. For example, the composition may comprise about 5% by weight to about 25% by weight water, such as about 10% by weight water.

The composition may comprise an inorganic cation, such as calcium ions. The composition may comprise any suitable concentration of an inorganic cation. For example, the composition may comprise about 0.2% by weight to about 5% by weight calcium ions, such as about 0.5% by weight calcium ions.

The composition may comprise a flavorant. For example, the composition may comprise menthol.

The composition may comprise any other suitable components in any suitable concentrations.

In some examples, the composition is a gel.

For purposes of the present disclosure, a "gel" is a substantially dilute cross-linked system, which exhibits no flow when in the steady-state.

The cartridge is configured to be received by an aerosol generating device such that a heating element of the device may heat the closed end of the housing of the cartridge, and thus may heat the composition that is disposed in the housing in proximity to the closed end.

The cartridge may be shaped and sized for use with any suitable aerosol generating device comprising a receptacle for receiving the cartridge and a heating element configured and positioned to heat the distal end of the cartridge when the cartridge is received by the aerosol generating device.

The aerosol generating device preferably comprises control electronics operably coupled to the heating element. The control electronics may be configured to control heating of the heating element. The control electronics may be internal to a housing of the device.

The control electronics may be provided in any suitable form and may, for example, include a controller or a memory and a controller. The controller may include one or more of an Application Specific Integrated Circuit (ASIC) state machine, a digital signal processor, a gate array, a microprocessor, or equivalent discrete or integrated logic circuitry. Control electronics may include memory that contains instructions that cause one or more components of the circuitry to carry out a function or aspect of the control electronics. Functions attributable to control electronics in this disclosure may be embodied as one or more of software, firmware, and hardware.

The electronic circuitry may comprise a microprocessor, which may be a programmable microprocessor. The electronic circuitry may be configured to regulate a supply of power to the heating element. The power may be supplied to the heating element in the form of pulses of electrical current. The control electronics may be configured to monitor the electrical resistance of the heating element and to control the supply of power to the heating element depending on the electrical resistance of the heating element. In this manner, the control electronics may regulate the temperature of the resistive element.

The aerosol generating device may comprise a temperature sensor, such as a thermocouple, operably coupled to the control electronics to control the temperature of the heating elements. The temperature sensor may be positioned in any suitable location. For example, the temperature sensor may be in contact or in proximity to the heating element. The sensor may transmit signals regarding the sensed temperature to the control electronics, which may adjust heating of the heating element to achieve a suitable temperature at the sensor.

Regardless of whether the aerosol generating device includes a temperature sensor, the device may be configured to heat the composition, which is disposed in the cartridge, to an extent sufficient to generate an aerosol.

The control electronics may be operably coupled to a power supply, which may be internal to the housing. The aerosol generating device may comprise any suitable power supply. For example, a power supply of an aerosol generating device may be a battery, or set of batteries. The batteries or power supply unit can be rechargeable, as well as being removable and replaceable. Any suitable battery may be used.

The aerosol generating device may include any suitable heating element. Preferably, the heating element comprises a resistive heating component, such as one or more resistive wires or other resistive elements. The resistive wires may be in contact with a thermally conductive material to distribute heat produced over a broader area. Examples of suitable conductive materials include aluminium, copper, zinc, nickel, silver, and combinations thereof. For purposes of this disclosure, if resistive wires are in contact with a thermally conductive material, both the resistive wires and the thermally conductive material are part of the heating element.

The heating element may be formed in any suitable manner. The heating element may comprise a cavity configured to receive and surround the closed end of the cartridge. The heating element may comprise an elongate element configured to extend along a side of the housing of the cartridge when the closed end of the cartridge is received by the device. In some embodiments, the heating element of the device is an elongate heating element, and an adaptor may be used to transfer heat from the heating element to the cartridge. For example, the adaptor may comprise a cavity configured to receive and surround the cartridge. The adaptor may be formed from thermally conductive material. For example, adaptor may be formed from aluminium, sheet metal, or the like.

In some embodiments, the cartridge may comprise more than one internal sub-cartridges, with each sub-cartridge comprising a flow control apparatus and housing generally as described above. The sub-cartridges may be retained in an external housing. The cartridge may comprise a manifold to connect the flow control devices of multiple sub cartridges to a single open end of the external housing.

In some embodiments, all of the sub-cartridges may comprise the same composition. In some embodiments, the sub-cartridges may comprise different compositions. In some embodiments, one sub-cartridge comprises a composition comprising nicotine and another sub-cartridge comprises a nicotine-free composition, for example a composition comprising a flavorant.

In some embodiments, the aerosol generating device may be configured to receive more than one cartridge described herein. For example, the aerosol generating device may comprise a receptacle into which an elongate heating element extends. One cartridge may be received in the receptacle on one side of the heating element, and another cartridge may be received in the receptacle on the other side of the heating element.

In another aspect of the invention, there may be provided a mouthpiece unit for use with an aerosol generating device, the mouthpiece unit comprising a housing having a first open end and a second open end and an aperture between the first open end and the second open end. The first open end may comprise or form a mouthpiece. Flow control apparatus is disposed in the mouthpiece unit housing. The flow control apparatus comprises a proximal end, a distal end, and an internal airflow passageway between the distal end and the proximal end, wherein the proximal end is closer to the first open end of the housing than the distal end. The internal airflow passageway of the flow control apparatus comprises a first portion between the proximal and the distal end. The airflow passageway has an airflow cross section between the proximal end and the distal end and the airflow cross section at the distal end is greater than the airflow cross section at the first portion. The first portion of the airflow passageway may comprise an airflow cross section that is substantially constant from the proximal end to the distal end. The first portion of the airflow passageway may comprise a constricted airflow cross section from the distal end towards the proximal end. The first portion of the airflow passageway may be configured to accelerate air as it flows from the distal end towards the proximal end. A seal is provided between an exterior portion of the flow control apparatus and an interior of the housing, wherein the seal is between the first open end of the housing and the aperture of the housing. A channel is provided between the exterior of the flow control apparatus and the interior of the housing, wherein the channel is in communication with the aperture and the second open end of the housing.

The second open end of the mouthpiece unit may be adapted to receive a container or a capsule comprising a composition, for example a composition comprising nicotine. The second open end of the mouthpiece unit may be configured to fluidly communicate with the container or capsule when the container or capsule is received by the mouthpiece unit. The second open end of the mouthpiece unit may be adapted such that the channel and the distal end of the internal airflow passageway are in fluid communication with the composition in the container or capsule when the container or capsule is received by the mouthpiece unit.

The container or capsule comprising the composition may comprise a housing. The second open end of the mouthpiece unit may be configured to removably couple to the housing of the container or capsule. In some embodiments, the mouthpiece unit may comprise a piercing element or a plurality of piercing elements to pierce or puncture the housing of the container or capsule to provide fluid communication between the mouthpiece unit and the composition within the container or capsule. In some embodiments, the container or capsule may comprise a deformable portion or a removable portion that may be deformed or removed by a user to open the container or capsule before the container or capsule is received by the mouthpiece unit.

In some embodiments, the mouthpiece unit may form part of an aerosol-generating device. The mouthpiece unit may be movably connected to a housing of the aerosol-generating device. For example, the mouthpiece unit may be pivotally or hinged connected to a housing of device or slidably connected to the housing of the device. Movement of the mouthpiece unit relative to the housing of the device may enable a container or capsule comprising a composition to be received by the device and operably connected to the device. The mouthpiece unit may be removably securable to the housing of the aerosol-generating device.

Any of the features described above in relation to the cartridge aspect described above may be equally applicable to the mouthpiece unit aspect and vice versa.

Reference will now be made to the drawings, which depict one or more aspects described in this disclosure. However, it will be understood that other aspects not depicted in the drawings fall within the scope of this disclosure. Like numbers used in the figures refer to like components, steps and the like. However, it will be understood that the use of a number to refer to a component in a given figure is not intended to limit the component in another figure labeled with the same number. In addition, the use of different numbers to refer to components in different figures is not intended to indicate that the different numbered components cannot be the same or similar to other numbered components. The figures are presented for purposes of illustration and not limitation. Schematic drawings presented in the figures are not necessarily to scale.

FIG. 1A is a schematic sectional view of an aerosol generating device and a schematic side view of a cartridge that may be inserted into the aerosol generating device.

FIG. 1B is a schematic sectional view of the aerosol generating device depicted in **FIG. 1A** and a schematic side view of the cartridge depicted in **FIG. 1A** inserted into the aerosol generating device.

FIG. 2A is a schematic sectional view of an adaptor and an aerosol generating device into which the adaptor may be inserted.

FIG. 2B is a schematic sectional view of the adaptor depicted in **FIG. 2A** inserted into the aerosol generating device depicted in **FIG. 2B**.

FIG. 2C is a schematic sectional view of the adaptor and aerosol generating device depicted in **FIG. 2B** and a schematic side view of a cartridge inserted into the adaptor.

FIGS. 3-6 are schematic sectional views of various embodiments of cartridges.

FIG. 7A is a schematic side view of a cartridge.

FIG. 7B is a schematic perspective view of an embodiment of the cartridge depicted in **FIG. 7A** in which a section of the housing removed.

FIG. 8 is a schematic side view of cartridges and schematic sectional view of an aerosol generating device into which the cartridges are inserted. Only a portion of the cartridges and aerosol generating device are shown.

FIG. 9 is a schematic sectional side view of cartridges and a schematic sectional view of an aerosol generating device into which the cartridges are inserted. Only a portion of the aerosol generating device is shown.

FIG. 10A is a schematic side view a cartridge.

FIG. 10B is a schematic side view of an embodiment of the cartridge depicted in **FIG. 10A** with a portion of housing removed.

FIG. 11A is an image of a flow control apparatus of a sample cartridge.

FIG. 11B is an image of sample cartridge in which the flow control apparatus depicted in **FIG. 11A** is inserted.

FIGS. 1A-B illustrate of an example of a cartridge **100** and aerosol generating device **200**. The cartridge **100** has a mouth end **101** and a closed distal end **103**. In **FIG. 1B**, the distal end **103** of the cartridge **100** is received in a receptacle **220** of the device **200**. The device **200** includes a housing **210** defining the receptacle **220**, which is configured to receive the container **100**. The device **200** also includes a heating element **230** that forms a cavity **235** configured to receive the cartridge **100**, preferably by interference fit. The heating element **230** may comprise an electrically resistive heating component. In addition, the device **200** includes a power supply **240** and control electronics **250** that cooperate to control heating of heating element **230**.

The heating element **230** may heat the distal end **103** of the cartridge **100**, which contains a composition comprising nicotine. Heating of the cartridge **100** causes the composition to form an aerosol containing nicotine, which may be inhaled by a user through the mouth end **101** of the cartridge **100**.

FIGS 2A-C illustrate an example of an aerosol generating device **200**, cartridge **100**, and adaptor **300**. The aerosol generating device **200** includes a housing **210** that forms a receptacle **220** for receiving aerosol generating articles. The device **200** includes an elongate heating element **230** that extends into the receptacle **230**. The heating element **230** is operably coupled to control electronics **250** and power supply **240**, which cooperate to heat the heating element **230**. The device **200** may be, for example, a Philip Morris International iQOS® aerosol generating device or other commercially available aerosol generating device that may be configured to receive aerosol generating articles other than the cartridges described in the present disclosure.

An adaptor **300** may be used to allow the device **200** to be used with a cartridge **100** described in the present disclosure. In the depicted embodiment, the adaptor **300** comprises a housing **310** that includes a thermally conductive material to transfer heat from the heating element **230** to the cartridge **100**. The housing **310** of the adaptor **300** defines a cavity **320** for receiving the cartridge **100** and a slot **330** for receiving the heating element **230** of the device **200**. The adaptor **300** may be inserted into the receptacle **220** of the device **200** such that the heating element **230** is received in the slot **330**, as depicted in **FIG. 2B**. Preferably, the heating element **230** contacts the housing **310** defining the slot **330** to make good thermal contact.

A distal end of the cartridge **100** may be inserted into the cavity **320** of the adaptor **300**, as depicted in **FIG. 2C**. When the cartridge **100** is received in the cavity **320** of the adaptor **300** and the heating element **230** of the device **200** is received in the slot **330** of the adaptor **300**, the heating element **230** of the device **200** may heat the cartridge **100** through the adaptor **300**.

Using an appropriate adaptor, one example of which is depicted in **FIGS. 2A-C**, any suitable aerosol generating device may be employed to heat a cartridge of the present disclosure.

FIG. 3 depicts an embodiment of a cartridge **100** including a housing **110** and a flow control apparatus **400**. The housing **110** and flow control apparatus **400** may be formed from a single part or multiple parts.

The flow control apparatus **400** has a proximal end **401**, a distal end **403** and an interior passageway **430** from the distal end **403** to the proximal end **401**. The flow control apparatus **400** has a first portion **410** and a second portion **420**. The first portion **410** defines a first portion of the passageway **430**, which extends from the distal end **413** of the first portion **410** to the proximal end **411** of the first portion **410**. The second portion **420** defines a second portion of the passageway **430**, which extends from the distal end **423** of the second portion **420** to the proximal end **421** of the second portion **420**. The first portion of the passageway **430** has a constricted cross section moving from the distal end **413** to the proximal end **411** of the first portion **410** to cause air to accelerate through this portion of the passageway **430** when a user draws on the mouth end **101** of the cartridge **100**. In other words, the cross section of the first portion of the passageway narrows from the distal end **413** to the proximal end **411**. The second portion of the passageway **430** has an expanding cross section from the distal end **423** to the proximal end **421** of the second portion **420** of the flow control apparatus **400**. In the second portion of the passageway **430**, airflow may decelerate.

The housing **110** defines an open mouth end **101** of the cartridge **100** and a closed distal end **103**. A composition **500**, such as a gel composition, is disposed in the closed distal end **103** of the housing. Aerosol generated from the composition **500** when heated may enter the headspace **140** in the housing **110** above the composition **500** to be carried through the passageway **430**.

Apertures **150** extend through the housing **110**. At least one aperture **150** is in communication with a channel **440** formed between an outer surface of the flow control apparatus **400** and an inner surface of the housing **110**. A seal is formed between the flow control apparatus **400** and the housing **110** at a location between the apertures **150** and the mouth end **101**.

When a user draws on the mouth end **101** of the cartridge **100**, air enters the apertures **150**, flows through the channel **440** into the headspace **140** above the composition **500**, where the air may entrain aerosol when the composition **500** is heated. The air may then flow through the airflow passageway **430**, and through the mouth end **101** to the user for inhalation. As air flows through the first portion of the passageway **430**, the airflow accelerates. As air flows through the second portion of the passageway **430**, the airflow decelerates. The second portion of the airflow passageway **430** is optional. In the depicted embodiment, the housing defines a cavity **130** between proximal end **401** of the flow control apparatus **400** and the mouth end **101** of the cartridge **100**, which could serve to decelerate the airflow prior to exiting the mouth end **101**.

FIG. 4 depicts another embodiment of a cartridge **100** including a housing **110** and a flow control apparatus **400**. The housing **110** and flow control apparatus **400** may be formed from a single part or multiple parts.

The flow control apparatus **400** has a proximal end **401**, a distal end **403** and an interior passageway **430** from the distal end **403** to the proximal end **401**. The flow control apparatus **400** has a first portion **410**, a second portion **420**, and a third portion **435**. The first portion **410** is between the second **420** and third **435** portions. The first portion **410** defines a first portion of the passageway **430**, which extends from the distal end **413** of the first portion **410** to the proximal end **411** of the first portion **410**. The second portion **420** defines a second portion of the passageway **430**, which extends from the distal end **423** of the second portion **420** to the proximal end **421** of the second portion **420**. The third portion **435** defines a third portion of the passageway

430, which extends from the distal end **433** of the third portion to the proximal end **431** of the third portion. The third portion **435** has a substantially constant inner diameter from the proximal end **431** to the distal end **433**. The first portion of the passageway **430** has a constricted cross section moving from the distal end **413** to the proximal end **411** of the first portion **410** to cause air to accelerate through this portion of the passageway **430** when a user draws on the mouth end **101** of the cartridge **100**. In other words, the cross section of the first portion of the passageway narrows from the distal end **413** to the proximal end **411**. The second portion of the passageway **430** has an expanding cross section from the distal end **423** to the proximal end **421** of the second portion **420** of the flow control apparatus **400**. In the second portion of the passageway **430**, airflow may decelerate.

Like the cartridge **100** depicted in **FIG. 3**, the cartridge depicted in **FIG. 4** includes a housing **110** that defines an open mouth end **101** and a closed distal end **103**. A composition **500**, such as a gel composition, is disposed in the closed distal end **103** of the housing. Aerosol generated from the composition **500** when heated may enter the headspace **140** in the housing **110** above the composition **500** to be carried through the passageway **430**.

While not shown in **FIG. 4**, the cartridge **100** includes at least one aperture (such as apertures **150** shown in **FIG. 3**) that extends through the housing **110** and is in communication with a channel **440** formed between an outer surface of the flow control apparatus **400** and an inner surface of the housing **110**. A seal is formed between the flow control apparatus **400** and the housing **110** at a location between the apertures and the mouth end **101**. The third portion **435** of the flow control apparatus **400**, among other things, serves to extend the length of the flow control apparatus **400** and channel **440** to provide additional distance between the apertures (not shown in **FIG. 4**, which may be located in proximity to a proximal end of the channel) and the composition **500** so that leakage of the composition through the apertures is not likely.

When a user draws on the mouth end **101** of the cartridge **100** depicted in **FIG. 4**, air enters the apertures, flows through the channel **440** into the headspace **140** above the composition **500**, where the air may entrain aerosol when the composition **500** is heated. The air may then flow through the airflow passageway **430**, and through the mouth end **101** to the user for inhalation. As air flows through the passageway **430**, the air flows through the third portion **435**, the first portion **410**, and then the second portion **420** of the cartridge **100**. As air flows through the first portion of the passageway **430**, the airflow accelerates. As air flows through the second portion of the passageway **430**, the airflow decelerates. The second and third portions of the airflow passageway **430** are optional. In the depicted embodiment, the housing defines a cavity **130** between proximal end **401** of the flow control apparatus **400** and the mouth end **101** of the cartridge **100**, which could serve to decelerate the airflow prior to exiting the mouth end **101**.

FIG. 5 and **FIG. 6** depict additional embodiments of cartridges **100** that include a housing **110** and a flow control apparatus **400**. The flow control apparatus **400** has a proximal end **401**, a distal end **403** and an interior passageway **430** from the distal end **403** to the proximal end **401**. The flow control apparatus **400** has a first portion **410** and a third portion **435**. The first portion **410** defines a first portion of the passageway **430**, which extends from the distal end **413** of the first portion **410** to the proximal end **411** of the first portion **410**. The third portion **435** defines a third portion of the passageway **430**, which extends from the distal end **433** of the third portion to the proximal end **431** of the third portion. The third portion **435** has a substantially constant inner diameter from the proximal end **431** to the distal end **433**.

In **FIG. 5**, the first portion of the passageway **430** has a substantially constant inner diameter from the distal end **413** to the proximal end **411** of the first portion **410**. The inner diameter of the passageway **430** at the first portion **410** is smaller than the inner diameter of the passageway at the third portion **435**. The restricted inner diameter of the passageway **430** at the first portion **410**, relative to at the third portion **435**, may cause air to accelerate as it flows from the third portion **435** to the first portion **410**.

In **FIG. 6**, the first portion **410** of the flow control apparatus **400** includes multiple segments **410A**, **410B**, **410C**, with stepped internal diameters. The most distal segment **410A** has the largest inner diameter, and the most proximal segment **410B** has the smallest inner diameter. As air flows through the passageway **430** from the first segment **410A** to the second segment **401B** and from the second segment **410B** to the third segment **410C**, the air may accelerate as the passageway **430** cross section constricts in a stepped manner.

The first portions **410** in **FIG. 5** and **FIG. 6** provide examples of construction that may be beneficial when the material employed to form the first portion **410** is not readily moldable. For example, the first portion **410** or the segments **410A**, **410B**, **410C** of the first portion **410** may be formed from cellulose acetate tow. In contrast, the first portions **410** of the flow control apparatus **400** depicted in **FIG. 3** and **FIG. 4** provide examples of construction that may be beneficial when the material employed to form the first portion **410** is moldable, such as when the first portion is formed from, for example, polyether ether ketone (PEEK).

Like the cartridge **100** depicted in **FIG. 3** and **FIG. 4**, the cartridges depicted in **FIG. 5** and **FIG. 6** include a housing **110** that defines an open mouth end **101** and a closed distal end **103**. A composition **500**, such as a gel composition, is disposed in the closed distal end **103** of the housing. Aerosol generated from the composition **500** when heated may enter the headspace **140** in the housing **110** above the composition **500** to be carried through the passageway **430**.

While not shown in **FIG. 5** and **FIG. 6**, the cartridge **100** includes at least one aperture (such as apertures **150** shown in **FIG. 3**) that extends through the housing **110** and is in communication with a channel **440** formed between an outer surface of the flow control apparatus

400 and an inner surface of the housing **110**. A seal is formed between the flow control apparatus **400** and the housing **110** at a location between the apertures and the mouth end **101**. The third portion **435** of the flow control apparatus **400**, among other things, serves to extend the length of the flow control apparatus **400** and channel **440** to provide additional distance between the apertures (not shown in **FIG. 5** and **FIG. 6**, which may be located in proximity to a proximal end of the channel) and the composition **500** so that leakage of the composition through the apertures is not likely.

When a user draws on the mouth end **101** of the cartridge **100** depicted in **FIG. 5** and **FIG. 6**, air enters the apertures, flows through the channel **440** into the headspace **140** above the composition **500**, where the air may entrain aerosol when the composition **500** is heated. The air may then flow through the airflow passageway **430**, and through the mouth end **101** to the user for inhalation. As air flows through the passageway **430**, the air flows through the third portion **435** and then the first portion **410** of the cartridge **100**. As air flows into the first portion of the passageway **430**, the airflow may accelerate because the inner diameter of the passageway **430** at the first portion **410** is less than at the third portion **435**. In the cartridge **100** depicted in **FIG. 6**, the airflow may accelerate as it passes each segment **410A**, **410B**, **410C** of the first portion **410**.

In the embodiments depicted in **FIG. 5** and **FIG. 6**, the housing defines a cavity **130** between proximal end **401** of the flow control apparatus **400** and the mouth end **101** of the cartridge **100**, which could serve to decelerate the airflow that exits the passageway **430** at the proximal end **401** of the flow control apparatus **400** prior to exiting the mouth end **101**.

FIGS. 7A-B illustrate an embodiment of a cartridge **100**. The cartridge **100** includes a housing **110** and apertures **150** through the housing **110**. The housing **110** includes an end cap **600** that forms the distal end **103** of the cartridge **100**. A composition comprising nicotine (not shown) may be disposed in the end cap. When heated, the composition may form an aerosol that may enter a headspace **140** above the end cap **600**.

At least one of the apertures **150** is in communication with at least one channel **440** formed between the flow control apparatus **400** and the housing **110** and between sidewalls **450**. The flow control apparatus **400** has a rim **460** that presses against an inner surface of the housing **110** to form a seal. The seal is formed between the mouth end **101** and the apertures **150**.

When a user draws on the mouth end **101**, air may enter the apertures **150**, flow through the channels **440** to the headspace **140**, and then through an internal passageway through the flow control apparatus **400**, into cavity **130** defined by the housing **110**, and through the mouth end **101** to the user for inhalation. The internal passageway of the flow control apparatus **400** may be configured in any suitable manner, such as shown in **FIGS. 3-6**.

FIG. 8 illustrates a portion of an aerosol generating device **200** configured to receive more than one cartridge **100**. Two cartridges **100** are received by the device **200**. Only distal portions of the cartridges **100** are shown. The aerosol generating device **200** has a housing **210** that forms a receptacle for receiving the cartridges **100**. A heating element **230** extends into the receptacle and forms two cavities, each configured to receive and contact a distal end portion of a cartridge **100**. The heating element **230** may surround the distal portion of the cartridge **100** when the cartridge **100** is received in the cavity of the heating element **230**.

FIG. 9 illustrates a portion of another aerosol generating device **200** configured to receive more than one cartridge **100**. Two cartridges **100** are received by the device **200**. The aerosol generating device **200** has a housing **210** that forms a receptacle for receiving the cartridges **100**. An elongate heating element **230** extends into the receptacle. One cartridge **100** is received on one side of the elongate heating element **230**, and the other cartridge **100** is received on the other side of the heating element **230**. The cartridges **100** preferably contact the heating element **230** for efficient heat transfer via conduction between the heating element and the cartridge housing.

The cartridges **100** depicted in **FIGS. 8** and **9** may contain the same compositions comprising nicotine. However, in some embodiments, the cartridges may comprise different compositions. In some embodiments, at least one of the cartridges **100** contains a composition that does not contain nicotine. For example, the composition in one of the cartridges **100** may comprise a flavorant. A user may select from a variety of cartridges **100** to arrive at a combination that suits the taste of the user. A manifold (not shown) may be employed to facilitate simultaneous drawing on both cartridges **100**. As such, the pair of cartridges **100** may be considered to be a pair of sub-cartridges, which when joined together form a complete cartridge.

FIGS. 10A-B illustrate an embodiment of a cartridge **100** that includes a mouthpiece **170** that forms a portion of the housing **110** and the flow control apparatus **400** of the cartridge **100**. The cartridges **100** include a closed-end tube **700** that forms the closed end **103** of the cartridge **100** and also forms a portion of the housing. The tube **700** is configured to be received by a distal portion of the mouthpiece **170**, such as by interference fit. The composition comprising nicotine (not shown) may be disposed in the closed-end tube **700**.

The flow control apparatus **400** includes an internal passageway (not shown) that includes a portion that accelerates air, and may include a portion that decelerates air. A seal is formed between the housing **110** and the flow control apparatus **400** because the housing **110** and the flow control apparatus **400** are formed from a single part. An aperture **150** is formed in the housing **110** and is in communication with a channel **640** that is formed at least in part by an inner surface of the housing **110**. Part of the channel **640** is generally formed between the inner surface of the housing **110** and an exterior of the flow control apparatus **400**. The channel **640** extends less than the full distance around the housing **110**. In this embodiment, the channel **640** extends around about 50% of the distance around the circumference of the housing. The channel **640** directs air from the aperture **150** towards an inner surface of the closed end **103**.

When a user draws on the mouth end **101**, air enters the cartridge **100** through the aperture **150**. The air flows through the channel **640** towards a composition disposed in the closed end **103**. The air then flows through an internal passageway of the flow control apparatus **400**, where the air is accelerated and optionally decelerated. The air may then exit the mouth end **101** for inhalation by a user.

FIG. 11A is an image of a flow control apparatus **400** formed from PEEK (material) by CNC machining. The flow control apparatus depicted in **FIG. 8A** had a length of 25mm, an outer diameter at the proximal end of 6.64 mm, and an outer diameter at the distal end of 6.29 mm. The outer diameter at the distal end is the diameter of the distal end from the base of the sidewalls. The flow control apparatus has 12 channels formed around its exterior surface, each sidewall having a substantially semi-circular transverse cross section. The channels have a radius of 0.75 mm and a length of 20mm. The flow control apparatus has an internal (airflow) passageway comprising three portions, a first portion (an air accelerating portion) a second portion (air decelerating portion) downstream or proximal to the first portion and a third portion upstream or distal to the first portion. The third portion of the interior passageway of the flow control apparatus extends from the distal end of the apparatus and has an inner diameter at the distal end of 5.09mm, which tapers down to a diameter of 4.83mm at a proximal end of the first portion of the interior passageway. The length of the first portion of the interior passageway is 15mm. The first portion of the interior passageway extends from a distal end at the proximal end of the third portion to a proximal end. The first portion of the internal passageway has an inner diameter of 2mm at its distal end, which constricts to 1mm at the proximal end. The length of the first portion of the interior passageway is 5.5 mm. The second portion of the interior passageway extends from a distal end at the proximal end of the first portion to a proximal end at the proximal end of the apparatus. The second portion of the internal passageway has an inner diameter of 1mm at its distal end, which is the same as the inner diameter at the proximal end of the first portion. The inner diameter of the second portion increases at a decreasing rate (*i.e.* in a curve) to the proximal end, which has an inner diameter of 5 mm. The length of the second portion is 4.5 mm. Accordingly, air drawn through the interior passageway of the flow control apparatus, from the distal end to the proximal end, encounters a chamber with a substantially constant inner diameter (the third portion), a constricted section configured to accelerate the air (the first portion), and an expanded section configured to decelerate the air (the second portion). It has been found that providing such an airflow passageway for the aerosol generated from the heated composition may enable aerosol volume and droplet size to be controlled such that a satisfactory aerosol reaches the mouthpiece for inhalation by the user.

FIG. 11B is an image of an assembled cartridge **100**. The cartridge **100** includes a housing **110** into which the flow control apparatus of **FIG. 11A** is inserted. The housing depicted in **FIG. 11B** is generally a right circularly cylindrical cardboard tube having a length of about 45 mm. One end of the tube is closed to provide the closed end of the housing for holding the composition. In this embodiment, the closed end of the tube has been closed by folding an end portions of the walls of the tube over themselves. However, it will be appreciated that the closed end may be closed by any other suitable means, such as by pinching and folding or by securing a cap over the closed end. The proximal portion of the exterior of the flow control apparatus, above the channels, has a diameter of about 6.64 mm. This diameter is substantially identical to the inner diameter of the cardboard tube, such that an interference fit seal is formed between the proximal portion of the exterior of the flow control apparatus and the interior of the tubular housing. The distal portion of the exterior of the flow control apparatus, extending the length of the channels, may have a diameter that is slightly less than the diameter of the proximal portion of the exterior of the flow control apparatus, such that the flow control apparatus may be easily inserted into the housing up to the proximal portion of the exterior, where the interference fit is made.

All scientific and technical terms used herein have meanings commonly used in the art unless otherwise specified. The definitions provided herein are to facilitate understanding of certain terms used frequently herein.

As used in this specification and the appended claims, the singular forms “a”, “an”, and “the” encompass embodiments having plural referents, unless the content clearly dictates otherwise.

As used in this specification and the appended claims, the term “or” is generally employed in its sense including “and/or” unless the content clearly dictates otherwise.

As used herein, “have”, “having”, “include”, “including”, “comprise”, “comprising” or the like are used in their open-ended sense, and generally mean “including, but not limited to”. It will be understood that “consisting essentially of”, “consisting of”, and the like are subsumed in “comprising,” and the like.

The words “preferred” and “preferably” refer to embodiments of the invention that may afford certain benefits under certain circumstances. However, other embodiments may also be preferred under the same or other circumstances. Furthermore, the recitation of one or more preferred embodiments does not imply that other embodiments are not useful, and is not intended to exclude other embodiments from the scope of the disclosure, including the claims.

Any direction referred to herein, such as "top," "bottom," "left," "right," "upper," "lower," and other directions or orientations are described herein for clarity and brevity are not intended to be limiting of an actual device or system. Devices and systems described herein may be used in a number of directions and orientations.

The embodiments exemplified above are not limiting. Other embodiments consistent with the embodiments described above will be apparent to those skilled in the art.

CLAIMS

1. A cartridge for use with an aerosol generating device, the cartridge comprising:

a housing defining a closed end, an open end, and an aperture between the closed end and the open end;

a composition disposed in the housing in proximity to the closed end, wherein the composition comprises nicotine;

flow control apparatus disposed in the housing, the flow control apparatus comprising

a proximal end, a distal end, and an internal airflow passageway between the distal end and the proximal end,

wherein the proximal end is closer to the open end of the housing than the distal end;

a seal between an exterior of the flow control apparatus and an interior of the housing, wherein the seal is between the open end of the housing and the aperture of the housing; and

a channel between a portion of the exterior of the flow control apparatus and the interior of the housing, wherein the channel is in communication with the aperture and directs air towards the composition comprising nicotine.

2. A cartridge according to claim 1, wherein the channel comprises sidewalls extending the length of the channel.

3. A cartridge according to claim 1 or claim 2, wherein the housing defines a plurality of apertures circumscribing the housing.

4. A cartridge according to any preceding claim, wherein the airflow passageway comprises a first portion between the proximal end and the distal end, wherein the first portion has a cross-sectional area that decreases from the distal end towards the proximal end.

6. A cartridge according to claim 4, wherein the airflow passageway further comprises a second portion closer to the proximal end than the first portion, wherein the second portion

of the airflow passageway has a cross-sectional area that increases from the distal end towards the proximal end.

7. A cartridge according to any one of the preceding claims, wherein flow control apparatus and the housing are separate parts.

8. A cartridge according to claim 7, wherein the flow control apparatus is removably securable to the housing.

9. A cartridge according to claim 7, wherein the seal between the exterior of the flow control apparatus and the interior of the housing comprises an interference fit between the flow control apparatus and the housing.

10. A cartridge according to any one of the preceding claims, wherein the housing comprises a first part and a second part, wherein the first part comprises a mouthpiece configured to retain the second part, wherein the second part comprises the composition comprising nicotine.

11. A cartridge according to claim 11, wherein the first part comprises the flow control apparatus.

12. A cartridge according to any one of the preceding claims, wherein the composition is a gel.

13. A system comprising:

a cartridge according to any one of claims 1 to 12; and

an aerosol generating device comprising a receptacle configured to receive at least the closed end of the housing and a heater operably coupled to the receptacle and configured to heat the receptacle.

14. A system according to claim 13, wherein the heater comprises an elongate heating element, wherein the system comprises a thermally conductive adaptor comprising the receptacle, and wherein the adaptor is configured to transfer heat from the heating element to the receptacle.

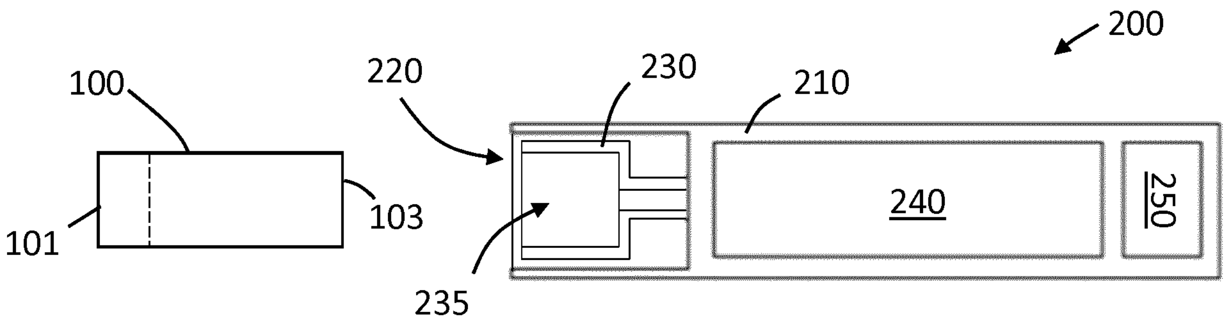


FIG. 1A

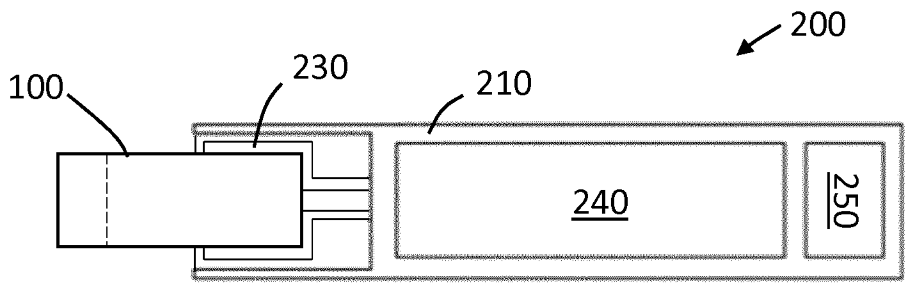


FIG. 1B

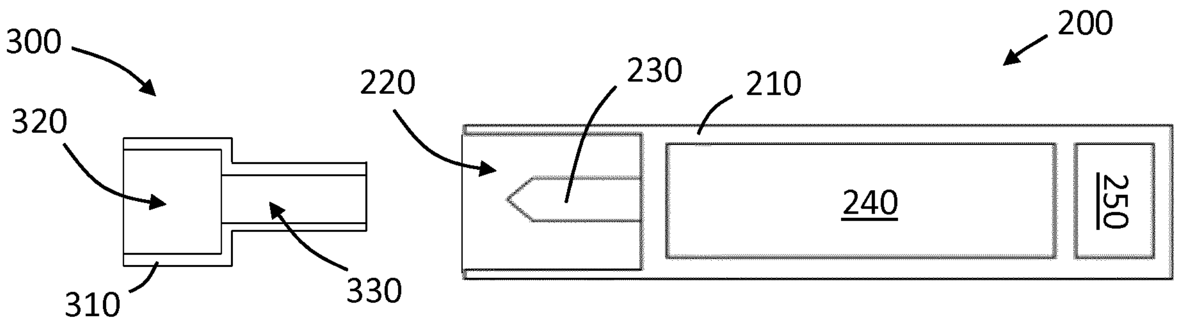


FIG. 2A

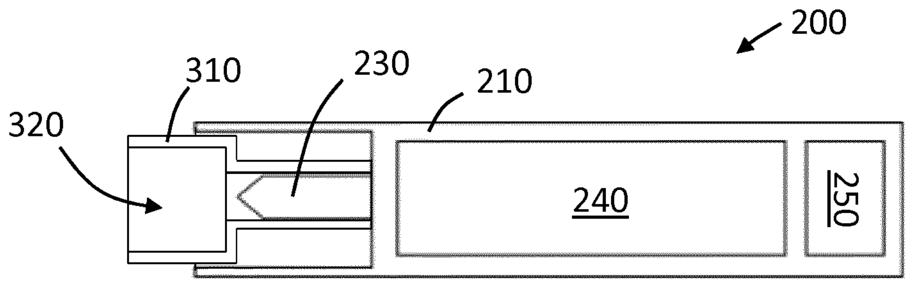


FIG. 2B

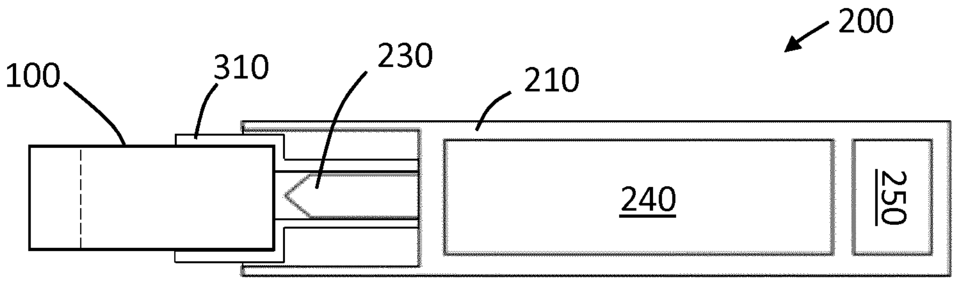
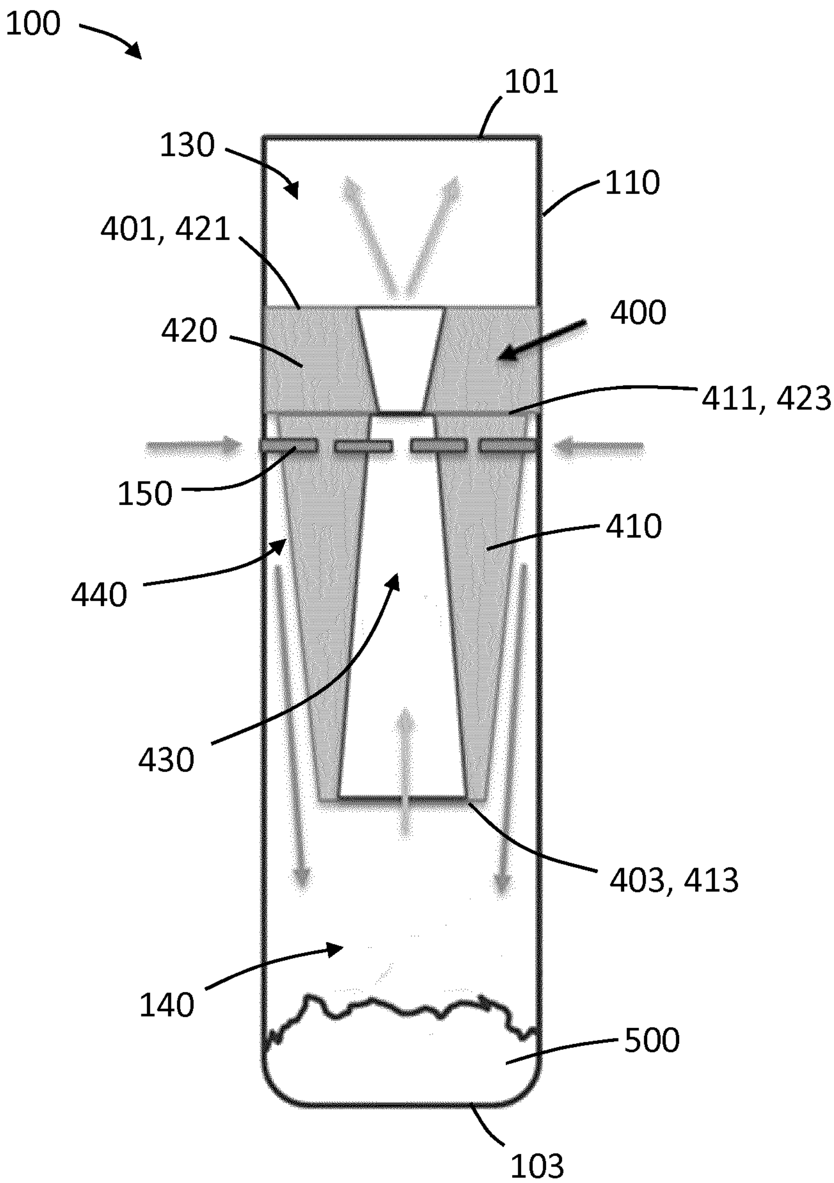


FIG. 2C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150
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440
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403, 413
140
500
103

FIG. 3

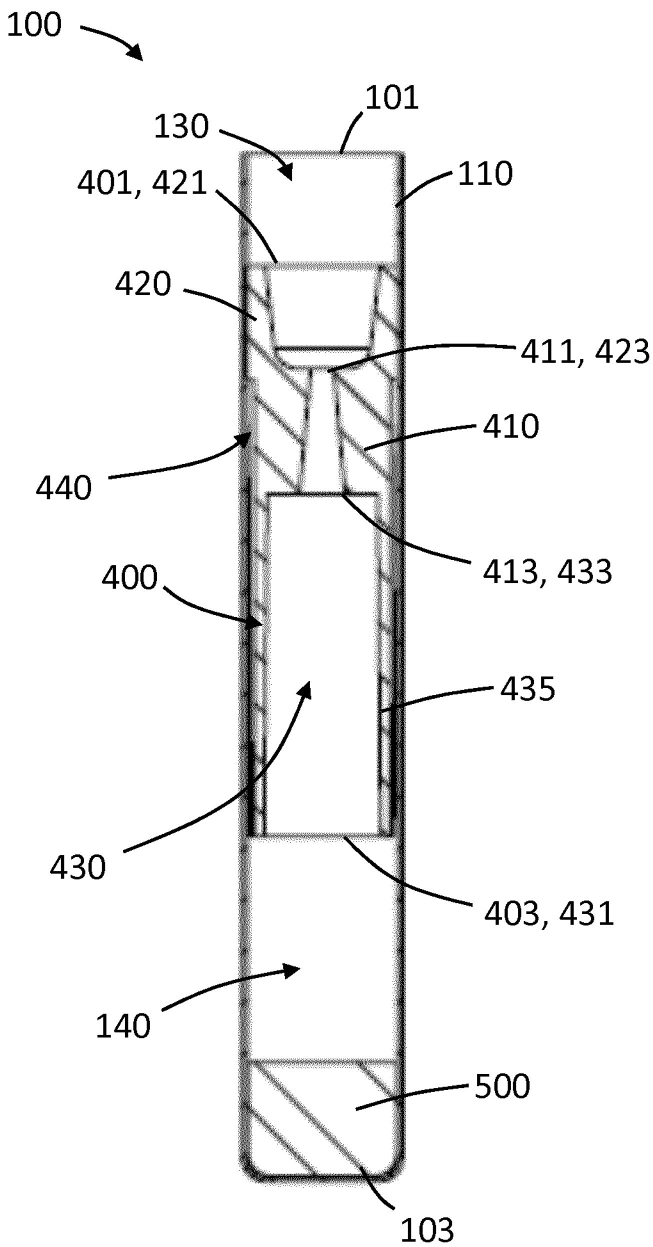
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FIG. 4

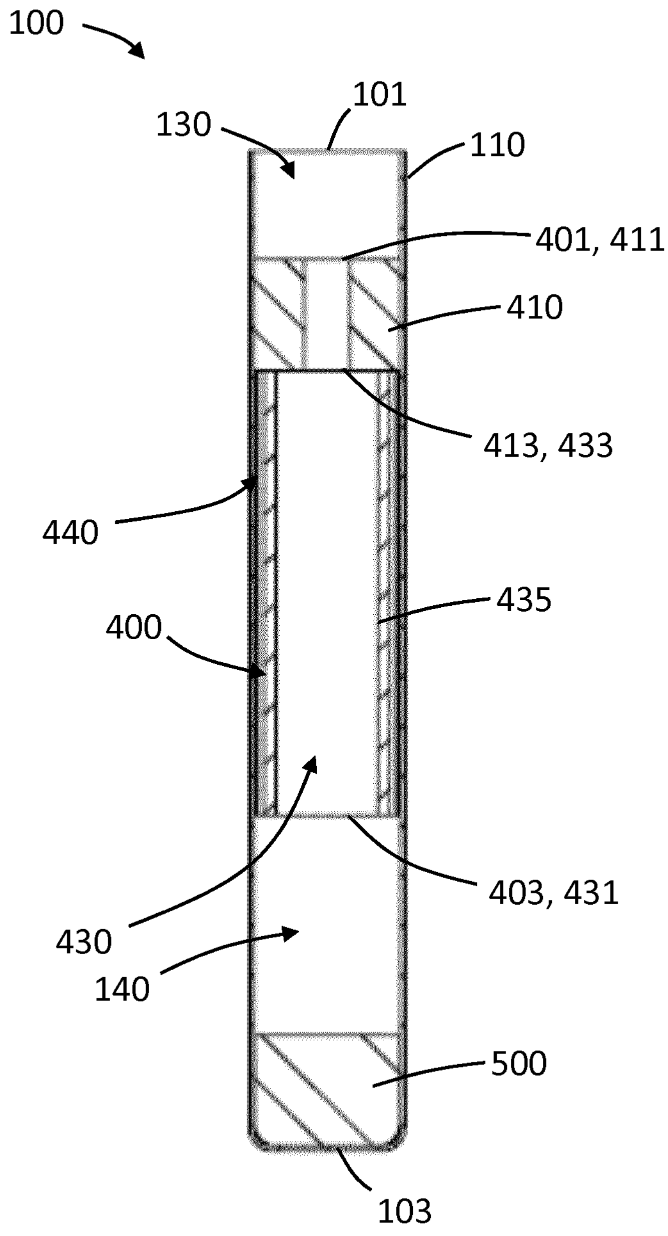
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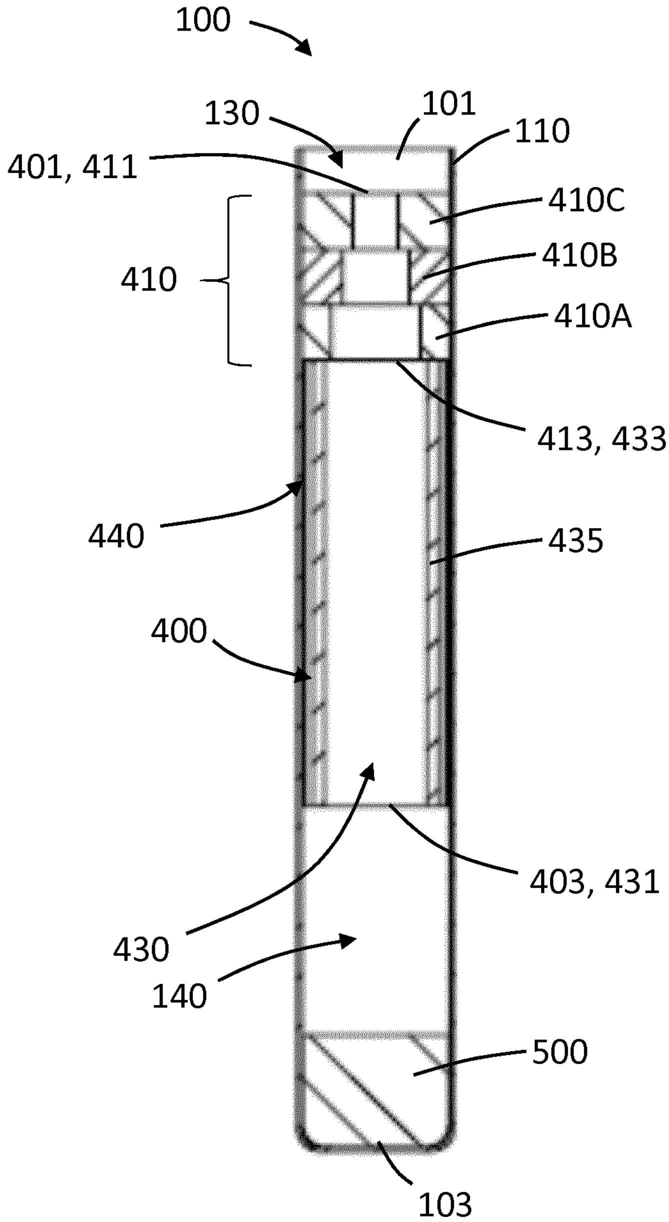
FIG. 5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103

FIG. 6

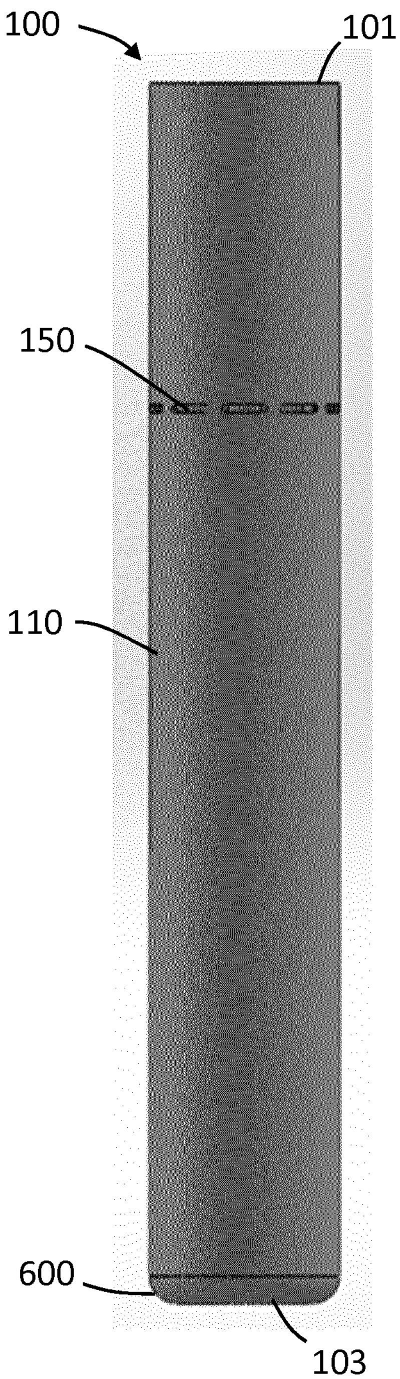

FIG. 7A

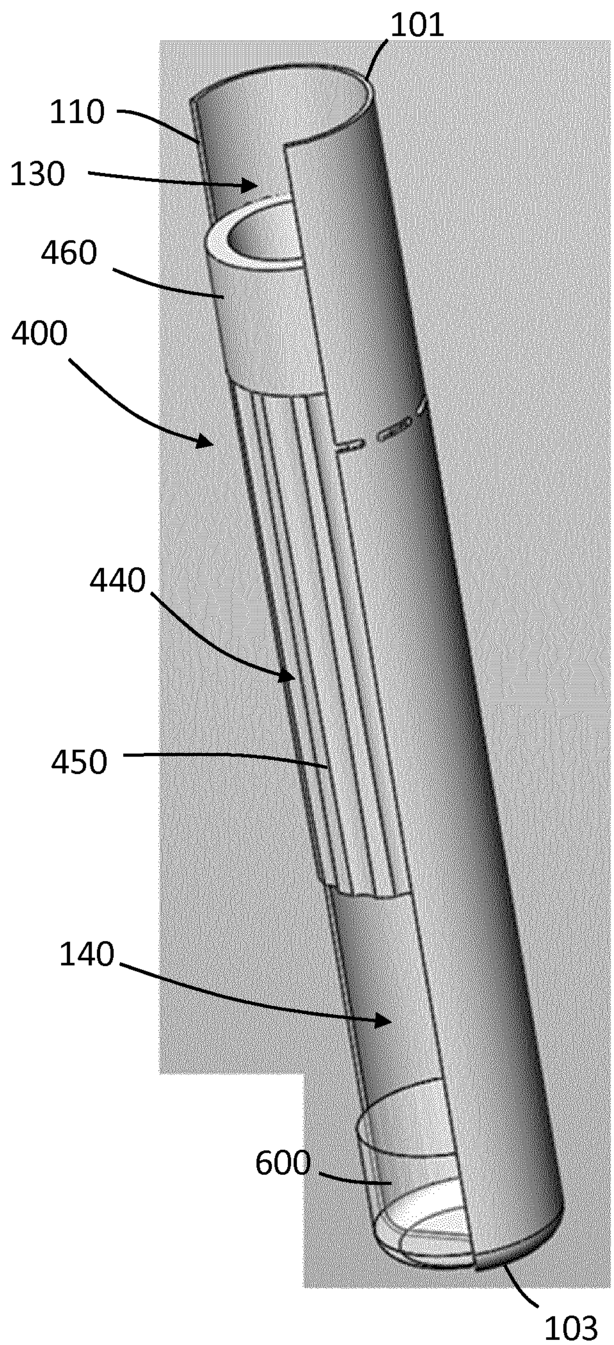

FIG. 7B

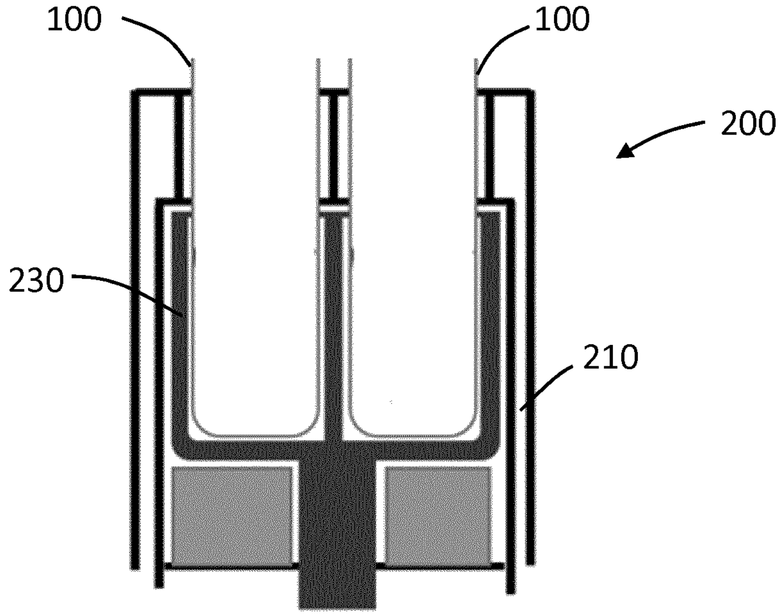

FIG. 8

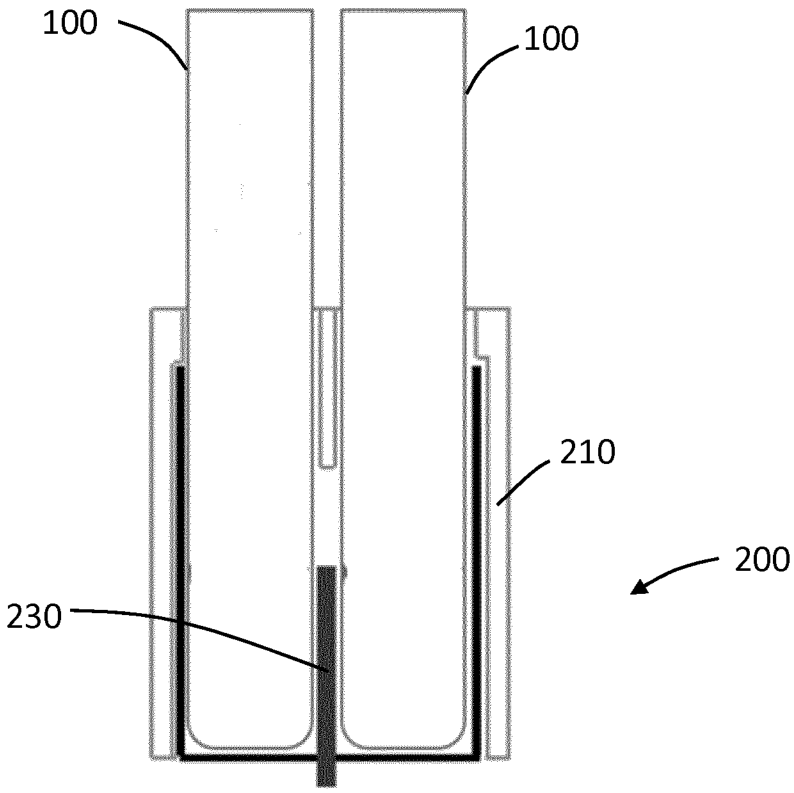

FIG. 9

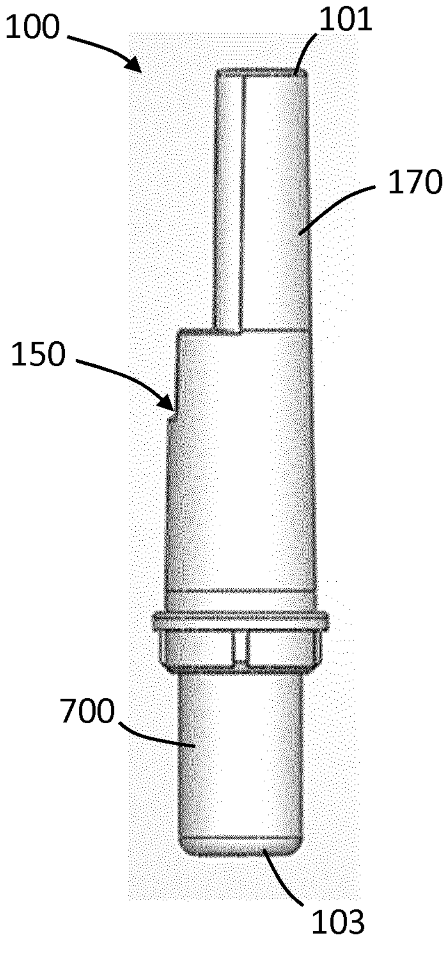

FIG. 10A

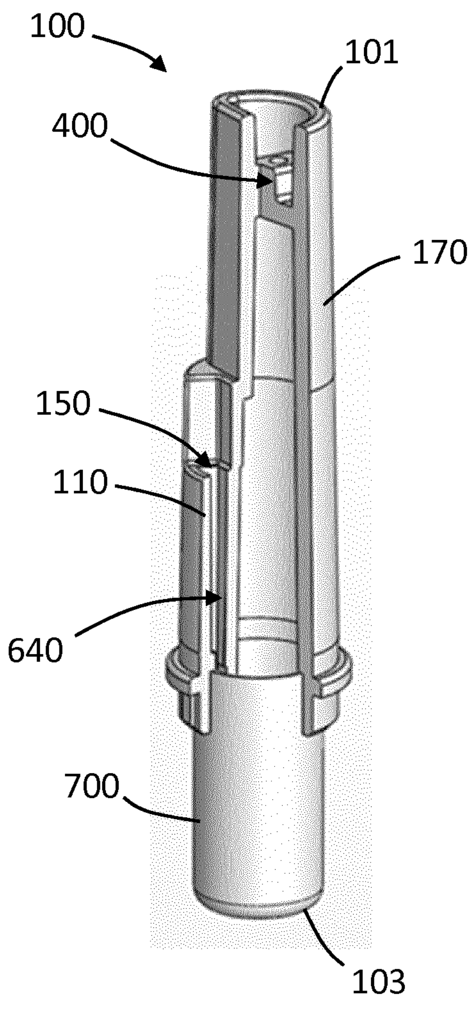

FIG. 10B

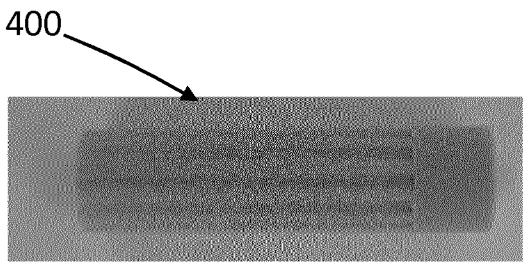

FIG. 11A

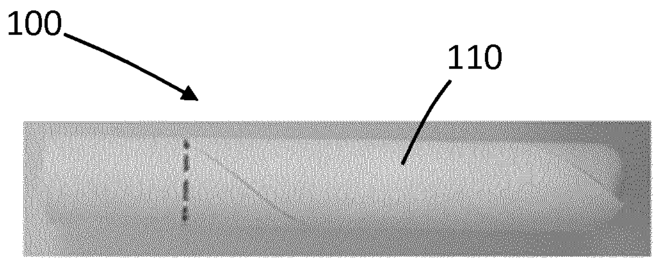

FIG. 11B

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/083779

A. CLASSIFICATION OF SUBJECT MATTER
INV. 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)
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

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A	KR 2014 0067691 A (KT & G CORP [KR]) 5 June 2014 (2014-06-05) figures paragraphs [0037] - [0081]	1-4,6-14
X	US 2011/094523 A1 (THORENS MICHEL [CH] ET AL) 28 April 2011 (2011-04-28)	1-4,6-11
Y	figures 1-2c	12,13
A	paragraphs [0025], [0036], [0047], [0067], [0070], [0083], [0086] - [0087]	14
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[X] Further documents are listed in the continuation of Box C.

[X] 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	Date of mailing of the international search report
26 February 2019	08/03/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Kirchmayr, Katrin

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	US 2017/265523 A1 (LIPOWICZ PETER [US]) 21 September 2017 (2017-09-21)	12,13
A	figures 1-4 paragraph [0049]	14
A	WO 2012/043941 A1 (SHIN JONG-SOO [KR]) 5 April 2012 (2012-04-05) figure 5	1-4,6-14

1

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Information on patent family members

International application No
PCT/EP2018/083779

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