(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) **World Intellectual Property Organization**
International Bureau

(43) **International Publication Date**
23 June 2022 (23.06.2022)

WIPO | PCT

(10) **International Publication Number**
WO 2022/128827 A1

(51) **International Patent Classification:**
A24F 40/40 (2020.01) *A24F 40/485* (2020.01)
A24F 40/465 (2020.01) *A24D 1/20* (2020.01)

(21) **International Application Number:** PCT/EP2021/085322

(22) **International Filing Date:** 10 December 2021 (10.12.2021)

(25) **Filing Language:** English

(26) **Publication Language:** English

(30) **Priority Data:**
20215117.1 17 December 2020 (17.12.2020) EP

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(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) **Title:** AEROSOL-GENERATING DEVICE, AEROSOL-GENERATING ARTICLE AND AEROSOL-DELIVERY SYSTEM

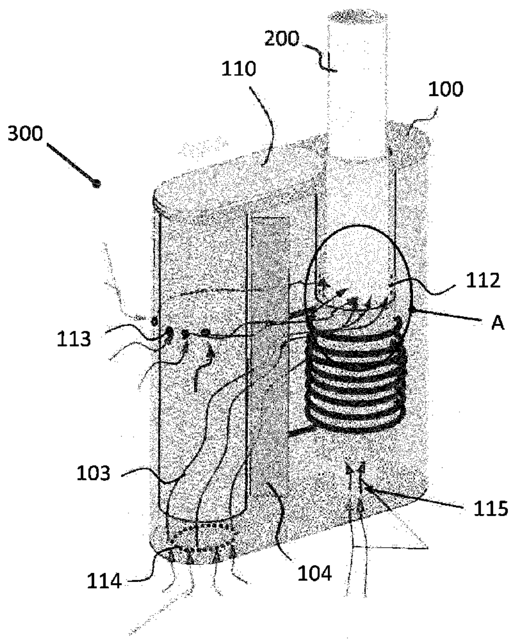

FIGURE 3

(57) **Abstract:** An aerosol-generating device (100) is configured for use in heating an aerosol-generating (200) article so as to generate an inhalable aerosol from an aerosol-forming substrate of the aerosol-generating article. The aerosol-generating device comprises a housing (101). The housing (101) comprises a cavity (105) configured to receive the aerosol-generating article (200). The housing (101) is adapted to define a cooling air flow path extending from outside of the housing (101), through an interior of the housing (101), to an air-permeabl e portion of a wall (106) of the cavity (105). The wall (106) of the cavity (105) is tubular. The air-permeable portion of the wall of the cavity comprises at least one annular air-permeable band (112). The annular air-permeable band (112) is configured to radially channel an air flow from the cooling air flow path into the cavity (105) around the periphery of the tubular wall (106) of the cavity (105).

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Published:

— *with international search report (Art. 21(3))*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

AEROSOL-GENERATING DEVICE, AEROSOL-GENERATING ARTICLE AND AEROSOL-DELIVERY SYSTEM

The present disclosure relates to an aerosol-generating device, an aerosol-generating article for use with an aerosol-generating device, and an aerosol-delivery system formed of both an aerosol-generating device and an aerosol-generating article.

Aerosol-generating devices configured to generate an aerosol from an aerosol-forming substrate, such as a tobacco-containing substrate, are known in the art. Such known devices may generate aerosol from the substrate through the application of heat to the substrate, rather than combustion of the substrate. The aerosol-forming substrate may be present as a component part of an aerosol-generating article, in which the article is physically separate from the aerosol-generating device. In use, the aerosol-generating device may receive the aerosol-generating article. The device may provide power to enable the transfer of heat from a heat source to the aerosol-forming substrate of the aerosol-generating article. During use of such known aerosol-generating devices and aerosol-generating articles, volatile compounds are released from the aerosol-forming substrate by heat transfer from the heat source and entrained in air drawn through the aerosol-generating article. As the released compounds cool, they condense to form an aerosol that is inhaled by the consumer. The transfer of heat to the aerosol-forming substrate to generate the aerosol may result in the aerosol evolved from the aerosol-forming substrate having very high temperatures, with the substrate known to reach temperatures of around 270 °C in some known aerosol-generating articles when heated. Known aerosol-generating articles may require a complex configuration of different components downstream of the substrate to cool the substrate to a level sufficient to avoid burning the mouth or throat of a user.

The present disclosure is concerned with providing improvements in the air flow management of aerosol-generating devices and aerosol-generating articles.

According to a first aspect of the present disclosure, there is provided an aerosol-generating device configured for use in heating an aerosol-generating article so as to generate an inhalable aerosol from an aerosol-forming substrate of the aerosol-generating article. The aerosol-generating device comprises a housing. The housing comprises a cavity configured to receive the aerosol-generating article. The housing is adapted to define a cooling air flow path extending from outside of the housing, through an interior of the housing, to an air-permeable portion of a wall of the cavity.

The ambient air outside of the device housing is likely to be cooler than within the housing when the device is operated. So, having the housing defining a cooling air flow path extending from outside of the housing provides a readily available source of ambient cooling air during use of the device. Providing the wall of the cavity with an air-permeable portion may allow an inflow of ambient cooling air received from outside the device to be directed, via the cooling air flow path, to the interior of the cavity. This may provide a beneficial effect of cooling the interior of the cavity. Further, when the aerosol-generating device is used in combination with an aerosol-generating article docked in the cavity, cooling air received via the air permeable portion of the wall of the cavity may be used to cool particular portions of the aerosol-generating article.

Preferably, the aerosol-generating device is configured such that, in use with an aerosol-generating article docked in the cavity, the air-permeable portion of the wall of the cavity is coincident with a corresponding air-permeable portion of an exterior wall of the aerosol-generating article. Having the air-permeable portions of the wall of the cavity of the aerosol-generating device and the exterior wall of the aerosol-generating article coinciding allows for efficient channelling of air flow from the cooling air flow path of the device into the interior of the aerosol-generating article.

As used herein, the term “air-permeable” is used to relate to an entity which allows air to pass through it. The term “air-permeable” also encompasses a volume characteristic of a suitable material, either in relation to all or part of its volume; for example, a material having a porosity in all or part of the volume of the material.

As used herein, the term “coincident” is used to mean overlapping, either precisely or in part.

As used herein, the term “aerosol-generating device” is used to describe a device that interacts with an aerosol-forming substrate of an aerosol-generating article to generate an aerosol. Preferably, the aerosol-generating device is a smoking device that interacts with an aerosol-forming substrate of an aerosol-generating article to generate an aerosol that is directly inhalable into a user’s lungs thorough the user's mouth. The aerosol-generating device may be a holder for a smoking article.

Preferably, the aerosol-generating article is a smoking article that generates an aerosol that is directly inhalable into a user’s lungs through the user's mouth. More preferably, the aerosol-generating article is a smoking article that generates a nicotine-containing aerosol that is directly inhalable into a user’s lungs through the user's mouth.

As used herein, the term “aerosol-forming substrate” denotes a substrate consisting of or comprising an aerosol-forming material that is capable of releasing volatile compounds upon heating to generate an aerosol.

Conveniently, the wall of the cavity may be tubular. The cavity may be provided with an open end and a closed end. The aerosol-generating device may be configured to receive the aerosol-generating article via the open end of the tubular cavity. The provision of a tubular cavity to the device is particularly suitable where the device is intended to be used with aerosol-generating articles which define a rod form, with the tubular shape of the cavity corresponding to the geometric profile of such a rod. For example, where the aerosol-generating article is a smoking article, the use of a rod-shaped geometry for the article corresponds to the geometry of known smoking articles such as conventional cigarettes and electronic cigarettes.

As used herein, the term “rod” is used to denote a generally cylindrical element of substantially circular, oval or elliptical cross-section.

The air-permeable portion of the wall of the cavity may comprise one or more of: a porous material, a plurality of slits, and a plurality of holes. By way of example and without limitation, the air-permeable portion of the wall of the cavity may be provided as a mesh, with interstices of the mesh defining openings in the mesh to thereby provide permeability to air flow through the mesh. Alternatively, the downstream end of the cooling air flow path may terminate in an open end without any mesh or other restriction being present, with this open end being the air-permeable portion of the wall of the cavity to channel cooling air from the cooling air path directly into the cavity. In a further alternative, the air-permeable portion of the wall of the cavity may comprise a plurality of pores, in which the plurality of pores define voids within the material of the wall. The size of any pores, slits or holes which may form part of the air-permeable portion of the wall of the cavity will directly affect the permeability to air flow of the air-permeable portion. So, the size of any such pores, slits or holes may be selected according to a desired volumetric flow rate of cooling air within the cavity of the aerosol-generating device.

As used herein, the terms “upstream” and “downstream” are used to describe the relative positions of elements, or portions of elements, of the heated aerosol-generating article in relation to the direction in which a user draws on the aerosol-generating article during use thereof.

Preferably, the wall of the cavity is tubular, and the air-permeable portion of the wall of the cavity comprises at least one annular air-permeable band. The provision of the air-permeable portion of the wall of the cavity as one more annular bands allows for cooling air from the cooling air flow path to be channelled radially into the cavity around the periphery of the tubular cavity wall. When the device is used with an aerosol-generating article docked in the cavity, with an exterior wall of the aerosol-generating article having a corresponding air-permeable portion provided as an annular band, coinciding alignment of the annular bands of the device and the article may provide for uniform radial inflow of cooling air into an interior of the aerosol-generating article about the periphery of the exterior wall of the article.

Conveniently, the at least one annular air-permeable band may comprise a first annular air-permeable band and a second annular air-permeable band. The first and second bands may be axially-spaced apart from each other along a longitudinal axis of the cavity and have distinct first and second permeabilities to air flow there through. The provision of different permeabilities to air flow for the first and second annular air-permeable bands may allow correspondingly different flow rates through the first and second annular bands. Accordingly, this may enable different levels of cooling to be achieved in different regions of the cavity.

Advantageously, the aerosol-generating device may further comprise control electronics provided within the housing. The cooling air flow path may extend through or adjacent to the control electronics for providing cooling thereto. In this manner, the cooling air from outside of the housing may help to avoid overheating of the control electronics of the device.

Preferably, the aerosol-generating device is free of any fan or similar means for urging a flow of air from outside the housing of the device along the cooling air flow path. Rather, it is preferred that a flow of air from outside the housing along the cooling air flow path is instead driven by a user applying suction to a mouth end of an aerosol-generating article docked in the cavity of the device. These features are discussed in more depth below in relation to a second aspect of the present disclosure, which defines an aerosol-delivery system. However, in an alternative example the aerosol-generating device may be configured to urge a flow of air from outside of the housing along the cooling air flow path towards the air-permeable portion of the wall of the cavity. By way of example, the device may comprise an electrically-powered fan provided within the housing to drive the flow of air along the cooling air flow path, the fan provided with electrical power from a power source provided in the device.

Conveniently, the aerosol-generating device may be an electrically-powered device for heating the aerosol-forming substrate of an aerosol-generating article by either or both of inductive heating and resistive heating. The device may comprise a power source for supplying electrical power. The power source is preferably a battery, thereby providing advantages of portability to the device. The battery is preferably a rechargeable battery.

In an example of an inductive heating version of the device, the wall of the cavity may comprise a susceptor portion. The susceptor portion may be axially spaced-apart from the air-permeable portion of the wall of the cavity along a longitudinal axis of the cavity. The aerosol-generating device may further comprise an inductor coil encircling the susceptor portion. Preferably, the inductor coil may encircle the susceptor portion radially outward of the susceptor portion. Locating the inductor coil radially outward of the susceptor portion avoids the inductor coil being damaged from contact with an aerosol-generating article during insertion of the article into the cavity. In use, electrical power supplied to the inductor coil (for example, by the above-mentioned power source of the device) results in the inductor coil inducing eddy currents in the susceptor portion. These eddy currents, in turn, result in the susceptor portion of the wall of the cavity generating heat. When an aerosol-generating article is docked in the cavity as described above, the heat generated in the cavity by the susceptor portion may transfer to the article to heat the aerosol-forming substrate within the article to a temperature sufficient to cause aerosol to evolve from the substrate. The susceptor portion is formed of material having an ability to absorb electromagnetic energy and convert it into heat. By way of example and without limitation, the susceptor portion may be formed of a ferromagnetic material, such as a steel.

In a variant to the inductive heating version of the device outlined above, the wall of the cavity may lack any susceptor, but still comprise an inductor coil encircling the wall of the cavity. Preferably the inductor coil may encircle the wall of the cavity radially outward of the wall. A susceptor may instead be provided as part of the aerosol-generating article; preferably being wholly or partly encapsulated within the aerosol-forming substrate of the aerosol-generating article.

In an example of a resistive heating version of the device, the cavity may comprise a resistive heating element. The resistive heating element may be arranged to, in use, encircle an aerosol-generating article docked in the cavity of the device. By way of example, the resistive heating element may have the form of an annular sleeve. The annular sleeve may be located in or form part of the wall of the cavity. Alternatively, the resistive heating element may be arranged, in use, to insert into the interior of an aerosol-generating article docked in the cavity of the device so as to be proximate to or in direct contact with aerosol-forming substrate of the article. By way of example, the resistive heating element may have the form of a blade. In use, electrical power would be supplied to the resistive heating element (for example, by the above-mentioned power source of the device), thereby resulting in heating of the heating element.

According to a second aspect of the present disclosure, there is provided an aerosol-delivery system comprising an aerosol-generating article and an aerosol-generating device. The aerosol-generating article defines a rod. The rod contains an aerosol-forming substrate. An exterior wall of the rod comprises an air-permeable portion. The air-permeable portion of the exterior wall of the rod is positioned downstream from the aerosol-forming substrate. The device and article are configured such that when the aerosol-generating article is docked in the cavity, the air-permeable portion of the wall of the cavity is coincident with the air-permeable portion of the exterior wall of the rod. The aerosol-generating device may be as described above for any of the examples relating to the first aspect of the present disclosure.

In this second aspect of the present disclosure, the coinciding alignment of the air-permeable portions of the wall of the cavity and the exterior wall of the rod help to facilitate efficient channelling of cooling air from the cooling air flow path of the device into an interior of the aerosol-generating article.

Preferably, the aerosol-forming substrate is a solid aerosol-forming substrate. However, the aerosol-forming substrate may comprise both solid and liquid components. Alternatively, the aerosol-forming substrate may be a liquid aerosol-forming substrate.

Preferably, the aerosol-forming substrate comprises nicotine. More preferably, the aerosol-forming substrate comprises tobacco. Alternatively or in addition, the aerosol-forming substrate may comprise a non-tobacco containing aerosol-forming material.

If the aerosol-forming substrate is a solid aerosol-forming substrate, the solid aerosol-forming substrate may comprise, for example, one or more of: powder, granules, pellets, shreds, strands, strips or sheets containing one or more of: herb leaf, tobacco leaf, tobacco ribs, expanded tobacco and homogenised tobacco.

Optionally, the solid aerosol-forming substrate may contain tobacco or non-tobacco volatile flavour compounds, which are released upon heating of the solid aerosol-forming substrate. The solid aerosol-forming substrate may also contain one or more capsules that, for example, include additional tobacco volatile flavour compounds or non-tobacco volatile flavour compounds and such capsules may melt during heating of the solid aerosol-forming substrate.

Optionally, the solid aerosol-forming substrate may be provided on or embedded in a thermally stable carrier. The carrier may take the form of powder, granules, pellets, shreds, strands, strips or sheets. The solid aerosol-forming substrate may be deposited on the surface of the carrier in the form of, for example, a sheet, foam, gel or slurry. The solid aerosol-forming substrate may be deposited on the entire surface of the carrier, or alternatively, may be deposited in a pattern in order to provide a non-uniform flavour delivery during use.

In a preferred embodiment, the aerosol-forming substrate comprises homogenised tobacco material. As used herein, the term “homogenised tobacco material” refers to a material formed by agglomerating particulate tobacco.

Preferably, the aerosol-forming substrate comprises a gathered sheet of homogenised tobacco material. As used herein, the term “sheet” refers to a laminar element having a width and length substantially greater than the thickness thereof. As used herein, the term “gathered” is used to describe a sheet that is convoluted, folded, or otherwise compressed or constricted substantially transversely to the longitudinal axis of the aerosol-generating article.

Preferably, the aerosol-forming substrate comprises an aerosol former. As used herein, the term “aerosol former” is used to describe any suitable known compound or mixture of compounds that, in use, facilitates formation of an aerosol and that is substantially resistant to thermal degradation at the operating temperature of the aerosol-generating article.

Suitable aerosol-formers are known in the art and include, but are not limited to: polyhydric alcohols, such as propylene glycol, triethylene glycol, 1,3-butanediol and glycerine; esters of polyhydric alcohols, such as glycerol mono-, di- or triacetate; and aliphatic esters of mono-, di- or polycarboxylic acids, such as dimethyl dodecanedioate and dimethyl tetradecanedioate. Preferred aerosol formers are polyhydric alcohols or mixtures thereof, such as propylene glycol, triethylene glycol, 1,3-butanediol and, most preferred, glycerine.

The aerosol-forming substrate may comprise a single aerosol former. Alternatively, the aerosol-forming substrate may comprise a combination of two or more aerosol formers.

Preferably, the aerosol-generating article may further comprise a first air flow path and a second air flow path. The rod has a mouth end and a distal end, the mouth end located downstream of the distal end. The first air flow path may extend through the aerosol-forming substrate along an interior of the rod downstream towards the mouth end such that, on application of suction at the mouth end, air is drawn into the aerosol-generating article and passes through the aerosol-forming substrate along the interior of the rod downstream towards the mouth end. The second air flow path may extend through the air-permeable portion of the exterior wall of the rod to feed cooling air-flow received from the cooling air flow path when the article is docked in the cavity of the device to a mixing region inside the rod. The air-permeable portion and the mixing region may be located downstream of and immediately adjacent to the aerosol-forming substrate such that, in use, air flow along the second air flow path mixes in the mixing region with aerosol flow along the first air flow path. By locating the air-permeable portion and mixing region downstream of and immediately adjacent to the aerosol-forming substrate, air received from the cooling air flow path of the device and flowing along the second air flow path is able to efficiently cool down any hot aerosol gases evolved from the heating of the aerosol-forming substrate and flowing along the first air flow path. Also, locating the air-permeable portion and mixing region downstream of and immediately adjacent to the aerosol-forming substrate may ensure that the cooling air and aerosol are efficiently mixed before reaching the mouth end of the rod. Efficient mixing of the cooling air and aerosol within the rod of the aerosol-generating article is important in providing an enhanced experience to a user of the system. This efficient mixing of cooling air and aerosol contrasts with conventional ventilated cigarettes. Conventional ventilated cigarettes introduce air into the cigarette via perforations provided at or in close proximity to the mouth end of the cigarette and far away from the aerosol-forming substrate. Consequently, conventional ventilated cigarettes do not achieve thorough, efficient mixing of incoming ventilated air and hot aerosol gases, thereby potentially degrading the user experience.

Conveniently, the aerosol-forming substrate is located at the distal end, or closer to the distal end than to the mouth end.

Preferably, the interior of the rod is free of obstructions from the mixing region to the mouth end such that, in use, the mixed flow is unimpeded when flowing from the mixing region to the mouth end. By way of example, the aerosol-generating article may lack a mouthpiece filter or aerosol-cooling elements obstructing the flow path downstream towards the mouth end, as commonly found within known electronic cigarettes. The lack of any such obstructions within the interior of the rod downstream of the aerosol-forming substrate may help to reduce the resistance to draw of the first and second air flow paths, and reduce the amount of suction required to be applied by a user at the mouth end in order to inhale a given amount of the mixed flow of aerosol and cooling air. Further, this may also help to reduce the manufacturing complexity for the aerosol-generating article.

The air-permeable portion of the exterior wall of the rod may comprise one or more of a porous material, a plurality of slits, and a plurality of holes. By way of example and without limitation, the air-permeable portion of the exterior wall of the rod may be provided as a mesh, with interstices of the mesh defining openings in the mesh to thereby provide permeability to air flow through the mesh, i.e. through the exterior wall. In a further alternative, the air-permeable portion of the exterior wall of the rod may comprise a plurality of pores, in which the plurality of pores define voids within the material of the exterior wall. The size of any pores, slits or holes which may form part of the air-permeable portion of the exterior wall of the rod will directly affect the permeability to air flow of the air-permeable portion. The size of any such pores, slits or holes may be selected according to a desired volumetric flow rate of cooling air within the interior of the aerosol-generating article.

The exterior wall of the rod may be provided as a wrapper, the wrapper enclosing the aerosol-forming substrate. By way of example, the wrapper may be a cigarette paper. The wrapper may be provided with perforations to form the air-permeable portion of the exterior wall of the rod. Preferably, the wrapper has a thickness of between approximately 0.02 to 0.07 millimetres, or between approximately 0.03 to 0.05 millimetres. The aerosol-generating article defined by the rod preferably has a diameter of between approximately 3.7 to 9 millimetres, or between approximately 5.7 to 7.9 millimetres. The aerosol-generating article may have a total length of between approximately 30 millimetres and approximately 100 millimetres. In a preferred embodiment, the aerosol-generating article has a total length of approximately 45 millimetres.

Preferably, the air-permeable portion of the exterior wall of the rod comprises at least one annular air-permeable band. The use of an annular air-permeable band provides for uniform radial inflow of cooling air into the interior of the aerosol-generating article about the periphery of the article and improved mixing with hot aerosol evolved from the aerosol-forming substrate.

Advantageously, the at least one air-permeable band of the exterior wall of the rod may comprise a first annular air-permeable band and a second annular air-permeable band. The first and second bands may be axially-spaced apart from each other along a longitudinal axis of the rod and have distinct first and second permeabilities to air flow there through. The provision of different permeabilities to air flow for the first and second annular air-permeable bands may allow correspondingly different flow rates through the first and second annular bands. Accordingly, this may enable different levels of cooling to be achieved in different regions of the interior of the aerosol-generating article.

Preferably, the air-permeable portion of the exterior wall of the rod may have an axial length of between 0.2 to 4 millimetres, or more preferably between 0.2 to 2.5 millimetres, or more preferably between 0.2 to 1.8 millimetres, or more preferably between 0.2 to 1.5 millimetres. Limiting the axial length of the air-permeable portion of the exterior wall of the rod may assist in focussing the mixing of cooling air received via the air-permeable portion with aerosol evolved from the substrate to a narrow mixing region located downstream of the substrate.

Conveniently, the air-permeable portion of the exterior wall of the rod may extend downstream of the aerosol-forming substrate by no more than 4 millimetres, or preferably by no more than 2.5 millimetres, or more preferably by no more than 1.8 millimetres, or more preferably by no more than 1.5 millimetres, or more preferably by no more than 0.2 millimetres. By restricting the air-permeable portion to extend downstream from the aerosol-forming substrate by no more than a specified distance, mixing of cooling air received via the air-permeable portion with aerosol evolved from the substrate is able to be achieved immediately downstream of the substrate. This helps to ensure that when the mixed flow reaches the mouth end of the rod, a user receives an inhalable vapour which has been thoroughly mixed, thereby enhancing the user's experience.

Advantageously, the article and device may be configured such that on application of suction to the mouth end with the article docked in the device, between 50% to 90% of a combined volumetric flow along the first and second air flow paths flows through the air-permeable portion of the exterior wall of the rod along the second air flow path. Conveniently, the article and device may be configured such that on application of suction to the mouth end with the article docked in the device, between 55% to 75% of the combined volumetric flow along the first and second air flow paths flows through the air-permeable portion of the exterior wall of the rod along the second air flow path. The proportion of the combined volumetric flow which flows along the second air flow path rather than the first air flow path will be affected by the degree of air permeability of the air-permeable portion of the exterior wall of the rod, and the nature of the aerosol-forming substrate within the rod. For example, different aerosol-forming substrates will result in different resistances to draw for the first air flow path, with the resistance to draw also affected by the factors such as the compaction of the substrate (for example, where the substrate is a solid aerosol-forming substrate).

According to a third aspect of the present disclosure, there is provided an aerosol-generating article for use with an aerosol-generating device. The aerosol-generating article defines a rod. The rod contains an aerosol-forming substrate and has a distal end and a mouth end, the mouth end located downstream of the distal end. The aerosol-generating article comprises a first air flow path and a second air flow path. An exterior wall of the rod comprises an air-permeable portion, the air-permeable portion of the exterior wall of the rod positioned downstream from the aerosol-forming substrate. The first air flow path extends through the aerosol-forming substrate along an interior of the rod downstream towards the mouth end such that, on application of suction to the mouth end, air is drawn into the aerosol-generating article and passes through the aerosol-forming substrate along the interior of the rod downstream towards the mouth end. The second air-flow path extends through the air-permeable portion of the exterior wall of the rod to feed cooling air from outside the rod to a mixing region inside the rod. The air-permeable portion and the mixing region are together located downstream of and immediately adjacent to the aerosol-forming substrate such that, in use, air flow along the second air flow path mixes in the mixing region with aerosol flow along the first air flow path.

It will be understood that the aerosol-generating article of this third aspect is suitable for use with the aerosol-generating device of the first aspect discussed in the preceding paragraphs, and may also correspond to the aerosol-generating article which forms part of the aerosol-delivery system of the second aspect of the present disclosure.

By locating the air-permeable portion and mixing region downstream of and immediately adjacent to the aerosol-forming substrate, air received via the air-permeable portion of the exterior wall of the rod and flowing along the second air flow path may efficiently cool hot aerosol evolved from heating of the aerosol-forming substrate and flowing along the first air flow path. Locating the air-permeable portion and the mixing region downstream of and immediately adjacent to the aerosol-forming substrate may also ensure that the cooling air and aerosol are thoroughly mixed before reaching the mouth end of the rod. Efficient mixing of the cooling air and aerosol within the rod of the aerosol-generating article is important in providing an enhanced experience to a user of the system. This efficient mixing of cooling air and aerosol contrasts with conventional ventilated cigarettes. Conventional ventilated cigarettes introduce air into the cigarette via perforations provided at or in close proximity to the mouth end of the cigarette and far downstream from the aerosol-forming substrate. Conventional ventilated cigarettes do not achieve efficient mixing of incoming ventilation air and hot aerosol gases, thereby potentially degrading the user experience.

Preferably, the aerosol-forming substrate is located at or closer to the distal end of the rod than to the mouth end of the rod.

Preferably, the interior of the rod is free of obstructions from the mixing region to the mouth end such that, in use, the mixed flow is unimpeded when flowing from the mixing region to the mouth end. By way of example, the aerosol-generating article may lack a mouthpiece filter or aerosol-cooling elements obstructing the flow path downstream towards the mouth end, as commonly found within known electronic cigarettes. The lack of any such obstructions within the interior of the rod may help to reduce the resistance to draw of the first and second air flow paths, and reduce the amount of suction required to be applied by a user at the mouth end in order to inhale a given amount of the mixed flow of aerosol and cooling air. This may also reduce manufacturing complexity for the article.

As described in relation to the aerosol-delivery system of the second aspect of the present disclosure, the air-permeable portion of the exterior wall of the rod may comprise one or more of: a porous material, a plurality of slits, and a plurality of holes. By way of example and without limitation, the air-permeable portion of the exterior wall of the rod may be provided as a mesh, with interstices of the mesh defining openings in the mesh to thereby provide permeability to air flow through the mesh, i.e. through the exterior wall of the rod. In a further alternative, the air-permeable portion of the exterior wall of the rod may comprise a plurality of pores, in which the plurality of pores define voids within the material of the exterior wall. The size of any pores, slits or holes which may form part of the air-permeable portion of the exterior wall of the rod will directly affect the permeability to air flow of the air-permeable portion. The size of any such pores, slits or holes may be selected according to a desired volumetric flow rate of cooling air within the interior of the aerosol-generating article.

Where the aerosol-generating article is a smoking article for use in generating an aerosol directly inhalable into a user’s lungs via the user's mouth, the exterior wall of the rod may be provided as a cigarette paper, the cigarette paper provided with perforations to form the air-permeable portion of the exterior wall of the rod.

Again, as described in relation to the aerosol-delivery system of the second aspect of the present disclosure, preferably the air-permeable portion of the exterior wall of the rod may comprise at least one annular air-permeable band. The use of an annular air permeable band provides for uniform radial inflow of cooling air into the interior of the aerosol-generating article about the periphery of the article and improved mixing with hot aerosol flow emanating from the aerosol-forming substrate.

Advantageously, the at least one annular air-permeable band comprises a first annular air-permeable band and a second annular air-permeable band. The first and second bands may be axially-spaced apart from each other along a longitudinal axis of the rod and have distinct first and second permeabilities to air flow there through. The provision of different permeabilities to air flow for the first and second annular air-permeable bands may allow correspondingly different flow rates through the first and second annular bands. Accordingly, this may enable different levels of cooling to be achieved in different regions of the interior of the aerosol-generating article, depending on whether those regions are adjacent the first or second annular bands with their different respective permeabilities to air flow.

As described in relation to the aerosol-delivery system of the second aspect of the present disclosure, preferably the air-permeable portion of the exterior wall of the rod may have an axial length of between 0.2 to 4 millimetres, or more preferably between 0.2 to 2.5 millimetres, or more preferably between 0.2 to 1.8 millimetres, or more preferably between 0.2 to 1.5 millimetres. Limiting the axial length of the air-permeable portion of the exterior wall of the rod may assist in focussing the mixing of cooling air received via the air-permeable portion with aerosol evolved from the substrate to a narrow region located downstream of the substrate.

As described in relation to the aerosol-delivery system of the second aspect, conveniently the air-permeable portion of the exterior wall of the rod may extend downstream of the aerosol-forming substrate by no more than 4 millimetres, or preferably by no more than 2.5 millimetres, or more preferably by no more than 1.8 millimetres, or more preferably by no more than 1.5 millimetres, or more preferably by no more than 0.2 millimetres. By restricting the air-permeable portion to extend downstream from the aerosol-forming substrate by no more than a specified minimum distance, mixing of cooling air received via the air-permeable portion with aerosol evolved from the substrate is able to be achieved immediately downstream of the substrate. This helps to ensure that when the mixed flow reaches the mouth end of the rod, a user receives an inhalable vapour which has been thoroughly mixed.

As described in relation to the aerosol-delivery system of the second aspect of the present disclosure, advantageously the article is configured such that on application of suction to the mouth end, between 50% to 90% of a combined volumetric flow along the first and second air-flow paths flows through the air-permeable portion of the exterior wall of the rod along the second air flow path. Conveniently, the article may be configured such that on application of suction to the mouth end of the aerosol-generating article, between 55% to 75% of a combined volumetric flow along the first and second air flow paths flows through the air-permeable portion of the exterior wall of the rod along the second air flow path. The proportion of the combined volumetric flow which flows along the second air flow path rather than the first air flow path will be affected by the extent of air permeability of the air-permeable portion of the external wall of the rod, and the nature of the aerosol-forming substrate within the rod. For example, different aerosol-forming substrates will result in different resistances to draw for the first air flow path, with the resistance to draw also affected by the factors such as the compaction of the substrate (for example, where the substrate is a solid aerosol-forming substrate).

The invention is defined in the claims. However, below there is provided a non-exhaustive list of non-limiting examples. Any one or more of the features of these examples may be combined with any one or more features of another example, embodiment, or aspect described herein.

Example Ex1: An aerosol-generating device configured for use in heating an aerosol-generating article so as to generate an inhalable aerosol from an aerosol-forming substrate of the aerosol-generating article; the aerosol-generating device comprising a housing; the housing comprising a cavity configured to receive the aerosol-generating article; the housing adapted to define a cooling air flow path extending from outside of the housing, through an interior of the housing, to an air-permeable portion of a wall of the cavity.

Example Ex2: An aerosol-generating device according to Ex1; wherein, in use with an aerosol-generating article docked in the cavity, the air-permeable portion of the wall of the cavity is coincident with a corresponding air-permeable portion of an exterior wall of the aerosol-generating article.

Example Ex3: An aerosol-generating device according to either one of Ex1 or Ex2, in which the wall of the cavity is tubular, the cavity provided with an open end and a closed end, the aerosol-generating device configured to receive the aerosol-generating article via the open end of the tubular cavity.

Example Ex4: An aerosol-generating device according to any one of Ex1 to Ex3, in which the air-permeable portion of the wall of the cavity comprises one or more of: a porous material, a plurality of slits, and a plurality of holes.

Example Ex5: An aerosol-generating device according to any one of Ex1 to Ex4, in which the wall of the cavity is tubular, the air-permeable portion of the wall of the cavity comprising at least one annular air-permeable band.

Example Ex6: An aerosol-generating device according to Ex5, in which the at least one annular air-permeable band comprises a first annular air-permeable band and a second annular air-permeable band, the first and second bands axially-spaced apart from each other along a longitudinal axis of the cavity and having distinct first and second permeabilities to air flow there through.

Example Ex7: An aerosol-generating device according to any one of Ex1 to Ex6, the aerosol-generating device further comprising control electronics provided within the housing, the cooling air flow path extending through or adjacent to the control electronics for providing cooling thereto.

Example Ex8: An aerosol-generating device according to any one of Ex1 to Ex7, in which the aerosol-generating device is configured to urge a flow of air from outside of the housing along the cooling air flow path towards the air-permeable portion of the wall of the cavity.

Example Ex9: An aerosol-generating device according to any one of Ex1 to Ex8, in which the aerosol-generating device is an electrically-powered device for heating the aerosol-forming substrate of an aerosol-generating article by either or both of inductive heating and resistive heating, the device comprising a power source for supplying electrical power.

Example Ex10: An aerosol-generating device according to Ex9, in which the wall of the cavity comprises a susceptor portion, the susceptor portion axially spaced-apart from the air-permeable portion of the wall of the cavity along a longitudinal axis of the cavity, the aerosol-generating device further comprising an inductor coil encircling the susceptor portion.

Example Ex11: An aerosol-generating device according to either one of Ex9 or Ex10, in which the device comprises a resistive heating element provided in the cavity and configured to, in use, encircle or insert within an aerosol-generating article docked in the cavity.

Example Ex12: An aerosol-delivery system comprising: an aerosol-generating device according to any one of the preceding claims; an aerosol-generating article, the aerosol-generating article defining a rod, the rod containing an aerosol-forming substrate, an exterior wall of the rod comprising an air-permeable portion, the air-permeable portion of the exterior wall of the rod positioned downstream from the aerosol-forming substrate; the device and article configured such that when the aerosol-generating article is docked in the cavity, the air-permeable portion of the wall of the cavity is coincident with the air-permeable portion of the exterior wall of the rod.

Example Ex13: An aerosol-delivery system according to Ex12, in which the aerosol-generating article further comprises a first air flow path and a second air flow path; the rod having a mouth end and a distal end, the mouth end located downstream of the distal end; the first air flow path extending through the aerosol-forming substrate along an interior of the rod downstream towards the mouth end such that, on application of suction at the mouth end, air is drawn into the aerosol-generating article and passes through the aerosol-forming substrate along the interior of the rod downstream towards the mouth end; and the second air flow path extending through the air-permeable portion of the exterior wall of the rod to feed cooling air-flow received from the cooling air flow path when the article is docked in the cavity of the device to a mixing region inside the rod, the air-permeable portion and the mixing region located downstream of and immediately adjacent to the aerosol-forming substrate such that, in use, air flow along the second air flow path mixes in the mixing region with aerosol flow along the first air flow path.

Example Ex14: An aerosol-delivery system according to Ex13, in which the aerosol-forming substrate is located at the distal end, or closer to the distal end than to the mouth end.

Example Ex15: An aerosol-delivery system according to either of Ex13 or Ex14, in which the interior of the rod is free of obstructions from the mixing region to the mouth end such that, in use, the mixed flow is unimpeded when flowing from the mixing region to the mouth end.

Example Ex16: An aerosol-delivery system according to any one of Ex12 to Ex15, in which the air-permeable portion of the exterior wall of the rod comprises one or more of: a porous material, a plurality of slits, and a plurality of holes.

Example Ex17: An aerosol-delivery system according to any one of Ex12 to Ex16, in which the air-permeable portion of the exterior wall of the rod comprises at least one annular air-permeable band.

Example Ex18: An aerosol-delivery system according to Ex17, in which the at least one air-permeable band of the exterior wall of the rod comprises a first annular air-permeable band and a second annular air-permeable band, the first and second bands axially-spaced apart from each other along a longitudinal axis of the rod and having distinct first and second permeabilities to air-flow there through.

Example Ex19: An aerosol-delivery system according to any one of Ex12 to Ex18, in which the air-permeable portion of the exterior wall of the rod has an axial length of between 0.2 to 4 millimetres; or of between 0.2 to 2.5 millimetres; or of between 0.2 to 1.8 millimetres; or of between 0.2 to 1.5 millimetres.

Example Ex20: An aerosol-delivery system according to any one of Ex12 to Ex19, in which the air-permeable portion of the exterior wall of the rod extends downstream of the aerosol-forming substrate by no more than 4 millimetres, or by no more than 2.5 millimetres, or by no more than 1.8 millimetres, or by no more than 1.5 millimetres, or by no more than 0.2 millimetres.

Example Ex21: An aerosol-delivery system according to any of Ex13 to Ex20, in which the aerosol-generating article and the aerosol-generating device are configured such that on application of suction to the mouth end with the article docked in the device, between 50% to 90% of a combined volumetric flow along the first and second air flow paths flows through the air-permeable portion of the exterior wall of the rod along the second air flow path.

Example Ex22: An aerosol-delivery system according to Ex21, in which the aerosol-generating article and aerosol-generating device are configured such that on application of suction to the mouth end with the article docked in the device, between 55% to 75% of the combined volumetric flow along the first and second air flow paths flows through the air-permeable portion of the exterior wall of the rod along the second air flow path.

Example Ex23: An aerosol-generating article for use with an aerosol-generating device, the aerosol-generating article defining a rod, the rod containing an aerosol-forming substrate and having a distal end and a mouth end, the mouth end located downstream of the distal end; the aerosol-generating article comprising a first air flow path and a second air flow path; an exterior wall of the rod comprising an air-permeable portion, the air-permeable portion of the exterior wall of the rod positioned downstream from the aerosol-forming substrate; the first air flow path extending through the aerosol-forming substrate along an interior of the rod downstream towards the mouth end such that, on application of suction to the mouth end, air is drawn into the aerosol-generating article and passes through the aerosol-forming substrate along the interior of the rod downstream towards the mouth end; and the second air-flow path extending through the air-permeable portion of the exterior wall of the rod to feed cooling air from outside the rod to a mixing region inside the rod, the air-permeable portion and the mixing region located downstream of and immediately adjacent to the aerosol-forming substrate such that, in use, air flow along the second air flow path mixes in the mixing region with aerosol flow along the first air flow path.

Example Ex24: An aerosol-generating article according to Ex23, in which the aerosol-forming substrate is located at or closer to the distal end of the rod than to the mouth end of the rod.

Example Ex25: An aerosol-delivery system according to either of Ex23 or Ex24, in which the interior of the rod is free of obstructions from the mixing region to the mouth end such that, in use, the mixed flow is unimpeded when flowing from the mixing region to the mouth end.

Example Ex26: An aerosol-generating article according to any one of Ex22 to Ex25, in which the air-permeable portion comprises one or more of: a porous material, a plurality of slits, and a plurality of holes.

Example Ex27: An aerosol-generating article according to any one of Ex23 to Ex26, in which the air-permeable portion of the exterior wall of the rod comprises at least one annular air-permeable band.

Example Ex28: An aerosol-generating article according to Ex27, in which the at least one annular air-permeable band comprises a first annular air-permeable band and a second annular air-permeable band, the first and second bands axially-spaced apart from each other along a longitudinal axis of the rod and having distinct first and second permeabilities to air flow there through.

Example Ex29: An aerosol-generating article according to any one of Ex23 to Ex28, in which the air-permeable portion of the exterior wall of the rod has an axial length of between 0.2 to 4 mm, or of between 0.2 to 2.5 mm, or of between 0.2 to 1.8 mm, or of between 0.2 to 1.5 mm.

Example Ex30: An aerosol-generating article according to any one of Ex23 to Ex29, in which the air-permeable portion of the exterior wall of the rod extends downstream of the aerosol-forming substrate by no more than 4 millimetres, or by no more than 2.5 millimetres, or by no more than 1.8 millimetres, or by no more than 1.5 millimetres, or by no more than 0.2 millimetres.

Example Ex31: An aerosol-generating article according to any of Ex23 to Ex30, in which the article is configured such that on application of suction to the mouth end, between 50% to 90% of a combined volumetric flow along the first and second air flow paths flows through the air-permeable portion of the exterior wall of the rod along the second air flow path.

Example Ex32: An aerosol-generating article according to Ex31, in which the article is configured such that on application of suction to the mouth end, between 55% to 75% of a combined volumetric flow along the first and second air flow paths flows through the air-permeable portion of the exterior wall of the rod along the second air flow path.

Examples will now be further described with reference to the figures, in which:

Figure 1 illustrates a perspective view of an aerosol-generating device according to the present disclosure;

Figure 2 illustrates a further perspective view of the aerosol-generating device of figure 1, but with part of the housing of the device removed to allow viewing of the internals of the device.

Figure 3 corresponds to the view of figure 2, but with an aerosol-generating article coupled to the aerosol-generating device to provide an aerosol-delivery system.

Figure 4 illustrates a perspective view of the aerosol-generating article shown in figure 3.

Figures 5a, 5b and 5c illustrate three different side elevation views of the aerosol-generating article of figure 4.

Figures 6a, 6b relate to a second embodiment, and show detail views of: a) part of the wall of a cavity of the device and b) part of an exterior wall of the article.

Figure 1 shows an aerosol-generating device 100. The device 100 has a housing 101. An activation button 102 is incorporated into the housing 101.

As shown in figure 2, a power source in the form of a rechargeable battery 103 is located within the housing 101. Control electronics 104 are also located within the housing 101. The control electronics 104 are positioned adjacent the rechargeable battery 103. The housing 101 has a tubular cavity 105 extending within an interior of the device 100. The cavity 105 is defined by a tubular wall 106 extending within the device 100 along longitudinal axis 107. The cavity 105 has an open end 108 and a closed end 109, with the open and closed ends located at opposite ends of the cavity. The housing 101 is provided with a slidable cover 110 which can be moved to expose or close the open end 108 of the cavity 105.

As shown in figures 2 and 3, the tubular wall 106 has a lower portion 106a and an upper portion 106b. The lower portion 106a is formed of a different material to the upper portion 106b. The lower portion 106a is formed of a material having an ability to absorb electromagnetic energy and convert it into heat. So, for this embodiment, the lower portion 106a is a susceptor portion. Accordingly, the terms lower portion and susceptor portion are used here interchangeably for reference sign 106a. In this example, the susceptor portion 106a is formed of a steel. However, in other embodiments (not shown), the susceptor portion 106a may be formed of other materials having an ability to absorb electromagnetic energy and convert it into heat. An inductor coil 111 circumferentially encircles the susceptor portion 106a. The upper portion 106b of the tubular wall 106 is formed of a polymeric material. An annular region of the upper portion 106b of the tubular wall 106 of the cavity 105 is provided with a homogenous distribution of holes extending radially through the tubular wall to form an annular air-permeable band 112.

As shown in figures 2 and 3, a line of air inlets 113 is provided in a sidewall of the housing 101, with a circular arrangement of air inlets 114 provided in a bottom surface of the housing 101. As indicated by fluid flow lines in figure 3, air entering the housing 101 through air inlets 113, 114 flows through the interior of the housing to fluidically communicate with the annular air-permeable band 112.

As shown in figure 3, a single air inlet 115 is also provided in the bottom surface of the housing 101 directly beneath the closed end 109 of the cavity 105, with a fluid flow channel extending from the air inlet 115 to an opening (not shown) formed in the closed end 109 of the cavity 105. Fluid flow lines are included in figure 3 showing how air entering through the air inlet 115 fluidically communicates with the closed end 109 of the cavity 105.

As shown in figure 3, the aerosol-generating device 100 is used in conjunction with an aerosol-generating article 200. The aerosol-generating device 100 and aerosol-generating article 200 together form aerosol-delivery system 300.

As shown in the perspective view of figure 4, the aerosol-generating article 200 has the form of an elongate cylindrical rod. Accordingly, the terms aerosol-generating article and rod are used here interchangeably for reference sign 200. The aerosol-generating article 200 has a diameter d_{200} of between approximately 3.7 to 9 millimetres. However, in an alternative example, the diameter d_{200} is between approximately 5.7 to 7.9 millimetres. The aerosol-generating article 200 has a distal end 201 and a mouth end 202. The aerosol-generating article 200 has a wrapper 203 of cigarette paper. The wrapper 203 forms an exterior wall of the rod 200. As shown in figures 5b and 5c, a porous front-plug 204, a plug of aerosol-forming substrate 205 and a tubular core element 206 are assembled sequentially and coaxially within the wrapper 203. The porous front-plug 204 is located at the distal end 201. The plug of aerosol-forming substrate 205 is positioned immediately downstream of the front-plug 204. The tubular core element 206 is positioned immediately downstream of the plug of aerosol-forming substrate 205 and extends downstream towards the mouth end 202. In the embodiment shown, the hollow interior 207 of the tubular core element 206 is free of obstructions such as a mouthpiece filter element, to define an empty space. So, the hollow interior 207 means that the interior of the rod 200, between the downstream end of the aerosol-forming substrate 205 and the mouth end 202, defines an unobstructed flow path. However, in an alternative embodiment (not shown), a filter element may be located within the rod 200 adjacent the mouth end 202. For the embodiment shown and described herein, the aerosol-forming substrate 205 is a solid substrate containing tobacco. An annular region of the wrapper 203 is provided with a homogenous distribution of holes extending radially through the tubular wall to form an annular air-permeable band 208 in the wrapper 203 (i.e. the exterior wall) of the rod 200.

A first air flow path 209 extends through the aerosol-forming substrate 205 and along the hollow interior 207 of the tubular core element 206. A second air flow path 210 extends through the annular air-permeable band 208 to a mixing region 211 located within the rod 200. The mixing region 211 is where the first and second air flow paths 209, 210 coincide and their respective fluid flows mix and combine with each other, as will be described in more detail below.

The aerosol-generating article 200 shown in the figures and described herein is a smoking article intended for use with the aerosol-generating device 100, so as to generate aerosol from the aerosol-forming substrate 205 for inhalation by a user. The aerosol-generating device 100 is reusable, whereas the aerosol-generating article 200 is disposable and intended for single-use only.

In use, a user would first slide the slidable cover 110 to expose the open end 108 of the cavity 105. The user would then insert a fresh, unused aerosol-generating article 200 into the cavity 105 via the open end 108, until the distal end 201 of the article touches the closed end 109 of the cavity. In this position, the aerosol-generating article 200 is said to be docked in the cavity 105 of the aerosol-generating device 200. The combination of the aerosol-generating device 100 and aerosol-generating article 200 form an aerosol-delivery system 300. When the aerosol-generating article 200 is docked within the cavity 105, the annular air-permeable band 112 of the tubular wall 106 of the cavity 105 is coincident with the annular air-permeable band 208 of the wrapper 203 of the aerosol-generating article 200. Further, when the aerosol-generating device 200 is docked within the cavity 105, the plug of aerosol-forming substrate 205 is located wholly within the susceptor portion 106a and the inductor coil 111.

Upon the user pressing the activation button 102, the control electronics 104 control the supply of electrical power from the rechargeable battery 103 to the inductor coil 111. The resulting flow of electrical current through the inductor coil 111 induces eddy currents into the steel susceptor portion 106a. These eddy currents, in turn, result in heating of the susceptor portion 106a. Heat from the susceptor portion 106a radiates onto the aerosol-generating article 200 housed within the cavity 105. As the plug of aerosol-forming substrate 205 is located wholly within the susceptor portion 106a and the inductor coil 111, heat from the susceptor portion radiates onto the wrapper 203 of the aerosol-generating article 200 and is conducted to the plug of aerosol-forming substrate 205. The consequent heating of the aerosol-forming substrate 205 results in the substrate evolving aerosol.

The control electronics 104 are configured so as to adjust the temperature of the susceptor portion 106a according to a predetermined thermal profile. Once the susceptor portion 106a has attained a sufficiently high temperature to result in aerosol being evolved from the plug of aerosol-forming substrate 205, the user may then draw on the mouth end 202 of the aerosol-generating article 200 so as to apply suction to the mouth end. Each draw taken by the user on the aerosol-generating article 200 is commonly referred to as a “puff”.

The suction resulting from the user drawing on the mouth end 202 results in air being sucked into the aerosol-generating device 100 via inlet opening 115 and being conveyed through the closed end 109 of the cavity 105. The suction causes this air to flow along the first air flow path 209 by entering the aerosol-generating article 200 through the porous front plug 204 and onwards through the plug of aerosol-forming substrate 205. This air becomes entrained with aerosol evolved by the aerosol-forming substrate 205 due to heating by the susceptor portion 106a and continues to flow along first air flow path 209 to emerge from a downstream end of the plug of aerosol-forming substrate 205 into the mixing region 211.

The suction resulting from the user drawing on the mouth end 202 also results in external air being sucked into the housing 101 of the aerosol-generating device 100 via air inlets 113, 114. This air then flows within the interior of the housing 101 past the battery 103 and the control electronics 104, thereby helping to cool both the battery 103 and control electronics 104. This air then flows onwards to and through the annular air-permeable band 112 defined in the upper portion 106b of the tubular wall 106 of the cavity 105. The coinciding alignment of the annular air-permeable band 112 defined in the tubular wall 106 of the cavity 105 of the device 100 with the annular air-permeable band 208 defined in the wrapper 203 of the aerosol-generating article 200 results in much of the air flowing through the air-permeable band 112, then passing across a radial gap separating the tubular wall 106 and the article 200 and along the second air flow path 210 through the air-permeable band 208. In this manner, external air is able to be fed through the interior of the housing 101 of the aerosol-generating device 100 to provide cooling to the battery 103 and control electronics 104, and then be fed to within the aerosol-generating article 200 docked in the cavity 105. On passing through the annular air-permeable band 208 defined in the wrapper 203 of the article 200, the external air enters the mixing region 211.

In the mixing region 211, the heated aerosol flowing along the first air flow path 209 mixes with the cooling external air flowing along the second air flow path 210, resulting in cooling of the aerosol. The cooled, mixed flow then flows downstream along the hollow interior 207 of the tubular core element 206 towards the mouth end 202 to be inhaled by the user.

For the aerosol-generating article 200 shown in the figures, the annular air-permeable band 208 has an axial length L_{208} of 4 millimetre, with the upstream end of the annular band 208 being nearly coincident with the downstream end of the plug of aerosol-forming substrate 205. In alternative embodiments, the axial length L_{208} may be as little as 0.2 millimetres. The aerosol-generating article 200 shown in the figures may have a length of between approximately 30 millimetres and approximately 100 millimetres.

In an alternative embodiment, as shown in figure 6a, the annular air-permeable band 112 of the tubular wall 106 of the cavity 105 of the aerosol-generating device 100 is formed of two annular bands - a first annular band 112a and a second annular band 112b. Figure 6a shows a region ‘A’ (see figure 3) of the tubular wall 106. The first and second annular bands 112a, 112b are axially spaced apart from each other along the longitudinal axis 107, with the first annular band 112a being closer to the closed end 109 of the cavity 105 than the second annular band 112b. However, the first and second annular bands 112a, 112b have distinct (i.e. different) levels of permeability to air flow there through. For the example shown in figure 6a, both annular bands 112a, 112b are provided with a homogenous arrangement of holes extending through the tubular wall 106. However, the holes in the first annular band 112a are larger in area than the holes in the second annular band 112b. This difference in hole area has the effect that, in use, a greater volumetric flow of external cooling air flows through the first annular band 112a than through the second annular band 112b. This difference in volumetric flow rate provides differential cooling along the length or axis 107 of the cavity 105. To complement the first and second annular bands 112a, 112b provided in the tubular wall 106 of the aerosol-generating device 100, the annular air-permeable band 208 of the wrapper 203 of the aerosol-generating article 200 is similarly formed of two annular bands - a first annular band 208a and a second annular band 208b (as shown in figure 6b). Figure 6b shows a region ‘B (see figure 4) of the wrapper 203 of the aerosol-generating article 200. The first and second annular bands 208a, 208b are axially spaced apart from each other along the length of the article 200, with the first annular band 208a being closer to the distal end 201 of the article 200 than the second annular band 208b. However, the first and second annular bands 208a, 208b have distinct (i.e. different) levels of permeability to air flow there through. For the example shown in figure 6b, both annular bands 208a, 208b are provided with a homogenous arrangement of holes extending through the wrapper 203. However, the holes in the first annular band 208a are larger in area than the holes in the second annular band 208b. This difference in hole area has the effect that, in use, a greater volumetric flow of air flows through the first annular band 208a than through the second annular band 208b. This difference in volumetric flow rate provides differential cooling within the interior of the article 200 along the length of the article, with a higher level of cooling air being introduced closer to but immediately downstream of the aerosol-forming substrate, i.e. via first annular band 208a. The first and second annular bands 112a, 208a, 112b, 208b of the device 100 and the article 200 are arranged so that when the article is docked within the cavity 105 of the device, the first annular band 112a of the device coincides with the first annular band 208a of the article and the second annular band 112b of the device coincides with the second annular band 208b of the article. In the embodiment shown in figures 6a and 6b, the first annular bands 112a, 208a are of equal length and overlap each other entirely; similarly, the second annular bands 112b, 208b are also of equal length and overlap each other entirely. However, in a further alternative embodiment (not shown), the first annular bands 112a, 208a may instead overlap only in part; similarly, the second annular bands 112b, 208b instead also overlap only in part.

As an alternative to the use of different hole sizes in first and second annular bands 112a, 208a, 112b, 208b, different air permeabilities in the first and second bands may instead be provided by use of different hole densities in the first and second bands, or the use of materials having different porosity for the first and second bands.

For the purpose of the present description and of the appended claims, except where otherwise indicated, all numbers expressing amounts, quantities, percentages, and so forth, are to be understood as being modified in all instances by the term "about". Also, all ranges include the maximum and minimum points disclosed and include any intermediate ranges therein, which may or may not be specifically enumerated herein. In this context, therefore, a number “A” is understood as “A” ± 10% of “A”. Within this context, a number “A” may be considered to include numerical values that are within general standard error for the measurement of the property that the number “A” modifies. The number “A”, in some instances as used in the appended claims, may deviate by the percentages enumerated above provided that the amount by which “A” deviates does not materially affect the basic and novel characteristic(s) of the claimed invention. Also, all ranges include the maximum and minimum points disclosed and include any intermediate ranges therein, which may or may not be specifically enumerated herein.

CLAIMS

1. An aerosol-generating device configured for use in heating an aerosol-generating article so as to generate an inhalable aerosol from an aerosol-forming substrate of the aerosol-generating article;

the aerosol-generating device comprising a housing;

the housing comprising a cavity configured to receive the aerosol-generating article;

the housing adapted to define a cooling air flow path extending from outside of the housing, through an interior of the housing, to an air-permeable portion of a wall of the cavity;

wherein the wall of the cavity is tubular, the air-permeable portion of the wall of the cavity comprising at least one annular air-permeable band, the annular air-permeable band configured to radially channel an air flow from the cooling air flow path into the cavity around the periphery of the tubular wall of the cavity.

2. An aerosol-generating device according to claim 1;

wherein, in use with an aerosol-generating article docked in the cavity, the air-permeable portion of the wall of the cavity is coincident with a corresponding air-permeable portion of an exterior wall of the aerosol-generating article.

3. An aerosol-generating device according to either one of claim 1 or claim 2, in which the wall of the cavity is tubular, the cavity provided with an open end and a closed end, the aerosol-generating device configured to receive the aerosol-generating article via the open end of the tubular cavity.

4. An aerosol-generating device according to any one of claims 1 to 3, in which the air-permeable portion of the wall of the cavity comprises one or more of:

a porous material,

a plurality of slits, and

a plurality of holes.

5. An aerosol-generating device according to any one of claims 1 to 4, in which the at least one annular air-permeable band comprises a first annular air-permeable band and a second annular air-permeable band, the first and second bands axially-spaced apart from each other along a longitudinal axis of the cavity and having distinct first and second permeabilities to air flow there through.

6. An aerosol-generating device according to any one of claims 1 to 5, in which the aerosol-generating device is configured to urge a flow of air from outside of the housing along the cooling air flow path towards the air-permeable portion of the wall of the cavity.

7. An aerosol-delivery system comprising:

an aerosol-generating device according to any one of the preceding claims;

an aerosol-generating article, the aerosol-generating article defining a rod, the rod containing an aerosol-forming substrate, an exterior wall of the rod comprising an air-permeable portion, the air-permeable portion of the exterior wall of the rod positioned downstream from the aerosol-forming substrate;

the device and article configured such that when the aerosol-generating article is docked in the cavity, the air-permeable portion of the wall of the cavity is coincident with the air-permeable portion of the exterior wall of the rod.

8. An aerosol-delivery system according to claim 7, in which the aerosol-generating article further comprises a first air flow path and a second air flow path;

the rod having a mouth end and a distal end, the mouth end located downstream of the distal end;

the first air flow path extending through the aerosol-forming substrate along an interior of the rod downstream towards the mouth end such that, on application of suction at the mouth end, air is drawn into the aerosol-generating article and passes through the aerosol-forming substrate along the interior of the rod downstream towards the mouth end; and

the second air flow path extending through the air-permeable portion of the exterior wall of the rod to feed cooling air-flow received from the cooling air flow path when the article is docked in the cavity of the device to a mixing region inside the rod, the air-permeable portion and the mixing region located downstream of and immediately adjacent to the aerosol-forming substrate such that, in use, air flow along the second air flow path mixes in the mixing region with aerosol flow along the first air flow path to provide a mixed flow.

9. An aerosol-delivery system according to either one of claim 7 or claim 8, in which the air-permeable portion of the exterior wall of the rod comprises one or more of:

a porous material,

a plurality of slits, and

a plurality of holes.

10. An aerosol-generating article for use with an aerosol-generating device, the aerosol-generating article defining a rod, the rod containing an aerosol-forming substrate and having a distal end and a mouth end, the mouth end located downstream of the distal end;

the aerosol-generating article comprising a first air flow path and a second air flow path;

an exterior wall of the rod comprising an air-permeable portion, the air-permeable portion of the exterior wall of the rod positioned downstream from the aerosol-forming substrate;

the first air flow path extending through the aerosol-forming substrate along an interior of the rod downstream towards the mouth end such that, on application of suction to the mouth end, air is drawn into the aerosol-generating article and passes through the aerosol-forming substrate along the interior of the rod downstream towards the mouth end; and

the second air-flow path extending through the air-permeable portion of the exterior wall of the rod to feed cooling air from outside the rod to a mixing region inside the rod, the air-permeable portion and the mixing region located downstream of and immediately adjacent to the aerosol-forming substrate such that, in use, air flow along the second air flow path mixes in the mixing region with aerosol flow along the first air flow path;

in which the air-permeable portion of the exterior wall of the rod comprises at least one annular air-permeable band, the at least one annular air-permeable band comprising a first annular air-permeable band and a second annular air-permeable band, the first and second bands axially-spaced apart from each other along a longitudinal axis of the rod and having distinct first and second permeabilities to air flow there through.

11. An aerosol-generating article according to claim 10, in which the aerosol-forming substrate is located at or closer to the distal end of the rod than to the mouth end of the rod.

12. An aerosol-delivery system according to either one of claim 10 or claim 11, in which the interior of the rod is free of obstructions from the mixing region to the mouth end such that, in use, the mixed flow is unimpeded when flowing from the mixing region to the mouth end.

13. An aerosol-generating article according to any one of claims 10 to 12, in which the air-permeable portion comprises one or more of:

a porous material,

a plurality of slits, and

a plurality of holes.

14. An aerosol-generating article according to any one of claims 10 to 13, in which the air-permeable portion of the exterior wall of the rod has an axial length of between 0.2 to 4 mm, or of between 0.2 to 2.5 mm, or of between 0.2 to 1.8 mm, or of between 0.2 to 1.5 mm.

15. An aerosol-generating article according to any one of claims 10 to 14, in which the air-permeable portion of the exterior wall of the rod extends downstream of the aerosol-forming substrate by no more than 4 millimetres, or by no more than 2.5 millimetres, or by no more than 1.8 millimetres, or by no more than 1.5 millimetres, or by no more than 0.2 millimetres.

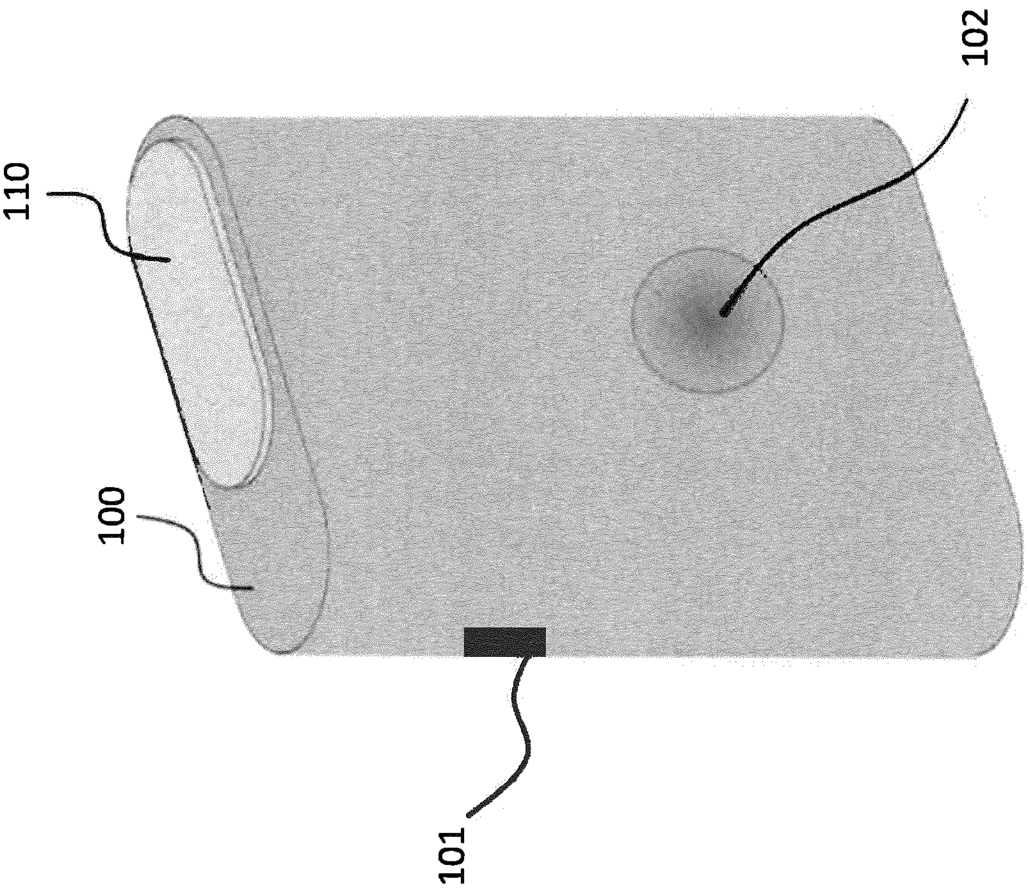

FIGURE 1

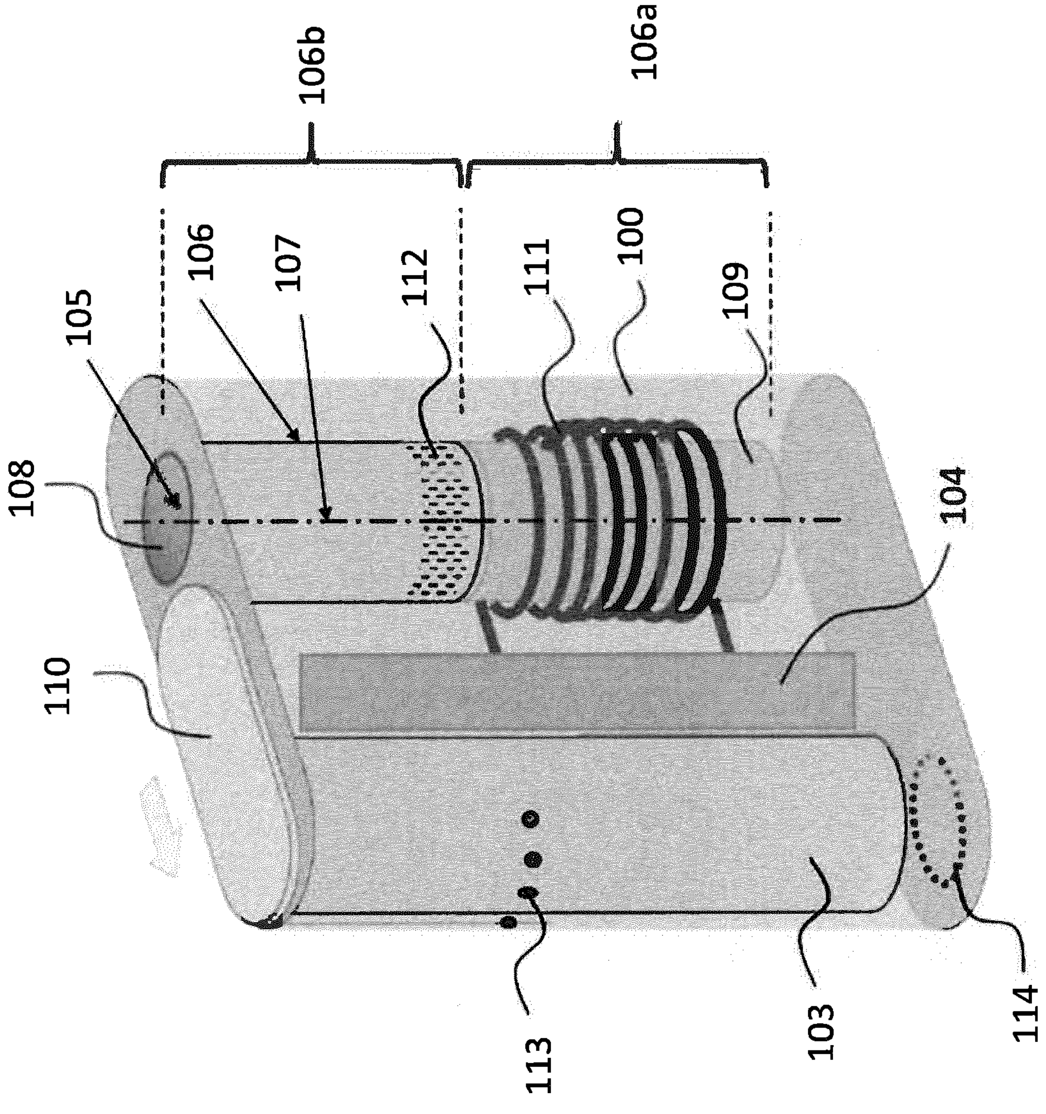

FIGURE 2

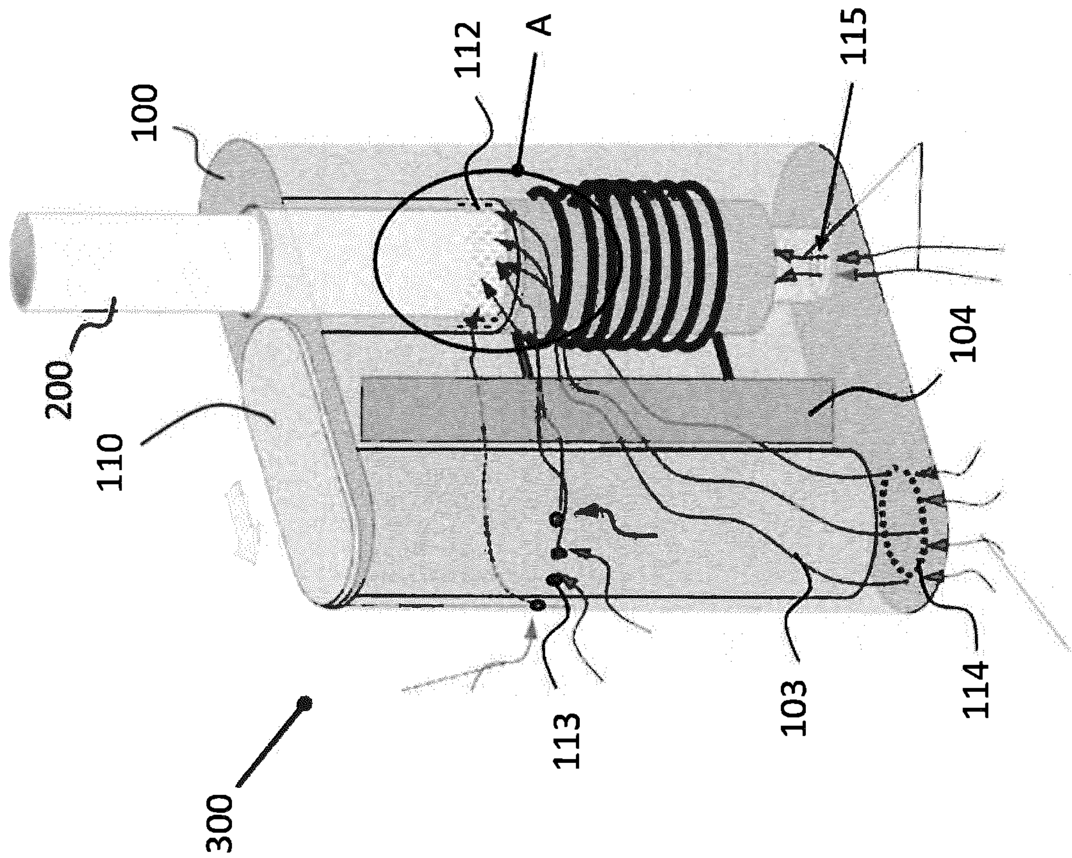

FIGURE 3

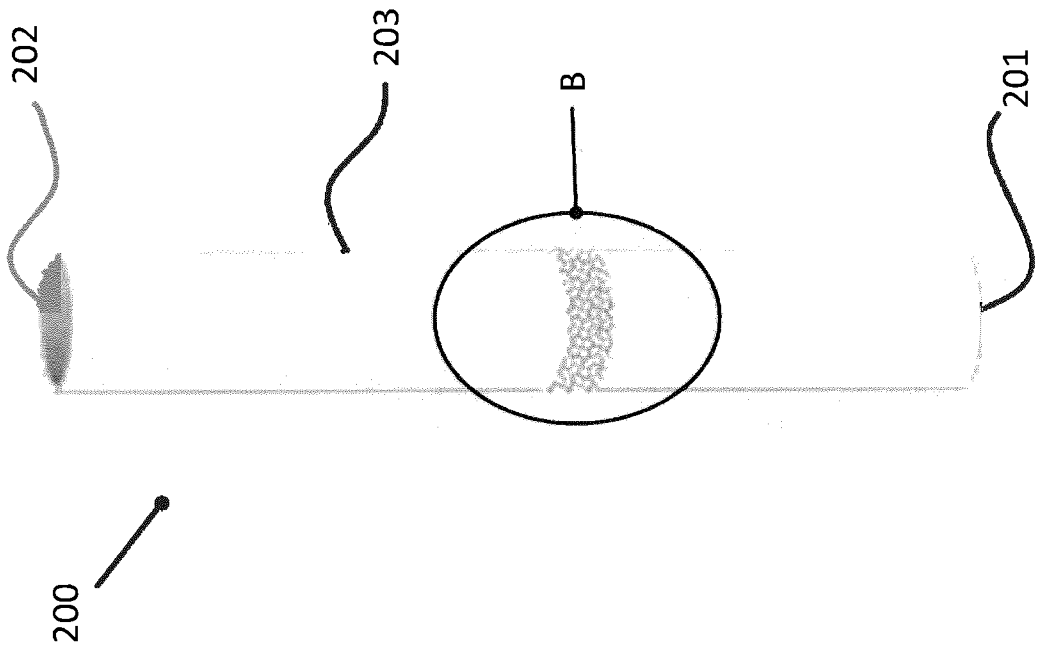

FIGURE 4

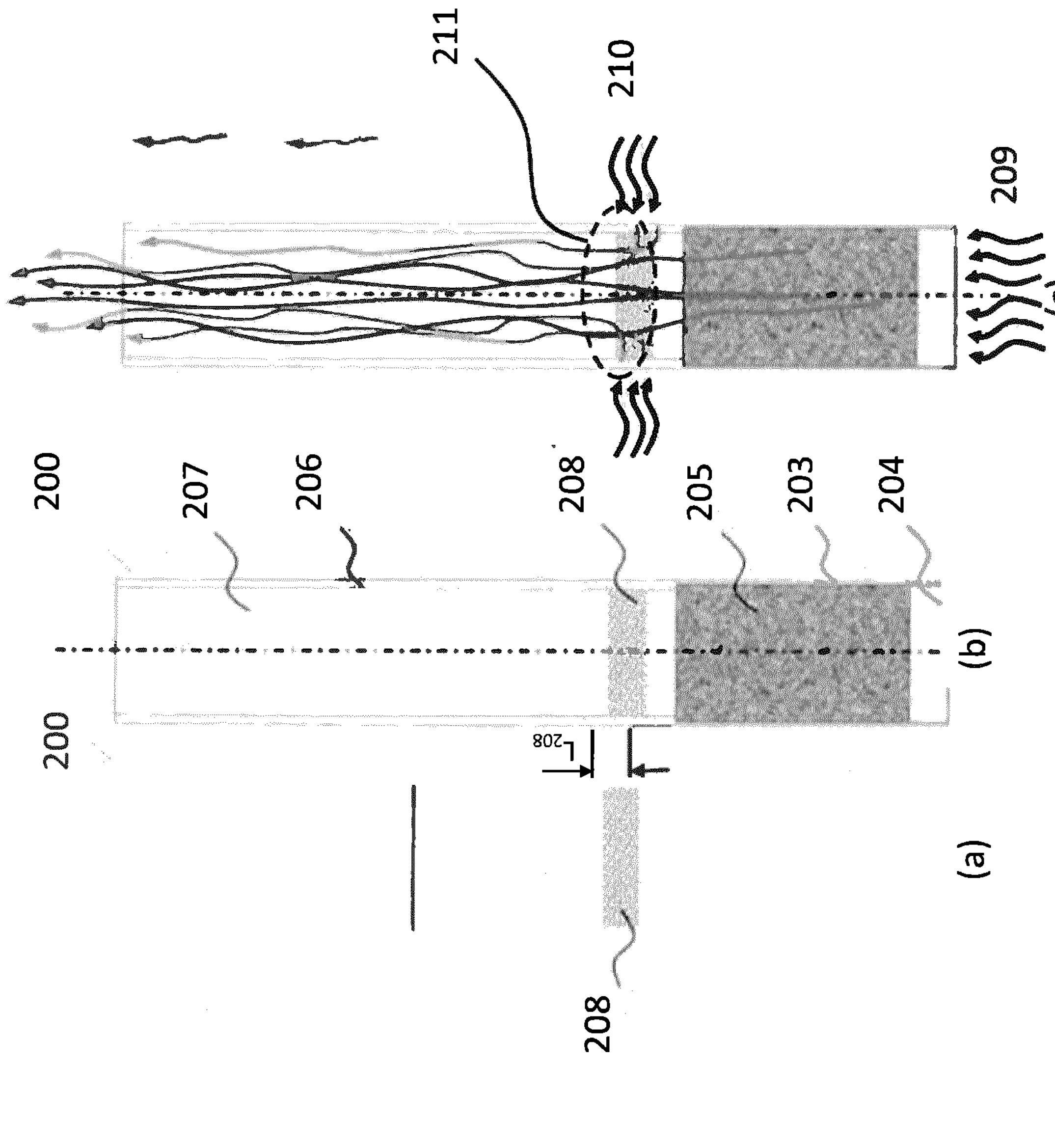

FIGURE 5

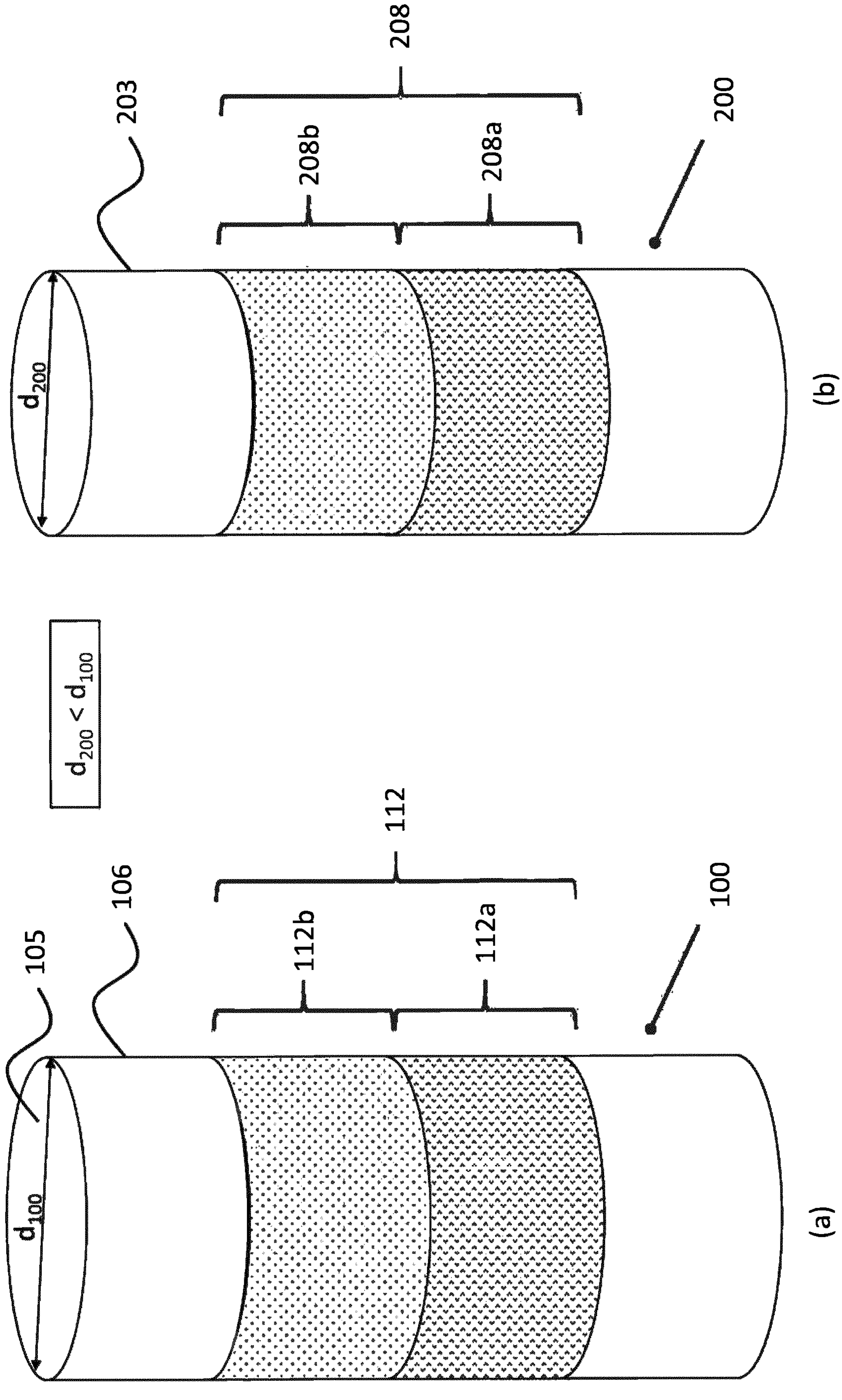
208
203
208b
208a
200
d_{200}
(b)
$d_{200} < d_{100}$
112
105
106
112b
112a
100
d_{100}
(a)

FIGURE 6

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2021/085322

A. CLASSIFICATION OF SUBJECT MATTER

INV. A24F40/40 A24F40/465 A24F40/485 A24D1/20

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 A24D

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.
X A	US 2004/149296 A1 (ROSTAMI ALI A [US] ET AL) 5 August 2004 (2004-08-05) paragraph [0020] - paragraph [0027]; claims; figures	1-4,6 5
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A	WO 2019/081571 A1 (BRITISH AMERICAN TOBACCO INVESTMENTS LTD [GB]) 2 May 2019 (2019-05-02) page 9, line 9 - page 11, line 12; figures	1-15

-/--

[x] Further documents are listed in the continuation of Box C.

[x] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 March 2022	11/04/2022

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	Marzano Monterosso

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X	WO 2020/089115 A1 (NERUDIA LTD [GB]) 7 May 2020 (2020-05-07)	7-15
A	page 13, line 28 - page 14, line 16; figure 3 page 15, line 28 - page 16, line 14; claims; figure 7	1-6
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A	claims; figures; examples	10-15
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Information on patent family members

International application No
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