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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
15 June 2023 (15.06.2023)

WIPO | PCT

(10) International Publication Number
WO 2023/104706 A1

(51) International Patent Classification:
A24D 1/20 (2020.01) *A24B 3/14* (2006.01)

(21) International Application Number:
PCT/EP2022/084390

(22) International Filing Date:
05 December 2022 (05.12.2022)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
21212574.4 06 December 2021 (06.12.2021) 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, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, 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, CV, 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, ME, 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).

Published:
— *with international search report (Art. 21(3))*

(54) Title: AEROSOL-GENERATING ARTICLE COMPRISING HOLLOW TUBULAR SUBSTRATE ELEMENT

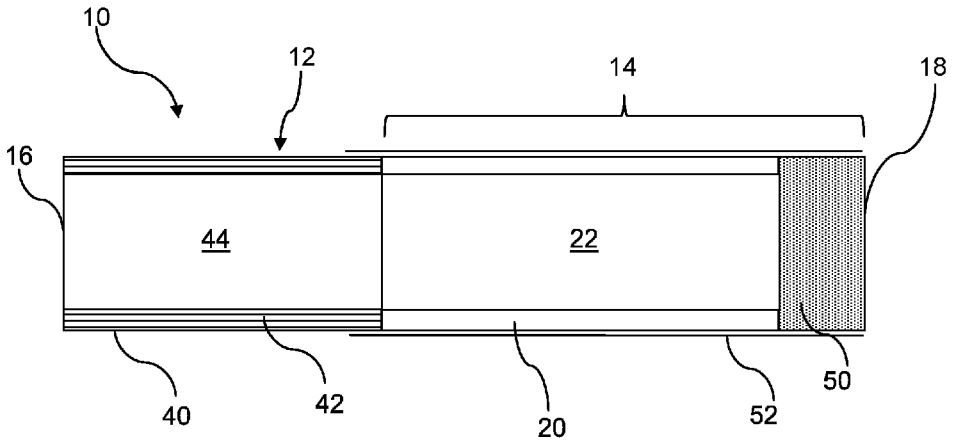


Figure 1

(57) Abstract: An aerosol-generating article (10)(110) comprises: an aerosol-generating substrate (12) comprising a hollow tubular substrate element (40)(140) having a multi-layered peripheral wall (42) defining a longitudinal airflow channel (44)(144), wherein the peripheral wall (42) is formed of a plurality of overlapping layers of homogenised tobacco material and wherein the longitudinal airflow channel (44)(144) has a diameter of at least 3 millimetres; and a downstream section (14) provided downstream of the aerosol-generating substrate (12).

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AEROSOL-GENERATING ARTICLE COMPRISING HOLLOW TUBULAR SUBSTRATE ELEMENT

The present invention relates to an aerosol-generating article comprising an aerosol-generating substrate that is adapted to produce an inhalable aerosol upon heating.

Aerosol-generating articles in which an aerosol-generating substrate, such as a tobacco-containing substrate, is heated rather than combusted, are known in the art. Typically, in such heated smoking articles an aerosol is generated by the transfer of heat from a heat source to a physically separate aerosol-generating substrate or material, which may be located in contact with, within, around, or downstream of the heat source. During use of the aerosol-generating article, volatile compounds are released from the aerosol-generating substrate by heat transfer from the heat source and are entrained in air drawn through the aerosol-generating article. As the released compounds cool, they condense to form an aerosol.

A number of prior art documents disclose aerosol-generating devices for consuming aerosol-generating articles. Such devices include, for example, electrically heated aerosol-generating devices in which an aerosol is generated by the transfer of heat from one or more electrical heater elements of the aerosol-generating device to the aerosol-generating substrate of a heated aerosol-generating article. For example, electrically heated aerosol-generating devices have been proposed that comprise an internal heater blade which is adapted to be inserted into the aerosol-generating substrate. Use of an aerosol-generating article in combination with an external heating system is also known. For example, WO-A-2020/115151 describes the provision of one or more heating elements arranged around the periphery of the aerosol-generating article when the aerosol-generating article is received in a cavity of the aerosol-generating device. As an alternative, inductively heatable aerosol-generating articles comprising an aerosol-generating substrate and a susceptor arranged within the aerosol-generating substrate have been proposed by WO-A-2015/176898.

In general, it can be difficult to provide efficient heating of an aerosol-generating substrate throughout the whole rod of the substrate. The portions of the substrate closest to the heating element will inevitably be heated most effectively whilst the imperfect transfer of heat through the substrate will mean that portions of the substrate furthest from the heating element may not be effectively heated. The generation of aerosol from these portions of the substrate that are not effectively heated is therefore not optimal and in some cases, parts of the substrate may not reach a sufficiently high temperature during use for an aerosol to be generated at all. For example, where an external heating element is used to heat a rod of aerosol-generating substrate, as described above, the central portion of the rod of aerosol-generating substrate is unlikely to generate as much aerosol as the outer portions of the rod and in some cases, may not generate

any aerosol. Overall, the generation of aerosol from the aerosol-generating rod is therefore likely to be inefficient, with potential waste of a portion of the aerosol-generating substrate.

It would therefore be desirable to provide an aerosol-generating article having an aerosol-generating substrate that is adapted to provide more efficient aerosolisation of the aerosol-generating substrate and that reduces waste of the substrate materials, such as tobacco. It would be particularly desirable to provide such an article with a relatively simple design so that it can be manufactured in a cost effective way and incorporated into existing product designs. It would be further desirable to provide such an article that can be readily adapted so that it can be heated in a variety of types of heating device, including inductive and resistive heating devices.

The present disclosure relates to an aerosol-generating article. The aerosol-generating article may comprise an aerosol-generating substrate comprising a hollow tubular substrate element. The hollow tubular substrate element may have a multi-layered peripheral wall defining a longitudinal airflow channel. The peripheral wall may be formed of a plurality of overlapping layers of homogenised tobacco material. The longitudinal airflow channel may have a diameter of at least 3 millimetres. The aerosol-generating article may further comprise a downstream section provided downstream of the aerosol-generating substrate.

According to the present invention there is provided an aerosol-generating article comprising: an aerosol-generating substrate comprising a hollow tubular substrate element having a multi-layered peripheral wall defining a longitudinal airflow channel, wherein the peripheral wall is formed of a plurality of overlapping layers of homogenised tobacco material and wherein the longitudinal airflow channel has a diameter of at least 3 millimetres; and a downstream section provided downstream of the aerosol-generating substrate.

As used herein, the term “aerosol-generating article” refers to a heated article for producing an aerosol, wherein the article comprises an aerosol-generating substrate that is suitable and intended to be heated or combusted in order to release volatile compounds that can form an aerosol. Such articles are commonly referred to as heat-not-burn articles. A conventional cigarette is lit when a user applies a flame to one end of the cigarette and draws air through the other end. The localised heat provided by the flame and the oxygen in the air drawn through the cigarette causes the end of the cigarette to ignite, and the resulting combustion generates an inhalable smoke. By contrast, in “heated aerosol-generating articles”, an aerosol is generated by heating an aerosol-generating substrate and not by combusting the aerosol-generating substrate. Known heated aerosol-generating articles include, for example, electrically heated aerosol-generating articles and aerosol-generating articles in which an aerosol is generated by the transfer of heat from a combustible fuel element or heat source to a physically separate aerosol-generating substrate.

Also known are aerosol-generating articles that are adapted to be used in an aerosol-generating system that supplies the aerosol former to the aerosol-generating articles. In such a

system, the aerosol-generating substrate in the aerosol-generating articles contains substantially less aerosol former relative to those aerosol-generating substrates which carries and provides substantially all the aerosol former used in forming the aerosol during operation.

As used herein, the term "aerosol-generating substrate" refers to a substrate capable of releasing upon heating volatile compounds, which can form an aerosol. The aerosol generated from aerosol-generating substrates of aerosol-generating articles described herein may be visible or invisible and may include vapours (for example, fine particles of substances, which are in a gaseous state, that are ordinarily liquid or solid at room temperature) as well as gases and liquid droplets of condensed vapours.

As used herein, the term "homogenised plant material" encompasses any plant material formed by the agglomeration of particles of plant. For example, sheets or webs of homogenised tobacco material for the aerosol-generating substrates of the present invention may be formed by agglomerating particles of tobacco material obtained by pulverising, grinding or comminuting plant material and optionally one or more of tobacco leaf lamina and tobacco leaf stems. The homogenised plant material may be produced by casting, extrusion, paper making processes or other any other suitable processes known in the art.

As defined above, the present invention provides an aerosol-generating article having a novel aerosol-generating substrate, which is in the form of a hollow tubular substrate element. The hollow tubular substrate element is formed from a plurality of overlapping layers of homogenised tobacco material, which combine to form the peripheral wall of the hollow tubular substrate element. The "peripheral" wall of the hollow tubular substrate corresponds to the main wall defining the tubular structure. Preferably, the hollow tubular substrate element consists of the peripheral wall only. The peripheral wall therefore contains all of the homogenised tobacco material that will generate an aerosol upon heating of the aerosol-generating substrate.

The peripheral wall of the hollow tubular substrate element defines a longitudinal airflow channel, wherein the term "longitudinal" relates to the longitudinal axis of the aerosol-generating article. The longitudinal airflow channel has a diameter of at least about 3 millimetres. Preferably, the longitudinal airflow channel is substantially empty so that there is nothing in the channel that may potentially impede the flow of air and aerosol through the hollow tubular substrate element. In particular, the longitudinal airflow channel is substantially free from tobacco material.

The provision of an aerosol-generating substrate in a tubular form advantageously enables the amount of tobacco material in the aerosol-generating substrate to be optimised so that aerosol can be efficiently generated from the aerosol-generating substrate upon heating. The tubular form also removes the central portion of homogenised tobacco material that would potentially not be heated as effectively as the outer portion, in particular, in an aerosol-generating device comprising external heating means. Overall, the amount of tobacco material can therefore be significantly reduced compared to conventional solid plugs of homogenised tobacco material

and tobacco waste can be reduced. For example, it has been found that the amount of tobacco material used in the hollow tubular substrate element of aerosol-generating articles according to the invention can be reduced by up to 40 percent compared to the amount of tobacco material used in the solid plug of substrate in a conventional aerosol-generating article, whilst retaining a similar delivery of aerosol to the consumer.

The amount of tobacco material provided in the substrate can be readily adapted through controlling the parameters of the hollow tubular substrate element, such as the density of the peripheral wall and the wall thickness. In this way, it is possible to adapt the hollow tubular substrate element so that it matches the heating zone of the associated aerosol-generating device. The proportion of the aerosol-generating substrate that can be heated to the necessary temperature for aerosol generation is therefore maximised so that the generation of aerosol from the aerosol-generating substrate is optimised.

The hollow tubular substrate element is formed by a plurality of overlapping layers of homogenised tobacco material. Preferably, the plurality of overlapping layers of homogenised tobacco material are directly overlying each other so that adjacent layers are in direct contact with each other, without intermediate layers. The plurality of overlapping layers of homogenised tobacco material can advantageously be arranged to define a plurality of voids between adjacent layers. As a result, the peripheral wall typically has a porous structure. As described in more detail below, the voids that are defined between adjacent layers of homogenised tobacco material can advantageously provide both transverse and longitudinal porosity so that aerosol generated upon heating of the aerosol-generating substrate is effectively released into the longitudinal airflow channel and flows through the channel mixed with external air, which is drawn through the article upon puffing by the consumer.

The multi-layered arrangement of the layers additionally provides a relatively dense structure which has sufficient structural rigidity to provide the aerosol-generating substrate in an aerosol-generating article without the need for any additional support, such as carrier layers or internal support members within the longitudinal airflow channel.

The provision of the longitudinal airflow channel having a diameter of at least about 3 millimetres also advantageously provides greater control over air flow management through the aerosol-generating article.

The hollow tubular substrate element has a relatively simple structure that can be produced in a straightforward and cost effective way, using existing apparatus. The hollow tubular substrate element can then be incorporated into aerosol-generating articles with other components, using known assembly methods and apparatus.

Advantageously, if desired, the hollow tubular substrate element can be incorporated directly into the aerosol-generating article without an outer wrapper. This provides a distinctive appearance and texture to the outer surface of the aerosol-generating substrate.

As described above, the hollow tubular substrate element forming the aerosol-generating substrate of aerosol-generating articles according to the invention is formed of a plurality of overlapping layers of homogenised tobacco material. The layers overlap with each other in a transverse direction in order to provide a multi-layered structure.

Preferably, the hollow tubular substrate element comprises at least about 2 overlapping layers of homogenised tobacco material, more preferably at least about 3 overlapping layers of homogenised tobacco material.

The hollow tubular substrate element preferably comprises up to about 10 overlapping layers of homogenised tobacco material, more preferably up to about 5 overlapping layers of homogenised tobacco material. For example, the hollow tubular substrate element may comprise between about 2 and about 10 overlapping layers of homogenised tobacco material, or between about 3 and about 5 overlapping layers of homogenised tobacco material.

As described above, the peripheral wall of the hollow tubular substrate element preferably has a porous structure as a result of the voids formed between overlapping layers of homogenised tobacco material. Preferably, the peripheral wall is porous both transversally and longitudinally.

Preferably, the peripheral wall of the hollow tubular substrate element has a cross-sectional porosity of at least about 0.3, more preferably at least about 0.35 and most preferably at least about 0.4.

Preferably, the peripheral wall has a cross-sectional porosity of up to about 0.7, more preferably up to about 0.65, most preferably up to about 0.6.

For example, the cross-sectional porosity of the peripheral wall may be between about 0.3 and about 0.7, or between about 0.35 and about 0.65 or between about 0.4 and about 0.6.

As used herein, the term “porosity” refers to a fraction of void space in an air permeable or porous body. Specifically, in the context of the present invention, the term “cross-sectional porosity” refers to the fraction of void space in a cross-sectional area of the peripheral wall of the hollow tubular substrate element. The cross-sectional porosity is the area fraction of void space in a transverse cross-sectional area of the peripheral wall. The transverse cross-sectional area of the peripheral wall is the area of the peripheral wall in a plane that is perpendicular to the longitudinal axis of the hollow tubular substrate element.

The cross-sectional porosity of the peripheral wall enables aerosol to pass in a transverse direction through the peripheral wall so that it can be drawn into and through the longitudinal airflow channel.

Further details relating to the measurement of cross-sectional porosity in a porous or air permeable body can be found in the publication of International patent application WO-A-2016/023965 in the name of the present applicant.

Advantageously, the transverse cross-sectional porosity may be determined using a digital imaging process. An image of a transverse cross-section of the hollow tubular substrate may be

obtained and a threshold may be applied to differentiate pixels that represent aerosol-forming substrate from pixels that represent void. The transverse cross-sectional porosity is calculated according to the equation: $P_o = N_{void}/ N_{tot}$ where P_o is the overall porosity of the transverse cross-sectional area, N_{void} is the number of pixels representing void space within the transverse cross-sectional area and N_{tot} is the total number of pixels in transverse cross-sectional area.

It is noted that the digital image acquisition may be done by any suitable method, for example by using digital cameras or computer tomography. The images may be represented by any suitable image format in full RGB (red-green-blue) colour, grey-scale, or binary (black and white) representations. Preferably the background in any image is uniform to facilitate the detection and removal of the background during image processing. The resolution of any image should be high enough to accurately resolve the morphology of the hollow tubular substrate.

Preferably, the peripheral wall of the hollow tubular substrate element has a density of at least about 200 milligrams per cubic centimetre, more preferably at least about 300 milligrams per cubic centimetre, more preferably at least about 400 milligrams per cubic centimetre, more preferably at least about 500 milligrams per cubic centimetre, more preferably at least about 600 milligrams per cubic centimetre, more preferably at least about 700 milligrams per cubic centimetre, more preferably at least about 800 milligrams per cubic centimetre,.

Preferably, the peripheral wall of the hollow tubular substrate element has a density of less than about 1 gram per cubic centimetre.

In the context of the present invention the “density” refers to the bulk density of the peripheral wall including the overlapping layers, rather than the density of the individual layers. The relatively high density of the peripheral wall maximises the amount of tobacco material that can be provided for a given length of the aerosol-generating substrate, so that the amount of aerosol generated from the hollow tubular substrate element can be maximised.

Preferably, the peripheral wall provides at least about 150 milligrams of homogenised tobacco material per centimetre of length of the hollow tubular substrate, more preferably at least about 200 milligrams of homogenised tobacco material per centimetre of length, more preferably at least about 300 milligrams of homogenised tobacco material per centimetre of length, more preferably at least about 400 milligrams of homogenised tobacco material per centimetre of length, more preferably at least about 500 milligrams of homogenised tobacco material per centimetre of length, more preferably at least about 600 milligrams of homogenised tobacco material per centimetre of length, more preferably at least about 700 milligrams of homogenised tobacco material per centimetre of length, more preferably at least about 800 milligrams of homogenised tobacco material per centimetre of length. This is based on a measurement taken at 22.5 degrees Celsius, 60 percent humidity.

Preferably, the longitudinal tensile strength of the hollow tubular substrate element, measured according to TAPPI test method T494 om-01 2006, is between 11 kNewtons per metre and 14 kNewtons per metre.

Preferably, the axial compressive strength of the hollow tubular substrate element, measured according to the test method described in ASTM D695-15 (2018), is between 7 MPa and 9 MPa.

Preferably, the radial compressive strength of the hollow tubular substrate element, measured according to the test method described in ASTM D2412-11 (2018), is between 7 MPa and 9 MPa.

Preferably, the hollow tubular substrate element has a length of at least about 10 millimetres, more preferably at least about 12 millimetres, more preferably at least about 15 millimetres.

Preferably, the hollow tubular substrate element has a length of up to about 40 millimetres, more preferably up to about 37 millimetres, more preferably up to about 35 millimetres.

For example, the hollow tubular substrate element may have a length of between about 10 millimetres and about 40 millimetres, or between about 12 millimetres and about 37 millimetres, or between about 15 millimetres and about 35 millimetres.

As discussed above, the length of the hollow tubular substrate element can advantageously be matched to the longitudinal dimensions of the heating element in the corresponding aerosol-generating device which will be used to heat the aerosol-generating article. In this way, as much as possible of the aerosol-generating substrate can be heated during use, in order to optimise the amount of aerosol that can be generated and reduce the amount of tobacco waste.

Preferably, the ratio of the length of the hollow tubular substrate element to the overall length of the aerosol-generating article is at least about 0.15. More preferably, the ratio of the length of the hollow tubular substrate element to the overall length of the aerosol-generating article is at least about 0.25. More preferably, the ratio of the length of the hollow tubular substrate element to the overall length of the aerosol-generating article is at least about 0.4.

Preferably, the ratio of the length of the hollow tubular substrate element to the overall length of the aerosol-generating article is up to about 0.6. More preferably, the ratio of the length of the hollow tubular substrate element to the overall length of the aerosol-generating article is up to about 0.55. More preferably, the ratio of the length of the hollow tubular substrate element to the overall length of the aerosol-generating article is up to about 0.5.

For example, the ratio of the length of the hollow tubular substrate element to the overall length of the aerosol-generating article may be between about 0.15 and about 0.6, more preferably between about 0.25 and about 0.55, more preferably between about 0.4 and about 0.5.

Preferably, the hollow tubular substrate element has an external diameter of at least about 4 millimetres, more preferably at least about 4.25 millimetres and more preferably at least about 4.5 millimetres.

Preferably, the hollow tubular substrate element has an external diameter of up to about 9 millimetres, more preferably up to about 8 millimetres and more preferably up to about 7.5 millimetres.

For example, the hollow tubular substrate element may have an external diameter of between about 4 millimetres and about 9 millimetres, or between about 4.25 millimetres and about 8 millimetres, or between about 4.5 millimetres and about 7.5 millimetres.

Preferably, the external diameter of the hollow tubular substrate element is substantially the same as the external diameter of the aerosol-generating article.

As described above, the hollow tubular substrate element provides a longitudinal airflow channel which is defined by the peripheral wall. The longitudinal airflow channel extends between the ends of the hollow tubular substrate element and is preferably open at both the upstream and downstream ends. The open upstream end provides the main air inlet for drawing air through the aerosol-generating article when the consumer puffs on the article. The longitudinal airflow channel therefore provides the main passageway for the flow of air and aerosol through the article.

Preferably, the hollow tubular substrate element provides an unrestricted flow channel. This means that the hollow tubular substrate element provides a negligible level of resistance to draw (RTD). The term “negligible level of RTD” is used to describe an RTD of less than 1 mm H_2O per 10 millimetres of length of the hollow tubular element, preferably less than 0.4 mm H_2O per 10 millimetres of length of the hollow tubular element, more preferably less than 0.1 mm H_2O per 10 millimetres of length of the hollow tubular element.

The longitudinal airflow channel has a diameter of at least 3 millimetres. This corresponds to the internal diameter of the hollow tubular substrate element. Preferably, the longitudinal airflow channel has a diameter of at least about 3.25 millimetres, more preferably at least about 3.5 millimetres.

Preferably, the longitudinal airflow channel has a diameter of up to about 7 millimetres, more preferably up to about 6 millimetres, more preferably up to about 5.5 millimetres.

For example, the longitudinal airflow channel may have a diameter of between about 3 millimetres and about 7 millimetres, or between about 3.25 millimetres and about 6 millimetres, or between about 3.5 millimetres and about 5.5 millimetres.

The provision of an airflow channel having a minimum diameter of 3 millimetres enables the volume of the channel to be sufficiently large that it provides a desired level of airflow, whilst also retaining a sufficient wall thickness. This is necessary so that there is a sufficient amount of tobacco material provided within the hollow tubular substrate element and so that the hollow tubular substrate element has a sufficiently high rigidity that it can be self-supporting.

The longitudinal airflow channel may have a constant diameter along the length of the hollow tubular substrate element. However, the diameter of the longitudinal airflow channel may vary along the length of the hollow tubular substrate element.

Preferably, the longitudinal airflow channel has a transverse cross-section that is substantially circular. Alternatively, the longitudinal airflow channel may have a transverse cross-section that is substantially oval.

Preferably, the ratio of the internal diameter to the external diameter of the hollow tubular substrate element is at least about 0.4, more preferably at least about 0.45 and more preferably at least about 0.5.

Preferably, the external diameter of the hollow tubular substrate element and the diameter of the longitudinal airflow channel are adapted to provide a desired wall thickness for the peripheral wall. Preferably, the peripheral wall has a wall thickness of at least about 1 millimetre, more preferably at least about 1.25 millimetres and more preferably at least about 1.5 millimetres.

Preferably, the peripheral wall has a wall thickness of up to about 2.25 millimetres, more preferably up to about 2 millimetres, more preferably up to about 1.8 millimetres.

For example, the peripheral wall may have a thickness of between 1 millimetre and about 2.25 millimetres, or between about 1.25 millimetres and about 2 millimetres, or between about 1.5 millimetres and about 1.8 millimetres.

The overlapping layers of homogenised tobacco material may be arranged in any suitable way in order to provide the desired wall thickness and porosity for the peripheral wall. Each layer of homogenised tobacco material will typically extend around the hollow tubular substrate element at least once and preferably, each layer of homogenised tobacco material extends around the hollow tubular substrate element a plurality of times to build up the structure of the peripheral wall.

Preferably, the plurality of layers of homogenised tobacco material are helically wound about the longitudinal axis of the hollow tubular substrate element. This provides a spiral wound structure that is similar to that the layered structure of conventional paper straws. Hollow tubular substrate elements incorporating a helical arrangement of layers for use in the present invention can be manufactured using existing straw making apparatus, such as the Hauni Straw Maker (HSM) from Hauni Maschinenbau GmbH.

The use of a spiral wound structure provides optimal structural strength to the hollow tubular substrate element, with increased mechanical strength in all directions compared to a similar structure with simple longitudinal wrapping. In addition, the helically wound arrangement enables a higher density of homogenised tobacco material to be obtained in the peripheral wall. The manufacturing method used to create the helical arrangement of layers additionally provides greater control over the dimensions of the hollow tubular substrate element, so that there is minimal variation in the external and internal diameter. This provides greater consistency between products.

The hollow tubular substrate element may optionally include an adhesive agent for sealing adjacent layers to each other. Suitable adhesive agents would be known to the skilled person. Preferably, the adhesive agent is a water based adhesive, for example, a water based starch adhesive or a polyvinyl alcohol (PVOH) adhesive.

In certain embodiments of the present invention, the aerosol-generating substrate may further comprise a sealing element at the upstream end of the hollow tubular substrate element which covers the upstream end of the hollow tubular substrate element. In such embodiments, the open upstream end of the hollow tubular substrate element is therefore covered and sealed closed by the sealing element, so that air cannot be drawn into the longitudinal airflow channel. The sealing element therefore needs to be adapted so that it can be removed or pierced prior to use, in order to open the upstream end of the hollow tubular substrate element and also air to enter the longitudinal airflow channel.

The peripheral wall of the hollow tubular substrate element, which is formed of the overlapping layers of homogenised tobacco material is preferably at least partially exposed on the outer surface of the hollow tubular substrate element. The hollow tubular substrate element is therefore preferably unwrapped along at least a part of its length. The outer surface of the peripheral wall should provide an acceptable surface to form the exterior of the aerosol-generating article and the layered structure may provide a distinctive appearance and texture.

Alternatively, the hollow tubular substrate element may be overwrapped with at least one wrapper. For example, the hollow tubular substrate element may be overwrapped with a conventional paper wrapper. The hollow tubular substrate element may be overwrapped with a tobacco containing wrapper, such as a tobacco paper wrapper.

The hollow tubular substrate element is formed of a plurality of layers of homogenised tobacco material, which are preferably in sheet form. As used herein with reference to the invention, the term “sheet” describes a laminar element having a width and length substantially greater than the thickness thereof.

The sheets may each individually have a thickness of between 100 micrometres and 600 micrometres, preferably between 150 micrometres and 300 micrometres, and most preferably between 200 micrometres and 250 micrometres.

The homogenised tobacco material comprises tobacco particles. Sheets of homogenised tobacco material for use in the invention may have a tobacco content of at least about 40 percent by weight on a dry weight basis, more preferably of at least about 50 percent by weight on a dry weight basis more preferably at least about 70 percent by weight on a dry weight basis and most preferably at least about 90 percent by weight on a dry weight basis.

With reference to the present invention, the term “tobacco particles” describes particles of any plant member of the genus *Nicotiana*. The term “tobacco particles” encompasses ground or powdered tobacco leaf lamina, ground or powdered tobacco leaf stems, tobacco dust, tobacco

fines, and other particulate tobacco by-products formed during the treating, handling and shipping of tobacco. In a preferred embodiment, the tobacco particles are substantially all derived from tobacco leaf lamina. By contrast, isolated nicotine and nicotine salts are compounds derived from tobacco but are not considered tobacco particles for purposes of the invention and are not included in the percentage of particulate plant material.

The homogenised tobacco material may further comprise one or more aerosol formers. Upon volatilisation, an aerosol former can convey other vaporised compounds released from the aerosol-generating substrate upon heating, such as nicotine and flavourants, in an aerosol. Suitable aerosol formers for inclusion in the homogenised plant material are known in the art and include, but are not limited to: polyhydric alcohols, such as triethylene glycol, propylene glycol, 1,3-butanediol and glycerol; 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.

The homogenised tobacco material may have an aerosol former content of between about 5 percent and about 30 percent by weight on a dry weight basis, such as between about 10 percent and about 25 percent by weight on a dry weight basis, or between about 15 percent and about 20 percent by weight on a dry weight basis. The aerosol former may act as a humectant in the homogenised tobacco material.

The two or more overlapping layers of homogenised tobacco material forming the peripheral wall of the hollow tubular substrate element may all be formed of the same homogenised tobacco material. Alternatively, the peripheral wall includes one or more layers of a first homogenised tobacco material and one or more layers of a second homogenised tobacco material that is different to the first homogenised tobacco material. The peripheral wall is therefore formed from a combination of at least two different homogenised tobacco materials. The first homogenised tobacco material and the second homogenised tobacco material may differ from each other in composition. For example, the first and second homogenised tobacco materials may have a different tobacco content to each other, or a different aerosol former content, or both. Alternatively or in addition, the first and second homogenised tobacco materials have be provided with different levels of flavourants in order to provide flavour profiles. Alternatively or in addition, the first homogenised tobacco material and the second homogenised tobacco material may differ from each other in one or more physical parameters including but not limited to density, porosity or thickness.

The use of different homogenised tobacco materials within the hollow tubular substrate element provides greater flexibility over delivery of the aerosol upon heating. For example, the composition of the first and second homogenised tobacco materials may be adapted to provide delivery of aerosol at different times or different rates. The use of different homogenised tobacco

materials can also provide improved stability, for example by avoiding the combination of potentially incompatible components.

Preferably, the plurality of layers of homogenised tobacco material includes one or more sheets of cast leaf.

Preferably, the cast leaf has a porosity of between about 20 and about 60 percent, more preferably between about 30 percent and about 50 percent, more preferably between about 35 percent and about 45 percent, at 25 degrees Celsius.

Alternatively or in addition to the one or more sheet of cast leaf, the plurality of layers of homogenised tobacco material may include one or more layers of cigarillo paper.

Preferably, the cigarillo paper has a porosity of between about 30 percent and about 80 percent, more preferably between about 40 percent and about 70 percent, more preferably between about 50 percent and about 60 percent, at 25 degrees Celsius.

The peripheral wall may be formed of alternating layers of cast leaf and cigarillo paper.

The hollow tubular substrate element of aerosol-generating articles according to the present invention preferably comprises one or more susceptor elements located in contact with the peripheral wall, for inductive heating of the homogenised tobacco material during use.

As used herein, the term 'susceptor element' refers to an element comprising a material that is capable of converting electromagnetic energy into heat. When a susceptor element is located in an alternating electromagnetic field, the susceptor is heated. Heating of the susceptor element may be the result of at least one of hysteresis losses and eddy currents induced in the susceptor, depending on the electrical and magnetic properties of the susceptor material.

A susceptor element may be arranged such that, when the aerosol-generating article is received in the cavity of the aerosol-generating device, the oscillating electromagnetic field generated by the inductor coil induces a current in the susceptor element, causing the susceptor element to heat up. In these embodiments, the aerosol-generating device is preferably capable of generating a fluctuating electromagnetic field having a magnetic field strength (H-field strength) of between 1 and 5 kilo amperes per metre (kA m), preferably between 2 and 3 kA/m, for example about 2.5 kA/m. The electrically-operated aerosol-generating device is preferably capable of generating a fluctuating electromagnetic field having a frequency of between 1 and 30 MHz, for example between 1 and 10 MHz, for example between 5 and 7 MHz.

The susceptor element may comprise any suitable material. The susceptor element may be formed from any material that can be inductively heated to a temperature sufficient to release volatile compounds from the aerosol-generating substrate. Suitable materials for the elongate susceptor element include graphite, molybdenum, silicon carbide, stainless steels, niobium, aluminium, nickel, nickel containing compounds, titanium, and composites of metallic materials. Some susceptor elements comprise a metal or carbon. Advantageously the susceptor element may comprise or consist of a ferromagnetic material, for example, ferritic iron, a ferromagnetic

alloy, such as ferromagnetic steel or stainless steel, ferromagnetic particles, and ferrite. A suitable susceptor element may be, or comprise, aluminium. The susceptor element preferably comprises more than about 5 percent, preferably more than about 20 percent, more preferably more than about 50 percent or more than about 90 percent of ferromagnetic or paramagnetic materials. Some elongate susceptor elements may be heated to a temperature in excess of about 250 degrees Celsius.

The susceptor element may comprise a non-metallic core with a metal layer disposed on the non-metallic core. For example, the susceptor element may comprise metallic tracks formed on an outer surface of a ceramic core or substrate.

Preferably, the hollow tubular substrate element comprises one or more susceptor elements on a surface of the peripheral wall. The hollow tubular substrate element may comprise one or more susceptor elements on the inner surface of the peripheral wall, within the longitudinal airflow channel. Alternatively or in addition, the hollow tubular substrate element may comprise one or more susceptor elements on the outer surface of the peripheral wall.

Preferably, the hollow tubular substrate element comprises a tubular susceptor element provided over at least one surface of the peripheral wall. The tubular susceptor element may be provided over the inner surface of the peripheral wall, to heat the hollow tubular substrate element internally. Alternatively, the tubular susceptor element may be provided over the outer surface of the hollow tubular substrate element to heat the hollow tubular substrate element externally.

The use of a tubular susceptor element advantageously optimises heating of the homogenised tobacco material within the peripheral wall, since the susceptor element is in contact with a relatively large surface area of the homogenised tobacco material. Due to the tubular form of the hollow tubular substrate element, the thickness of the substrate is relatively low so that heat can be transferred efficiently through the peripheral wall, from the side on which the tubular susceptor element is located.

As defined above, in the aerosol-generating articles of the present invention, the aerosol-generating substrate formed of the hollow tubular substrate element is combined with a downstream section, located downstream of the aerosol-generating substrate. The downstream section is preferably located immediately downstream of the aerosol-generating substrate. The downstream section of the aerosol-generating article preferably extends between the aerosol-generating substrate and the downstream end of the aerosol-generating article. The downstream section may comprise one or more elements, each of which will be described in more detail within the present disclosure.

Preferably, the downstream section comprises at least one hollow tubular element. The hollow tubular element may be provided immediately downstream of the aerosol-generating substrate. In other words, the hollow tubular element may abut a downstream end of the aerosol-generating substrate. This arrangement optimises flow of the aerosol from the longitudinal airflow

channel of the hollow tubular substrate element into the downstream section and through the aerosol-generating article.

Preferably, the downstream section of the aerosol-generating article comprises a single hollow tubular element. In other words, the downstream section of the aerosol-generating article may comprise only one hollow tubular element.

As used throughout the present disclosure, the “hollow tubular element” denotes a generally elongate element defining a lumen or airflow passage along a longitudinal axis thereof. In particular, the term "tubular" will be used in the following with reference to a tubular element having a substantially cylindrical cross-section and defining at least one airflow conduit establishing an uninterrupted fluid communication between an upstream end of the tubular element and a downstream end of the tubular element. However, it will be understood that alternative geometries (for example, alternative cross-sectional shapes) of the tubular element may be possible. The hollow tubular element may be an individual, discrete element of the aerosol-generating article which has a defined length and thickness.

In the context of the present invention, the hollow tubular element of the downstream section provides an unrestricted flow channel through the airflow passage. This means that the hollow tubular element provides a negligible level of resistance to draw (RTD), as defined above. The airflow passage should therefore be free from any components that would obstruct the flow of air in a longitudinal direction. Preferably, the airflow passage is substantially empty.

The hollow tubular element of the downstream section provides an empty cavity downstream of the aerosol-generating substrate, which enhances cooling and nucleation of aerosol particles generated by the aerosol-generating substrate. The hollow tubular element of the downstream section therefore functions as an aerosol-cooling element.

The length of the hollow tubular element may be at least about 12 mm. The length of the hollow tubular element may be at least about 15 mm. The length of the hollow tubular element may be at least about 20 mm.

The length of the hollow tubular element of the downstream section may be less than or equal to about 50 mm. The length of the hollow tubular element may be less than or equal to about 45 mm. The length of the hollow tubular element may be less than or equal to about 40 mm.

For example, the length of the hollow tubular element of the downstream section may be between about 12 mm and 50 mm. The length of the hollow tubular element may be between about 15 mm and 45 mm. The length of the hollow tubular element may be between about 20 mm and 40 mm. The length of the hollow tubular element may be about 30 mm.

A relatively long hollow tubular element provides and defines a relatively long internal cavity within the downstream section of the aerosol-generating article. Providing a relatively long

cavity maximises the nucleation benefits described above, thereby improving aerosol formation and cooling.

The ratio between the length of the hollow tubular substrate element and the length of the hollow tubular element of the downstream section may be less than or equal to about 1.25. Preferably, a ratio between the length of the hollow tubular substrate element and the length of the hollow tubular element of the downstream section may be less than or equal to about 1. More preferably, a ratio between the length of the hollow tubular substrate element and the length of the hollow tubular element of the downstream section may be less than or equal to about 0.75.

The ratio between the length of the hollow tubular substrate element and the length of the hollow tubular element of the downstream section may be at least about 0.25. Preferably, a ratio between the length of the hollow tubular substrate element and the length of the hollow tubular element of the downstream section may be at least about 0.30. More preferably, a ratio between the length of the hollow tubular substrate element and the length of the hollow tubular element of the downstream section may be at least about 0.40.

For example, the ratio between the length of the hollow tubular substrate element and the length of the hollow tubular element of the downstream section may be between about 0.25 and about 1.25, or between about 0.3 and about 1, or between about 0.4 and about 0.75.

The ratio between the length of the hollow tubular element of the downstream section and the total length of the downstream section may be less than or equal to about 1. Preferably, the ratio between the length of the hollow tubular element of the downstream section and the total length of the downstream section may be less than or equal to about 0.90. More preferably, the ratio between the length of the hollow tubular element of the downstream section and the total length of the downstream section may be less than or equal to about 0.85.

The ratio between the length of the hollow tubular element of the downstream section and the total length of the downstream section may be at least about 0.35. Preferably, the ratio between the length of the hollow tubular element of the downstream section and the total length of the downstream section may be at least about 0.45. More preferably, the ratio between the length of the hollow tubular element of the downstream section and the total length of the downstream section may be at least about 0.50.

For example, the ratio between the length of the hollow tubular element of the downstream section and the total length of the downstream section may be between about 0.35 and about 1, or between about 0.45 and about 0.9, or between about 0.5 and about 0.85.

The ratio between the length of the hollow tubular element of the downstream section and the overall length of the aerosol-generating article may be less than or equal to about 0.80. Preferably, the ratio between the length of the hollow tubular element of the downstream section and the overall length of the aerosol-generating article may be less than or equal to about 0.70. More preferably, the ratio between the length of the hollow tubular element of the downstream

section and the overall length of the aerosol-generating article may be less than or equal to about 0.60.

The ratio between the length of the hollow tubular element of the downstream section and the overall length of the aerosol-generating article may be at least about 0.25. Preferably, the ratio between the length of the hollow tubular element of the downstream section and the overall length of the aerosol-generating article may be at least about 0.30. More preferably, the ratio between the length of the hollow tubular element of the downstream section and the overall length of the aerosol-generating article may be at least about 0.40.

For example, the ratio between the length of the hollow tubular element of the downstream section and the overall length of the aerosol-generating article may be between about 0.25 and about 0.8, or between about 0.3 and about 0.7, or between about 0.4 and about 0.6.

The wall thickness of the hollow tubular element of the downstream section may be at least about 100 micrometres. The wall thickness of the hollow tubular element of the downstream section may be at least about 150 micrometres. The wall thickness of the hollow tubular element of the downstream section may be at least about 200 micrometres, preferably at least about 250 micrometres and even more preferably at least about 500 micrometres (or 0.5 mm).

The wall thickness of the hollow tubular element of the downstream section may be less than or equal to about 2 millimetres, preferably less than or equal to about 1.5 millimetres and even more preferably less than or equal to about 1.25 mm. The wall thickness of the hollow tubular element of the downstream section may be less than or equal to about 1 millimetre. The wall thickness of the hollow tubular element of the downstream section may be less than or equal to about 500 micrometres.

The wall thickness of the hollow tubular element of the downstream section may between about 100 micrometres and about 2 millimetres, preferably between about 150 micrometres and about 1.5 millimetres, even more preferably between about 200 micrometres and about 1.25 millimetres.

Keeping the wall thickness of the hollow tubular element of the downstream section relatively low ensures that the overall internal volume of the hollow tubular element – which is made available for the aerosol to begin the nucleation process as soon as the aerosol components leave the aerosol-generating substrate – and the cross-sectional surface area of the longitudinal airflow channel of the hollow tubular element are effectively maximised, whilst at the same time ensuring that the hollow tubular element has the necessary structural strength to prevent a collapse of the aerosol-generating article as well as to provide some support to the rod of aerosol-generating substrate, and that the RTD of the hollow tubular element is minimised. Greater values of cross-sectional surface area of the cavity of the hollow tubular element are understood to be associated with a reduced speed of the aerosol stream travelling along the aerosol-generating article, which is also expected to favour aerosol nucleation. Further, it would

appear that by utilising a hollow tubular element having a relatively low thickness, it is possible to substantially prevent diffusion of the ventilation air prior to its contacting and mixing with the stream of aerosol, which is also understood to further favour nucleation phenomena. In practice, by providing a more controllably localised cooling of the stream of volatilised species, it is possible to enhance the effect of cooling on the formation of new aerosol particles.

The hollow tubular element of the downstream section preferably has an outer diameter that is approximately equal to the outer diameter of the aerosol-generating substrate and to the outer diameter of the aerosol-generating article.

The hollow tubular element may have an outer diameter of between 5 millimetres and 12 millimetres, for example of between 5 millimetres and 10 millimetres or of between 6 millimetres and 8 millimetres. Preferably, the hollow tubular element has an external diameter of 7.2 millimetres plus or minus 10 percent.

The hollow tubular element of the downstream section may have a constant internal diameter along a length of the hollow tubular element. However, the internal diameter of the hollow tubular element may vary along the length of the hollow tubular element.

The hollow tubular element of the downstream section may have an internal diameter of at least about 2 millimetres. For example, the hollow tubular element may have an internal diameter of at least about 2.5 millimetres, at least about 3 millimetres, or at least about 3.5 millimetres. The provision of a hollow tubular element having an internal diameter as set out above may advantageously provide sufficient rigidity and strength to the hollow tubular element.

The hollow tubular element of the downstream section may have an internal diameter of no more than about 10 millimetres. For example, the hollow tubular element may have an internal diameter of no more than about 9 millimetres, no more than about 8 millimetres, or no more than about 7.5 millimetres. The provision of a hollow tubular element having an internal diameter as set out above may advantageously reduce the resistance to draw of the hollow tubular element.

For example, the hollow tubular element of the downstream section may have an internal diameter of between about 2 millimetres and about 10 millimetres, between about 2.5 millimetres and about 9 millimetres, between about 3 millimetres and about 8 millimetres, or between about 3.5 millimetres and about 7.5 millimetres.

The ratio of the internal diameter of the hollow tubular substrate element to the internal diameter of the hollow tubular element of the downstream section is preferably between about 0.8 and about 1.2, more preferably between about 0.9 and about 1.1, most preferably about 1.

Particularly preferably, the internal diameter of the hollow tubular substrate element is substantially equal to the internal diameter of the hollow tubular element of the downstream section.

The hollow tubular element of the downstream section may comprise a paper-based material. The hollow tubular element may comprise at least one layer of paper. The paper may

be very rigid paper. The paper may be crimped paper, such as crimped heat resistant paper or crimped parchment paper.

Preferably, the hollow tubular element may comprise cardboard. The hollow tubular element may be a cardboard tube. The hollow tubular element may be formed from cardboard. Advantageously, cardboard is a cost-effective material that provides a balance between being deformable in order to provide ease of insertion of the article into an aerosol-generating device and being sufficiently stiff to provide suitable engagement of the article with the interior of the device. A cardboard tube may therefore provide suitable resistance to deformation or compression during use.

The hollow tubular element may be a paper tube. The hollow tubular element may be a tube formed from spirally wound paper. The hollow tubular element may be formed from a plurality of layers of the paper. The paper may have a basis weight of at least about 50 grams per square meter, at least about 60 grams per square meter, at least about 70 grams per square meter, or at least about 90 grams per square meter.

The hollow tubular element of the downstream section may comprise a polymeric material. For example, the hollow tubular element may comprise a polymeric film. The polymeric film may comprise a cellulosic film. The hollow tubular element may comprise low density polyethylene (LDPE) or polyhydroxyalkanoate (PHA) fibres. The hollow tube may comprise cellulose acetate tow.

Where the hollow tubular element comprises cellulose acetate tow, the cellulose acetate tow may have a denier per filament of between about 2 and about 4 and a total denier of between about 25 and about 40.

In some embodiments, the aerosol-generating article according to the present invention may comprise a ventilation zone at a location along the downstream section. In more detail, in those embodiments wherein the downstream section comprises a hollow tubular element, the ventilation zone may be provided at a location along the hollow tubular element.

As such, a ventilated cavity is provided downstream of the rod of aerosol-generating substrate. This provides particularly efficient cooling of the aerosol and promotes enhanced nucleation of aerosol particles.

The ventilation zone may typically comprise a plurality of perforations through the peripheral wall of the hollow tubular element. Preferably, the ventilation zone comprises at least one circumferential row of perforations. In some embodiments, the ventilation zone may comprise two circumferential rows of perforations. For example, the perforations may be formed online during manufacturing of the aerosol-generating article. Preferably, each circumferential row of perforations comprises from 8 to 30 perforations.

The downstream section may further comprise a mouthpiece element. The mouthpiece element may be located at the downstream end of the aerosol-generating article. The mouthpiece

element is preferably located downstream of the hollow tubular element of the downstream section, which is described above. The mouthpiece element may extend between the hollow tubular element of the downstream section and the downstream end of the aerosol-generating article.

The provision of a mouthpiece element at the downstream end of the aerosol-generating articles according to the present invention provides an appealing appearance and mouthfeel to the consumer.

The mouthpiece element may comprise at least one mouthpiece filter segment formed of a fibrous filtration material. Parameters or characteristics described in relation to the mouthpiece element as a whole may equally be applied to a mouthpiece filter segment of the mouthpiece element.

The fibrous filtration material may be for filtering the aerosol that is generated from the aerosol-generating substrate. Suitable fibrous filtration materials would be known to the skilled person. Particularly preferably, the at least one mouthpiece filter segment comprises a cellulose acetate filter segment formed of cellulose acetate tow.

The mouthpiece element may consist of a single mouthpiece filter segment. The mouthpiece element may include two or more mouthpiece filter segments axially aligned in an abutting end to end relationship with each other.

The downstream section may comprise a mouth end cavity at the downstream end, downstream of the mouthpiece element as described above. The mouth end cavity may be defined by a further hollow tubular element provided at the downstream end of the mouthpiece element. The mouth end cavity may be defined by an outer wrapper of the aerosol-generating article, wherein the outer wrapper extends in a downstream direction from (or past) the mouthpiece element.

The mouthpiece element may optionally comprise a flavourant, which may be provided in any suitable form. For example, the mouthpiece element may comprise one or more capsules, beads or granules of a flavourant, or one or more flavour loaded threads or filaments.

Preferably, the mouthpiece element, or mouthpiece filter segment thereof, has a low particulate filtration efficiency.

Preferably, the mouthpiece element is circumscribed by a plug wrap. Preferably, the mouthpiece element is unventilated such that air does not enter the aerosol-generating article along the mouthpiece element.

The mouthpiece element preferably has an external diameter that is approximately equal to the external diameter of the aerosol-generating article. The diameter of a mouthpiece element (or mouthpiece filter segment) may be substantially the same as the outer diameter of the hollow tubular element. As mentioned in the present disclosure, the outer diameter of the hollow tubular element may be about 7.2mm, plus or minus 10 percent.

The diameter of the mouthpiece element may be between about 5 mm and about 10 mm. The diameter of the mouthpiece element may be between about 6 mm and about 8 mm. The diameter of the mouthpiece element may be between about 7 mm and about 8 mm. The diameter of the mouthpiece element may be about 7.2 mm, plus or minus 10 percent. The diameter of the mouthpiece element may be about 7.25 mm, plus or minus 10 percent.

Unless otherwise specified, the resistance to draw (RTD) of a component or the aerosol-generating article is measured in accordance with ISO 6565-2015. The RTD refers the pressure required to force air through the full length of a component. The terms “pressure drop” or “draw resistance” of a component or article may also refer to the “resistance to draw”. Such terms generally refer to the measurements in accordance with ISO 6565-2015 are normally carried out at under test at a volumetric flow rate of about 17.5 millilitres per second at the output or downstream end of the measured component at a temperature of about 22 degrees Celsius, a pressure of about 101 kPa (about 760 Torr) and a relative humidity of about 60%.

The resistance to draw (RTD) of the downstream section may be at least about 0 mm H_2O. The RTD of the downstream section may be at least about 3 mm H_2O. The RTD of the downstream section may be at least about 6 mm H_2O.

The RTD of the downstream section may be no greater than about 12 mm H_2O. The RTD of the downstream section may be no greater than about 11 mm H_2O. The RTD of the downstream section may be no greater than about 10 mm H_2O.

The resistance to draw of the downstream section may be greater than or equal to about 0 mm H_2O and less than about 12 mm H_2O. Preferably, the resistance to draw of the downstream section may be greater than or equal to about 3 mm H_2O and less than about 12 mm H_2O. The resistance to draw of the downstream section may be greater than or equal to about 0 mm H_2O and less than about 11 mm H_2O. Even more preferably, the resistance to draw of the downstream section may be greater than or equal to about 3 mm H_2O and less than about 11 mm H_2O. Even more preferably, the resistance to draw of the downstream section may be greater than or equal to about 6 mm H_2O and less than about 10 mm H_2O. Preferably, the resistance to draw of the downstream section may be about 8 mm H_2O.

The resistance to draw (RTD) characteristics of the downstream section may be wholly or mostly attributed to the RTD characteristics of the mouthpiece element of the downstream section. In other words, the RTD of the mouthpiece element of the downstream section may wholly define the RTD of the downstream section.

The resistance to draw (RTD) of the mouthpiece element may be at least about 0 mm H_2O. The RTD of the mouthpiece element may be at least about 3 mm H_2O. The RTD of the mouthpiece element may be at least about 6 mm H_2O.

The RTD of the mouthpiece element may be no greater than about 12 mm H_2O. The RTD of the mouthpiece element may be no greater than about 11 mm H_2O. The RTD of the mouthpiece element may be no greater than about 10 mm H_2O.

The resistance to draw of the mouthpiece element may be greater than or equal to about 0 mm H_2O and less than about 12 mm H_2O. Preferably, the resistance to draw of the mouthpiece element may be greater than or equal to about 3 mm H_2O and less than about 12 mm H_2O. The resistance to draw of the mouthpiece element may be greater than or equal to about 0 mm H_2O and less than about 11 mm H_2O. Even more preferably, the resistance to draw of the mouthpiece element may be greater than or equal to about 3 mm H_2O and less than about 11 mm H_2O. Even more preferably, the resistance to draw of the mouthpiece element may be greater than or equal to about 6 mm H_2O and less than about 10 mm H_2O. Preferably, the resistance to draw of the mouthpiece element may be about 8 mm H_2O.

As mentioned above, the mouthpiece element, or mouthpiece filter segment, may be formed of a fibrous material. The mouthpiece element may be formed of a porous material. The mouthpiece element may be formed of a biodegradable material. The mouthpiece element may be formed of a cellulose material, such as cellulose acetate. For example, a mouthpiece element may be formed from a bundle of cellulose acetate fibres having a denier per filament between about 10 and about 15. For example, a mouthpiece element formed from relatively low density cellulose acetate tow, such as cellulose acetate tow comprising fibres of about 12 denier per filament.

The mouthpiece element may be formed of a polylactic acid based material. The mouthpiece element may be formed of a bioplastic material, preferably a starch-based bioplastic material. The mouthpiece element may be made by injection moulding or by extrusion. Bioplastic-based materials are advantageous because they are able to provide mouthpiece element structures which are simple and cheap to manufacture with a particular and complex cross-sectional profile, which may comprise a plurality of relatively large air flow channels extending through the mouthpiece element material, that provides suitable RTD characteristics.

The mouthpiece element may be formed from a sheet of suitable material that has been crimped, pleated, gathered, woven or folded into an element that defines a plurality of longitudinally extending channels. Such sheet of suitable material may be formed of paper, cardboard, a polymer, such as polylactic acid, or any other cellulose-based, paper-based material or bioplastic-based material. A cross-sectional profile of such a mouthpiece element may show the channels as being randomly oriented.

The mouthpiece element may be formed in any other suitable manner. For example, the mouthpiece element may be formed from a bundle of longitudinally extending tubes. The longitudinally extending tubes may be formed from polylactic acid. The mouthpiece element may be formed by extrusion, moulding, lamination, injection, or shredding of a suitable material. Thus,

it is preferred that there is a low-pressure drop (or RTD) from an upstream end of the mouthpiece element to a downstream end of the mouthpiece element.

The length of the mouthpiece element may be at least about 1.5 mm. The length of the mouthpiece element may be at least about 2 mm. The length of the mouthpiece element may equal to or less than about 7 mm. The length of the mouthpiece element may be equal to or less than about 4 mm. For example, the length of the mouthpiece element may be between about 1.5 mm and about 7 mm. The length of the mouthpiece element may be between about 2 millimetres and about 4 millimetres.

The ratio between the length of the mouthpiece element and the length of the downstream section may be less than or equal to about 0.35. Preferably, the ratio between the length of the mouthpiece element and the length of the downstream section may be less than or equal to about 0.30. More preferably, the ratio between a length of the mouthpiece element and the length of the downstream section may be less than or equal to about 0.25.

The ratio between the length of the mouthpiece element and the length of the downstream section may be at least about 0.03. Preferably, the ratio between a length of the mouthpiece element and the length of the downstream section may be at least about 0.05. More preferably, the ratio between the length of the mouthpiece element and the length of the downstream section may be at least about 0.1.

For example, the ratio between the length of the mouthpiece element and the length of the downstream section is from about 0.03 to about 0.35, preferably from about 0.05 to about 0.30, more preferably from about 0.1 to about 0.25.

The ratio between the length of the mouthpiece element and the overall length of the aerosol-generating article may be less than or equal to about 0.20. Preferably, the ratio between the length of the mouthpiece element and the overall length of the aerosol-generating article may be less than or equal to about 0.15. More preferably, the ratio between a length of the mouthpiece element and the overall length of the aerosol-generating article may be less than or equal to about 0.1.

The ratio between the length of the mouthpiece element and the overall length of the aerosol-generating article may be at least about 0.01. Preferably, the ratio between the length of the mouthpiece element and the overall length of the aerosol-generating article may be at least about 0.02. More preferably, the ratio between the length of the mouthpiece element and the overall length of the aerosol-generating article may be at least about 0.05.

For example, the ratio between the length of the mouthpiece element and the overall length of the aerosol-generating article is from about 0.01 to about 0.2, preferably from about 0.02 to about 0.15, more preferably from about 0.05 to about 0.1.

In embodiments where the downstream section comprises a hollow tubular element and a mouthpiece element, a ratio of the length of the hollow tubular element to the length of the

mouthpiece element may be at least about 1.5. In other words, the length of the hollow tubular element may be at least about 150% of the length of the mouthpiece element. The ratio of the length of the hollow tubular element to the length of the mouthpiece element may be at least about 5. The ratio of the length of the hollow tubular element to the length of the mouthpiece element may be at least about 7.5.

The ratio of the length of the hollow tubular element to the length of the mouthpiece element may be equal to or less than about 20. The ratio of the length of the hollow tubular element to the length of the mouthpiece element may be equal to or less than about 15. The ratio of the length of the hollow tubular element to the length of the mouthpiece element may be equal to or less than about 12.5.

For example, the ratio of the length of the hollow tubular element to the length of the mouthpiece element may be between about 1.5 and about 20, or between about 5 and about 15, or between about 7.5 and about 10.

The overall length of the downstream section is preferably at least about 15 millimetres, more preferably at least about 20 millimetres, more preferably at least about 25 millimetres.

The overall length of the downstream section is preferably less than about 50 millimetres, more preferably less than about 45 millimetres, more preferably less than about 40 millimetres.

For example, the downstream section may have an overall length of between about 20 millimetres and about 50 millimetres, more preferably between about 25 millimetres and about 45 millimetres, more preferably between about 30 millimetres and about 40 millimetres.

The ratio between the total length of the downstream section and an overall length of the aerosol-generating article may be less than or equal to about 0.80. Preferably, the ratio between the length of the downstream section and an overall length of the aerosol-generating article may be less than or equal to about 0.75. More preferably, the ratio between the length of the downstream section and the overall length of the aerosol-generating article may be less than or equal to about 0.70. Even more preferably, the ratio between the length of the downstream section and the overall length of the aerosol-generating article may be less than or equal to about 0.65.

The ratio between the length of the downstream section and the overall length of the aerosol-generating article may be at least about 0.30. Preferably, the ratio between the length of the downstream section and the overall length of the aerosol-generating article may be at least about 0.40. More preferably, the ratio between a length of the downstream section and the overall length of the aerosol-generating article may be at least about 0.50. Even more preferably, the ratio between a length of the downstream section and the overall length of the aerosol-generating article may be at least about 0.60.

Preferably, an overall length of an aerosol-generating article in accordance with the invention is at least about 35 millimetres. More preferably, an overall length of an aerosol-

generating article in accordance with the invention is at least about 40 millimetres. Even more preferably, an overall length of an aerosol-generating article in accordance with the invention is at least about 45 millimetres. Even more preferably, an overall length of an aerosol-generating article in accordance with the invention is at least about 50 millimetres.

An overall length of an aerosol-generating article in accordance with the invention is preferably less than or equal to 110 millimetres. More preferably, an overall length of an aerosol-generating article in accordance with the invention is preferably less than or equal to 100 millimetres. Even more preferably, an overall length of an aerosol-generating article in accordance with the invention is preferably less than or equal to 75 millimetres. Even more preferably, an overall length of an aerosol-generating article in accordance with the invention is preferably less than or equal to 70 millimetres.

For example, the overall length of the aerosol-generating article may be between about 35 millimetres and about 110 millimetres, or between about 40 millimetres and about 100 millimetres, or between about 45 millimetres and about 75 millimetres, or between about 50 millimetres and about 70 millimetres.

The aerosol-generating article preferably has an external diameter of at least 4 millimetres. Preferably, the aerosol-generating article has an external diameter of at least 4.5 millimetres. More preferably, the aerosol-generating article has an external diameter of at least 5 millimetres.

Preferably, the aerosol-generating article has an external diameter of less than or equal to about 9 millimetres. More preferably, the aerosol-generating article has an external diameter of less than or equal to about 8 millimetres. Even more preferably, the aerosol-generating article has an external diameter of less than or equal to about 7 millimetres.

For example, the aerosol-generating article may have an external diameter of between about 4 millimetres and about 9 millimetres, or between about 4.5 millimetres and about 8 millimetres, or between about 5 millimetres and about 7 millimetres.

The external diameter of the aerosol-generating article may be substantially constant over the whole length of the article. As an alternative, different portions of the aerosol-generating article may have different external diameters.

In certain embodiments of the present invention, one or more of the components of the aerosol-generating article are individually circumscribed by their own wrapper.

Preferably, the aerosol-generating substrate and the downstream section are combined together with an outer wrapper, such as a tipping wrapper.

Preferably, the components of the aerosol-generating article according to the present invention are made from biodegradable materials.

Preferably, the aerosol-generating articles according to the present invention as described herein are adapted for use in electrically-operated aerosol-generating systems in which the

aerosol-generating substrate of the heated aerosol-generating article is heated by an electrical heat source.

The heating element of such aerosol-generating devices may be of any suitable form to conduct heat. The heating of the aerosol-generating substrate may be achieved internally, externally or both. The heating element may preferably be a heater blade or pin adapted to be inserted into the substrate so that the substrate is heated from inside. The heating element may partially or completely surround the substrate and externally heat the substrate circumferentially from the outside.

The aerosol-generating system may be an electrically-operated aerosol generating system comprising an inductive heating device. Inductive heating devices typically comprise an induction source that is configured to be coupled to a susceptor, which may be provided externally to the aerosol-generating substrate or internally within the aerosol-generating substrate, as in certain embodiments of the present invention described above. The induction source generates an alternating electromagnetic field that induces magnetization or eddy currents in the susceptor. The susceptor may be heated as a result of hysteresis losses or induced eddy currents which heat the susceptor through ohmic or resistive heating.

Electrically operated aerosol-generating systems comprising an inductive heating device may also comprise the aerosol-generating article having the aerosol-generating substrate and a susceptor in thermal proximity to the aerosol-generating substrate. Typically, the susceptor is in direct contact with the aerosol-generating substrate and heat is transferred from the susceptor to the aerosol-generating substrate primarily by conduction. Examples of electrically operated aerosol-generating systems having inductive heating devices and aerosol-generating articles having susceptors are described in WO-A1-95/27411 and WO-A1-2015/177255.

The electrically operated aerosol-generating system may in some cases comprise an aerosol-generating article as defined above, a source of aerosol former and a means to vaporise the aerosol former, preferably a heating element. The source of aerosol former can be a reservoir, which can be refillable or replaceable, that resides on the aerosol generating device. While the reservoir is physically separate from the aerosol generating article, the vapour that is generated is directed through the aerosol-generating article. The vapour makes contact with the aerosol-generating substrate which releases volatile compounds, such as nicotine and flavorants in the particulate plant material, to form an aerosol. Optionally, to aid volatilization of compounds in the aerosol-generating substrate, the aerosol-generating system may further comprise a heating element to heat the aerosol-generating substrate, preferably in a co-ordinated manner with the aerosol former. However, in certain embodiments, the heating element used to heat the aerosol generating article is separate from the heater that heats the aerosol former.

As described above, the hollow tubular substrate element of aerosol-generating articles according to the invention can advantageously be adapted such that the length substantially

matches the longitudinal dimensions of the heating element of the aerosol-generating system which is intended to be used to heat the aerosol-generating article. This ensures that the hollow tubular substrate element is heated along substantially its full length, so that the generation of aerosol from the aerosol-generating substrate can be maximised.

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.

EX 1. An aerosol-generating article comprising: an aerosol-generating substrate comprising a hollow tubular substrate element having a multi-layered peripheral wall defining a longitudinal airflow channel, wherein the peripheral wall is formed of a plurality of overlapping layers of homogenised tobacco material; and a downstream section provided downstream of the aerosol-generating substrate.

EX2. An aerosol-generating article according to example EX1, wherein the longitudinal airflow channel has a diameter of at least 3 millimetres.

EX3. An aerosol-generating article according to example EX1 or EX2, wherein the hollow tubular substrate element comprises at least 2 overlapping layers of homogenised tobacco material.

EX4. An aerosol-generating article according to any of the preceding examples, wherein the hollow tubular substrate element comprises up to 10 overlapping layers of homogenised tobacco material.

EX5. An aerosol-generating article according to any of the preceding examples, wherein the peripheral wall of the hollow tubular substrate element has a cross-sectional porosity of at least about 0.3.

EX6. An aerosol-generating article according to any of the preceding examples, wherein the peripheral wall of the hollow tubular substrate element has a cross-sectional porosity of at least about 0.7.

EX7. An aerosol-generating article according to any of the preceding examples, wherein the peripheral wall of the hollow tubular substrate element has a density of at least 200 milligrams per cubic centimetre.

EX8. An aerosol-generating article according to any of the preceding examples, wherein the peripheral wall of the hollow tubular substrate element has a density of less than 1 gram per cubic centimetre.

EX9. An aerosol-generating article according to any of the preceding examples, wherein the peripheral wall of the hollow tubular substrate element provides at least 150 milligrams of homogenised tobacco material per centimetre of length of the hollow tubular substrate.

EX10. An aerosol-generating article according to any of the preceding examples, wherein the longitudinal tensile strength of the hollow tubular substrate element is between 11 kNewtons per metre and 14 kNewtons per metre.

EX11. An aerosol-generating article according to any of the preceding examples, wherein the axial compressive strength of the hollow tubular substrate element is between 7 MPa and 9 MPa.

EX12. An aerosol-generating article according to any of the preceding examples, wherein the radial compressive strength of the hollow tubular substrate element is between 7 MPa and 9 MPa.

EX13. An aerosol-generating article according to any of the preceding examples, wherein the hollow tubular substrate element has a length of up to 40 millimetres.

EX14. An aerosol-generating article according to any of the preceding examples, wherein the hollow tubular substrate element has a length of at least 10 millimetres.

EX15. An aerosol-generating article according to any of the preceding examples, wherein the ratio of the length of the hollow tubular substrate element to the overall length of the aerosol-generating article is at least 0.15.

EX16. An aerosol-generating article according to any of the preceding examples, wherein the ratio of the length of the hollow tubular substrate element to the overall length of the aerosol-generating article is up to 0.6.

EX17. An aerosol-generating article according to any of the preceding examples, wherein the hollow tubular substrate element has an external diameter of at least 4 millimetres.

EX18. An aerosol-generating article according to any of the preceding examples, wherein the hollow tubular substrate element has an external diameter of up to 9 millimetres.

EX19. An aerosol-generating article according to any of the preceding examples, wherein the hollow tubular substrate element provides an unrestricted flow channel.

EX20. An aerosol-generating article according to any of the preceding examples, wherein the longitudinal airflow channel of the hollow tubular substrate element has a diameter of up to 7 millimetres.

EX21. An aerosol-generating article according to any of the preceding examples, wherein the ratio of the internal diameter to the external diameter of the hollow tubular substrate element is at least 0.4.

EX22. An aerosol-generating article according to any of the preceding examples, wherein the peripheral wall has a wall thickness of at least 1 millimetre.

EX23. An aerosol-generating article according to any of the preceding examples, wherein the peripheral wall has a wall thickness of at up to 2.25 millimetres.

EX24. An aerosol-generating article according to any of the preceding examples, wherein the plurality of layers of homogenised tobacco material are helically wound about the longitudinal axis of the hollow tubular substrate element.

EX25. An aerosol-generating article according to any of the preceding examples, wherein the hollow tubular substrate element further comprises an adhesive agent for sealing adjacent layers to each other.

EX26. An aerosol-generating article according to any of the preceding examples, wherein the aerosol-generating substrate further comprises a sealing element at the upstream end of the hollow tubular substrate element, covering the upstream end of the hollow tubular substrate element.

EX27. An aerosol-generating article according to any of the preceding examples, wherein the homogenised tobacco material has a tobacco content of at least 40 percent by weight on a dry weight basis.

EX28. An aerosol-generating article according to any of the preceding examples, wherein the homogenised tobacco material further comprises one or more aerosol former.

EX29. An aerosol-generating article according to example EX28, wherein the homogenised tobacco material has an aerosol former content of between 5 percent and 30 percent by weight on a dry weight basis.

EX30. An aerosol-generating article according to any of the preceding examples, wherein the peripheral wall includes one or more layers of a first homogenised tobacco material and one or more layers of a second homogenised tobacco material that is different to the first homogenised tobacco material.

EX31. An aerosol-generating article according to example EX30, wherein the first and second homogenised tobacco materials have a different tobacco content to each other.

EX32. An aerosol-generating article according to example EX30 or EX31, wherein the first and second homogenised tobacco materials have or a different aerosol former content to each other.

EX33. An aerosol-generating article according to any of the preceding examples, wherein the plurality of layers of homogenised tobacco material includes one or more sheets of cast leaf.

EX34. An aerosol-generating article according to example EX33, wherein the cast leaf has a porosity of between 20 percent and 60 percent.

EX35. An aerosol-generating article according to any of the preceding examples, wherein the plurality of layers of homogenised tobacco material includes one or more layers of cigarillo paper.

EX36. An aerosol-generating article according to example EX35, wherein the cigarillo paper has a porosity of between 30 percent and 80 percent.

EX37. An aerosol-generating article according to any of the preceding examples, wherein the hollow tubular substrate element comprises one or more susceptor elements located in contact with the peripheral wall.

EX38. An aerosol-generating article according to example EX37, wherein the hollow tubular substrate element comprises one or more susceptor elements on a surface of the peripheral wall.

EX39. An aerosol-generating article according to example EX38, wherein the hollow tubular substrate element comprises a tubular susceptor element provided over at least one surface of the peripheral wall.

EX40. An aerosol-generating article according to any of the preceding examples, wherein the downstream section comprises a hollow tubular element.

EX41. An aerosol-generating article according to example EX40, wherein the length of the hollow tubular element of the downstream section is between 12 mm and 50 mm.

EX42. An aerosol-generating article according to example EX40 or EX41, wherein the ratio between the length of the hollow tubular substrate element and the length of the hollow tubular element of the downstream section is at least 0.25.

EX43. An aerosol-generating article according to any of examples EX40 to EX42, wherein the ratio between the length of the hollow tubular substrate element and the length of the hollow tubular element of the downstream section is less than or equal to 1.25.

EX44. An aerosol-generating article according to any of examples EX40 to EX43, wherein the ratio between the length of the hollow tubular element of the downstream section and the total length of the downstream section is at least 0.35.

EX45. An aerosol-generating article according to any of examples EX40 to EX44, wherein the ratio between the length of the hollow tubular element of the downstream section and the total length of the downstream section is less than or equal to 1.

EX46. An aerosol-generating article according to any of examples EX40 to EX45, wherein the ratio between the length of the hollow tubular element of the downstream section and the overall length of the aerosol-generating article is at least 0.25.

EX47. An aerosol-generating article according to any of examples EX40 to EX46, wherein the ratio between the length of the hollow tubular element of the downstream section and the overall length of the aerosol-generating article is less than or equal to 0.8.

EX48. An aerosol-generating article according to any of examples EX40 to EX47, wherein the wall thickness of the hollow tubular element of the downstream section is at least 100 micrometres.

EX49. An aerosol-generating article according to any of examples EX40 to EX48, wherein the wall thickness of the hollow tubular element of the downstream section is less than or equal to 2 millimetres.

EX50. An aerosol-generating article according to any of examples EX40 to EX49, wherein the hollow tubular element of the downstream section has an internal diameter of between 2 millimetres and 10 millimetres.

EX51. An aerosol-generating article according to any of examples EX40 to EX50, wherein the ratio of the internal diameter of the hollow tubular substrate element to the internal diameter of the hollow tubular element of the downstream section is between 0.8 and 1.2.

EX52. An aerosol-generating article according to any of the preceding examples, wherein the downstream section further comprises a mouthpiece element.

EX53. An aerosol-generating article according to example EX52, wherein the mouthpiece element comprises at least one segment of a fibrous filtration material.

EX54. An aerosol-generating article according to example EX52 or EX53, wherein the downstream section comprises a mouth end cavity at the downstream end, downstream of the mouthpiece element.

EX55. An aerosol-generating article according to any of the examples EX52 to EX54, wherein the length of the mouthpiece element is between 1.5 mm and 7 mm.

EX56. An aerosol-generating article according to any of the examples EX52 to EX55, wherein ratio between the length of the mouthpiece element and the length of the downstream section is less than or equal to 0.35.

EX57. An aerosol-generating article according to any of the examples EX52 to EX56, wherein the ratio between the length of the mouthpiece element and the overall length of the aerosol-generating article is less than or equal to 0.20.

EX58. An aerosol-generating article according to any of the preceding examples, wherein the RTD of the downstream section is no greater than 12 mm H_2O.

EX59. An aerosol-generating article according to any of the preceding examples, wherein the length of the downstream section is between 20 millimetres and 50 millimetres.

EX60. An aerosol-generating article according to any of the preceding examples, wherein the ratio between the total length of the downstream section and an overall length of the aerosol-generating article is less than or equal to 0.80.

EX61. An aerosol-generating article according to any of the preceding examples, wherein the components of the aerosol-generating article are made from biodegradable materials.

Specific embodiments will be further described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a schematic side-sectional view of the aerosol-generating article in accordance with a first embodiment of the invention; and

Figure 2 shows a schematic side sectional view of an aerosol-generating system comprising an aerosol-generating article in accordance with a second embodiment of the invention and an aerosol-generating device.

The aerosol-generating article 10 shown in Figure 1 comprises an aerosol-generating substrate 12 and a downstream section 14 at a location downstream of the aerosol-generating substrate 12. Thus, the aerosol-generating article 10 extends from an upstream or distal end 16 – which substantially coincides with an upstream end of the aerosol-generating substrate 12 – to a downstream or mouth end 18, which coincides with a downstream end of the downstream section 14. The downstream section 14 comprises a hollow tubular element 20 and a mouthpiece element 50.

The aerosol-generating article 10 has an overall length of about 45 millimetres and an outer diameter of about 7.2 mm.

The aerosol-generating substrate 12 comprises a hollow tubular substrate element 40 formed from a plurality of layers of homogenised tobacco material that have been helically wound about the longitudinal axis of the hollow tubular substrate element. The layers of homogenised tobacco material include a plurality of layers of cast leaf, alternating with layers of cigarillo paper. The hollow tubular substrate element 40 has a peripheral wall 42 formed of the overlapping layers of homogenised tobacco material. The peripheral wall 42 defines a central, longitudinal airflow channel 44 that extends through the hollow tubular substrate element 40. The upstream end of the airflow channel 44 provides an air inlet through which air can be drawn into the aerosol-generating article during use. The hollow tubular substrate element 40 is unwrapped, so that the layers of homogenised tobacco material are visible on the exterior surface of the aerosol-generating article.

The hollow tubular substrate element 40 does not substantially contribute to the overall RTD of the aerosol-generating article. The RTD of the hollow tubular substrate element 40 is therefore about 0 mm H_2O.

The hollow tubular element 20 of the downstream section 14 is located immediately downstream of the hollow tubular substrate element 40, the hollow tubular element 20 being in longitudinal alignment with the aerosol-generating substrate 12. The upstream end of the hollow tubular element 20 abuts the downstream end of the hollow tubular substrate element 40.

The hollow tubular element 20 is provided in the form of a hollow cylindrical tube made of cellulose acetate tow. The hollow tubular element 20 defines an internal cavity 22 that extends all the way from an upstream end of the hollow tubular element 20 to a downstream end of the hollow tubular element 20. The internal cavity 22 is substantially empty, and so substantially unrestricted airflow is enabled along the internal cavity 22. The hollow tubular element 20 does not substantially contribute to the overall RTD of the aerosol-generating article 10. The RTD of the hollow tubular element 20 is therefore about 0 mm H_2O.

As shown in Figure 1, the internal diameter of the hollow tubular element 20 of the downstream section 14 is substantially the same as the internal diameter of the hollow tubular substrate element 40.

The mouthpiece element 50 extends from the downstream end of the hollow tubular element 20 to the downstream or mouth end 18 of the aerosol-generating article 10. The mouthpiece element 50 comprises a low-density, cellulose acetate filter segment. The mouthpiece element 50 may be individually wrapped by a plug wrap (not shown).

The article 10 comprises a tipping wrapper 52 circumscribing the hollow tubular element 20 and the mouthpiece element 50. The tipping wrapper 52 additionally overlies an upstream

portion of the hollow tubular substrate element 40 in order to join the hollow tubular substrate element 40 and the downstream section 14.

The aerosol-generating article 10 is particularly suitable for use with an aerosol-generating device comprising external heating means, which heats the aerosol-generating substrate 12 externally. During use, the aerosol-generating article 10 is therefore preferably inserted into the heating cavity of an aerosol-generating device with the external surface of the hollow tubular substrate element 40 proximate the heating element or elements within the cavity. The heating of the hollow tubular substrate element 40 produces an aerosol from the layers of homogenised tobacco, which is drawn through the peripheral wall 42 and into the longitudinal airflow channel 44 of the hollow tubular substrate element 40, together with the air that is entering the longitudinal airflow channel 44 at the upstream end, as the consumer draws on the article. The combined air and aerosol are drawn through the aerosol-generating article 10 and delivered to the consumer from the downstream end of the aerosol-generating article 10.

Figure 2 illustrates an aerosol-generating system 100 comprising an aerosol-generating device 102 and an aerosol-generating article 110 according to a second embodiment of the invention. The aerosol-generating article 110 is similar to that shown in Figure 1 and described above, with a similar arrangement of components. However, the aerosol-generating article 110 additionally comprises a tubular susceptor element 160 within the longitudinal airflow channel 144 of the hollow tubular substrate element 140. The tubular susceptor element 160 is provided over the internal surface of the longitudinal airflow channel 144.

As shown in Figure 2, the aerosol-generating device 102 comprises a longitudinal heating cavity 104 for receiving the aerosol-generating article 110. The heating cavity 104 has a closed, distal end and an open, mouth end. Air flow inlets 106 are provided at the distal end of the cavity so that air can be drawn through the aerosol-generating article 110 during use. The heating cavity 104 comprises an arrangement of inductor coils 108 for inductively heating the tubular susceptor element 160 during use.

The aerosol-generating device 102 further comprises a power source (not shown) for supplying power to the inductor coils 108 and a controller (not shown) to controllably heat the aerosol-generating article 110 during use, when the aerosol-generating article 110 is received within the device 102.

CLAIMS

1. An aerosol-generating article comprising:

an aerosol-generating substrate comprising a hollow tubular substrate element having a multi-layered peripheral wall defining a longitudinal airflow channel, wherein the peripheral wall is formed of a plurality of overlapping layers of homogenised tobacco material and wherein the longitudinal airflow channel has a diameter of at least 3 millimetres; and

a downstream section provided downstream of the aerosol-generating substrate.

2. An aerosol-generating article according to claim 1, wherein the peripheral wall of the hollow tubular substrate element has a cross-sectional porosity of at least 0.3.

3. An aerosol-generating article according to claim 1 or 2, wherein the peripheral wall includes one or more layers of a first homogenised tobacco material and one or more layers of a second homogenised tobacco material having a different composition to the first homogenised tobacco material.

4. An aerosol-generating article according to claim 3, wherein the first homogenised tobacco material and the second homogenised tobacco material have a different porosity to each other.

5. An aerosol-generating article according to any preceding claim, wherein the plurality of layers of homogenised tobacco material are helically wound about the longitudinal axis of the hollow tubular substrate element.

6. An aerosol-generating article according to any preceding claim, wherein the peripheral wall has a density of at least 200 milligrams per cubic centimetre.

7. An aerosol-generating article according to any preceding claim, wherein the peripheral wall provides at least 150 milligrams of homogenised tobacco material per centimetre of the hollow tubular substrate element.

8. An aerosol-generating article according to any preceding claim, wherein the aerosol-generating substrate further comprises a susceptor element.

9. An aerosol-generating article according to claim 8, comprising a tubular susceptor element on at least one surface of the hollow tubular substrate element.

10. An aerosol-generating article according to any preceding claim, wherein the outer surface of the hollow tubular substrate element is at least partially exposed on the outer surface of the aerosol-generating article.

11. An aerosol-generating article according to any preceding claim, wherein the hollow tubular substrate element has a length of at least 15 millimetres.

12. An aerosol-generating article according to any preceding claim, wherein the ratio of the length of the hollow tubular substrate element to the total length of the article is at least 0.15.

13. An aerosol-generating article according to any preceding claim, wherein the downstream section comprises at least one hollow tubular element.

14. An aerosol-generating article according to claim 13, wherein ratio between the length of the hollow tubular substrate element and the length of the hollow tubular element of the downstream section is between 0.25 and 1.25.

15. An aerosol-generating article according to claim 13 or 14, wherein the downstream section further comprises a mouthpiece element at the downstream end of the article.

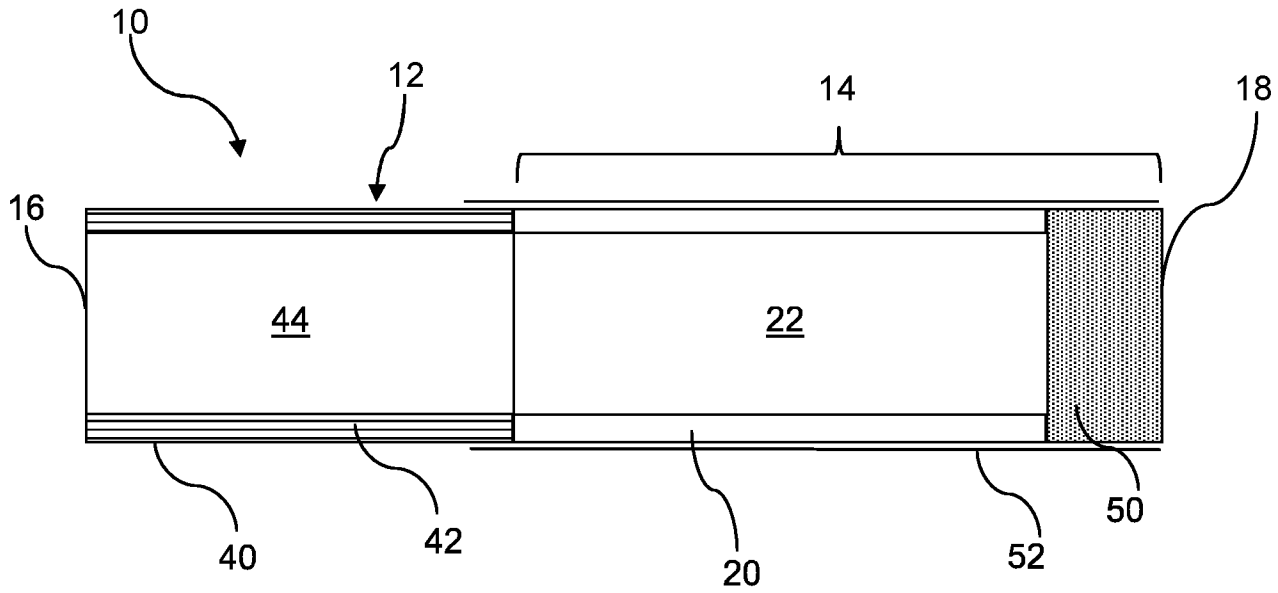


Figure 1

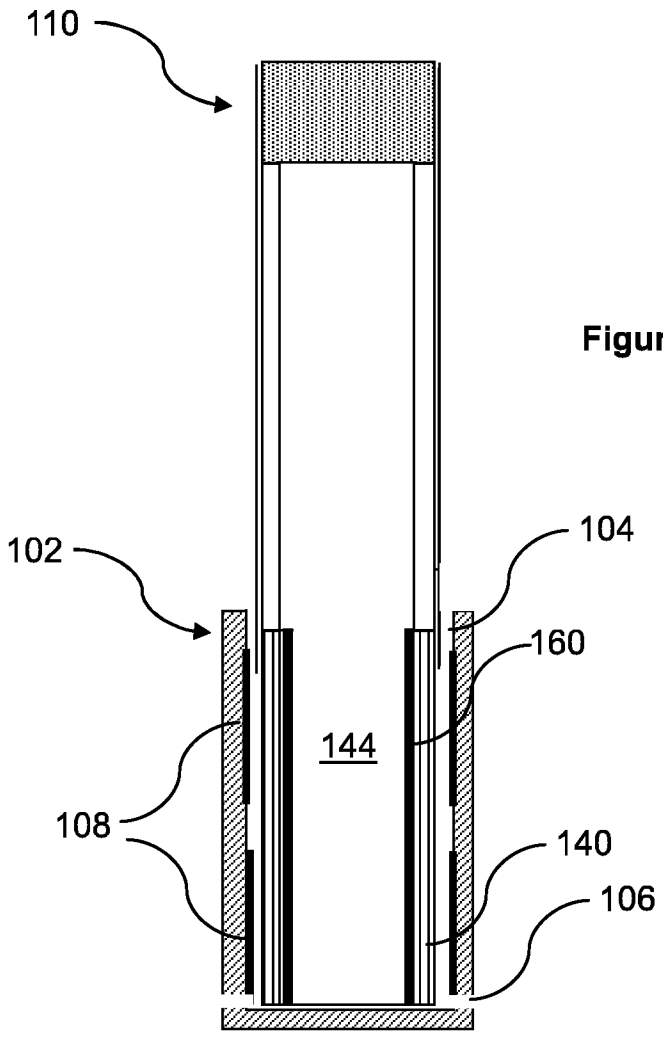


Figure 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2022/084390

A. CLASSIFICATION OF SUBJECT MATTER
INV. A24D1/20 A24B3/14
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 A24B

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)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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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 :

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"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

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Date of the actual completion of the international search	Date of mailing of the international search report
20 February 2023	27/02/2023

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	Kock, Søren

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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