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(54) AEROSOL GENERATING SYSTEM

(57) A solid aerosol precursor for an aerosol forming article is provided. The solid aerosol precursor comprises a sheet of aerosol forming substrate. The sheet has a longitudinal length and transverse width. The sheet is embossed with a 2-dimensional pattern of embossed regions and the sheet is separated along the longitudinal dimension into a plurality of strips. The strips are gathered together thereby forming the precursor.

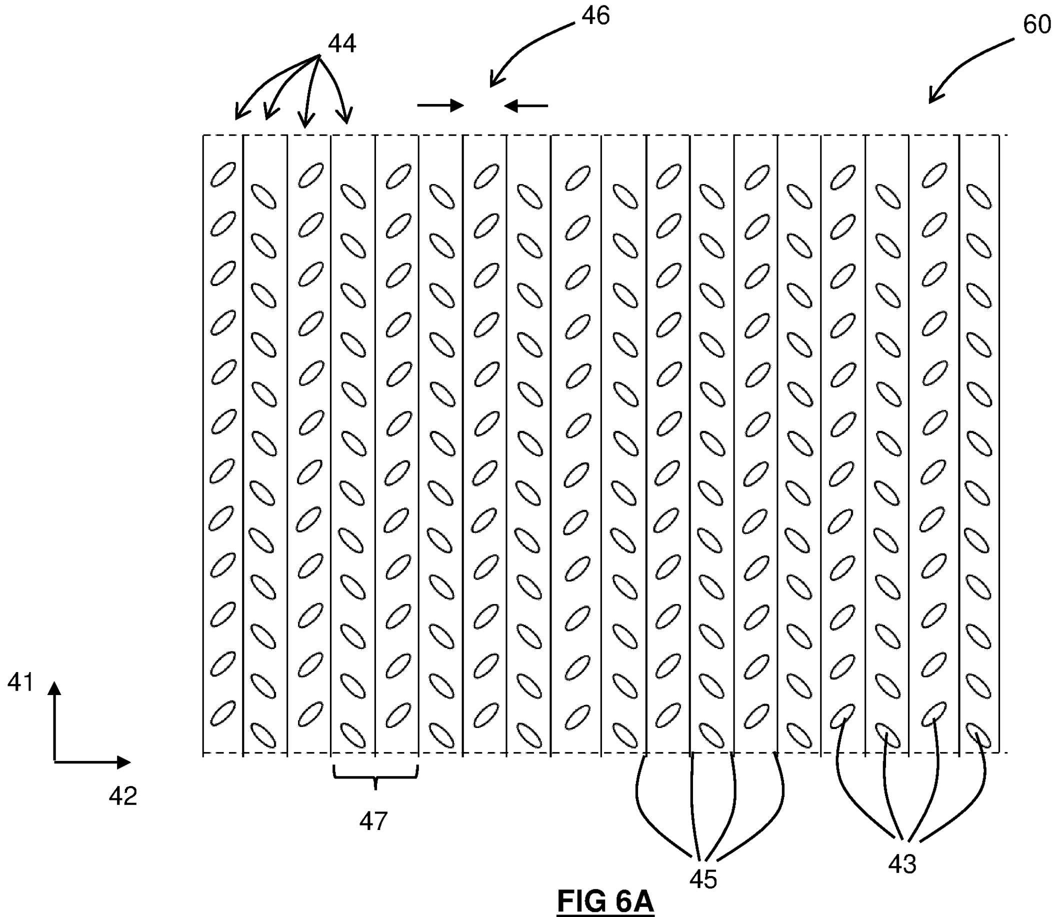

FIG 6A

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Description

FIELD

[0001] The present disclosure relates to the field of aerosol generating systems. In particular, the disclosure relates to aerosol generating systems including an embossed solid aerosol precursor.

BACKGROUND

[0002] Smoking substitute systems include electronic aerosol generation systems that permit a user to simulate the act of smoking by producing an aerosol (also referred to as a "vapour") that is drawn into the lungs through the mouth (inhaled) and then exhaled. The inhaled aerosol typically bears nicotine and/or flavourings without, or with fewer of, the odour and health risks associated with traditional smoking.

[0003] One approach for a smoking substitute system is the "heated tobacco" ("HT") approach in which tobacco is heated or warmed to release vapour. The tobacco may be leaf tobacco or reconstituted tobacco. The vapour may contain nicotine and/or flavourings. In the HT approach the intention is that the tobacco is heated but not burned, i.e. the tobacco does not undergo combustion.

[0004] A typical HT system may include a device and a consumable. The consumable may include the tobacco material. The device and consumable are configured to be physically coupled together. In use, heat is imparted to the tobacco material by a heating element of the device, wherein airflow through the tobacco material causes moisture in the tobacco material to be released as vapour. A vapour may also be formed from a carrier in the tobacco material (this carrier may for example include propylene glycol and/or vegetable glycerine) and additionally volatile compounds released from the tobacco. The released vapour may be entrained in the airflow drawn through the tobacco.

[0005] In some existing systems, the heating element penetrates into the tobacco portion of the consumable. This penetration can exert forces on the tobacco portion, which can cause the tobacco portion to be undesirably moved or shifted by the action of the heater. This may for example alter undesirably the airflow characteristics of the system.

[0006] There is a need for improved design of aerosol generating systems to enhance the user experience and improve the function of the aerosol generating system. In spite of the effort already invested in the development of aerosol generating systems further improvements are desirable.

SUMMARY

[0007] The present disclosure provides a solid aerosol precursor for an aerosol forming article, the precursor comprising: a sheet of aerosol forming substrate, the sheet having a longitudinal length and transverse width; wherein the sheet is separated along the longitudinal dimension into a plurality of strips; and wherein the strips are gathered together thereby forming the solid aerosol precursor.

[0008] In some embodiments, the separation of the sheet includes cutting the sheet along the length dimension of the sheet along a plurality of cut lines, so as to form the plurality of strips. In some embodiments, the gathering includes the bringing together of the strips such that they are in close contact with one another. In some embodiments, the strips are gathered to form a generally cylindrical solid aerosol forming precursor.

[0009] In some embodiments, the sheet is embossed with a 2-dimensional pattern of embossed regions. In some embodiments, this 2-d pattern is an array of embossed regions arranged across the sheet. In some embodiments the strips gathering of the strips may include bundling the strips together in the precursor. The 2-d pattern of embossed region permit an increase in inter-strip friction, reducing the risk to tobacco strip movement within the precursor. This movement may take place during heater insertion and / or removal for example, or simply during storage of the precursors or of consumables including the precursor.

[0010] In some embodiments the 2-dimensional pattern of embossed regions has a transverse periodicity in the transverse dimension, and a longitudinal periodicity in the longitudinal dimension. Independent selection of the periodicity in transverse and longitudinal directions may allow for a pattern leading to increased friction between strips. The transverse periodicity may be the minimum distance between two adjacent embossed regions in the transverse dimension. The longitudinal periodicity may be the minimum distance between two adjacent embossed regions in the longitudinal dimension.

[0011] In some embodiments the transverse periodicity is different from the longitudinal periodicity. This may permit a selection of embossing pattern that allows for increased friction. In particular, for example, tuning the pattern for longitudinal embossing sequence / pattern for interstrip friction, and transverse sequence / pattern to account for the locations of the strips.

[0012] In some embodiments, the transverse periodicity is substantially the same as the longitudinal periodicity. Such arrangements may allow for simpler manufacture.

[0013] In some embodiments, the transverse periodicity is substantially equal to the width of each of the plurality of strips. This permits one longitudinal sequence of embossed regions per strip. In turn, each strip is thus embossed, which may increase inter-strip friction when the strips are gathered into the precursor.

[0014] In some embodiments, each embossed region has a generally circular shape. This may permit a simpler manufacture process. Furthermore the friction resulting from the embossing may not be dependent on orientation of the strips in the precursor, leading to a more stable precursor when the strips are gathered.

[0015] In some embodiments each embossed region has a generally elongate shape. In such arrangements, it may be possible to increase interstrip friction in the precursor because it may be possible to have the embossed regions interdigitate between strips with increased resistance to relative movement.

[0016] In some embodiments, at least one of the elongate embossed regions is inclined at an orientation angle to the longitudinal axis of the strip, wherein the orientation angle is between 0 and 180 degrees. Inclining the embossed regions may result in increased friction as forces push or pull forces applied to the precursor / strips may be partially converted into a rotation resistance between the strips, resulting again in increased inter-strip friction in the precursor.

[0017] In some embodiments, a first embossed region is orientated at a first orientation angle to the longitudinal axis of the respective strip, and a second embossed region is orientated at a second orientation angle to the longitudinal axis of the respective strip, wherein the first and second orientation angles are different. This may result in increased friction via interdigitation of the embossed regions between strips in the precursor.

[0018] In some embodiments the first and second embossed regions are located on adjacent strips of the sheet. Adjacent strips on the sheet, when gathered into the precursor, may be more likely to be located adjacent to one another in the precursor, thus allowing for increased inter-strip friction in the precursor.

[0019] In some embodiments a first strip includes a first sequence of embossed regions and a second strip includes a second sequence of embossed regions, and wherein the first sequence is longitudinally offset from the second sequence. The longitudinal offset may be a phase offset between the first and second sequences. In such arrangements, when gathered into the precursor, adjacent strips may be more likely to have they respective embossed region sequences interdigitate with one another, increasing friction.

[0020] In some embodiments, the first and second strips are comprised within a repeating unit, wherein the repeating unit is repeated across a transverse dimension of the sheet. A repeating unit of longitudinal sequences of embossed regions may ensure that adjacent, and phase offset sequences, are close to one another on the sheet, and have an increased likelihood of being close to one another in the precursor, thus increasing friction.

[0021] In some embodiments, each strip has a substantially equal transverse width. This may permit a simpler manufacturing process.

[0022] Also provided is an aerosol forming article including an aerosol precursor according to the above and proceeding description.

[0023] In some embodiments, the article includes an aperture located immediately downstream of the precursor. The increased friction between the strips in the precursor may reduce the risk that one or more of the strips may be pushed through the aperture. Such push-up may undesirably alter the airflow through the article. In some embodiments, the article is a heated tobacco consumable.

[0024] In some embodiments the aperture is an upstream lumen of a bore. The bore may form a narrowing of the airflow path through the consumable / aerosol forming article. It is preferable that such a bore does not get blocked by precursor strips being pushed into it by the penetrative heater.

[0025] Also provided is an aerosol generating system including an aerosol generating device and aerosol forming article as described above. The aerosol forming article and aerosol generating device being for mutual engagement in use. In some embodiments the aerosol generating device includes a heater for penetrating into the solid aerosol forming precursor.

[0026] The present disclosure also provides a method of using an aerosol forming system, the aerosol generating system comprising an aerosol generating apparatus and an aerosol forming article; wherein the aerosol forming article includes a solid aerosol precursor as described herein and wherein the aerosol generating apparatus includes a heating system including a heater for penetration into the solid aerosol precursor. The method includes engaging the aerosol forming article with the aerosol generating system such that the heater penetrates the solid aerosol precursor, operating the heater such that the heater heats the solid aerosol precursor, and disengaging the aerosol forming article from the aerosol generating system such that the heater is withdrawn from the solid aerosol precursor. Features of the solid aerosol precursor, aerosol forming article, and aerosol generating system described herein are also applicable to this method of using an aerosol forming system.

[0027] The present disclosure also provides a method of forming an aerosol forming article including the steps of obtaining a sheet of aerosol forming substrate (for example, recon tobacco), embossing the sheet with a 2-dimensional pattern of embossed regions, separating the substrate into a plurality of strips, and gathering the strips together to form a solid aerosol precursor.

[0028] Optionally, the embossing and separation steps are performed simultaneously, for example via a cooperating pair of rollers that a) separates the sheet into strips, and b) imparts embossed region(s) onto the sheet / strips in the same process step.

[0029] Optionally, after the strips are gathered together, the strips are wrapped in a wrapping layer. The wrapping layer may be formed from a paper material.

[0030] Optionally, the method includes forming an aerosol forming article including the solid aerosol precursor.

[0031] Optionally the method includes locating a bore filter immediately downstream of the solid aerosol precursor.

[0032] Features of the solid aerosol precursor and of the aerosol forming article described herein are also applicable to the method of using an aerosol forming system.

[0033] The preceding summary is provided for purposes of summarizing some embodiments to provide a basic understanding of aspects of the subject matter described herein. Accordingly, the above-described features are merely examples and should not be construed to narrow the scope or spirit of the subject matter described herein in anyway. Moreover, the above and/or proceeding embodiments may be combined in any suitable combination to provide further embodiments. Other features, aspects, and advantages of the subject matter described herein will become apparent from the following Detailed Description, Figures, and Claims.

BRIEF DESCRIPTION OF THE FIGURES

[0034] Aspects, features and advantages of embodiments of the present disclosure will become apparent from the following description of embodiments in reference to the appended drawings in which like numerals denote like elements.

Figure 1A is a block system diagram showing componentry of an aerosol generating apparatus;

Figure 1B is a block system diagram showing componentry of the apparatus of figure 1 A;

Figure 2 is a diagram showing an embodiment of the apparatus of figure 1B;

Figure 3 is a diagram showing a consumable in accordance with an embodiment of the present invention;

Figure 4 is a diagram showing the consumable of Figure 3 engaged with an HT device, in accordance with the present invention;

Figure 5A is a diagram of a recon sheet in accordance with an embodiment of the present invention;

Figure 5B is a diagram of a recon sheet in accordance with an embodiment of the present invention;

Figure 5C is a cross section view of a recon strip in accordance with an embodiment of the present invention;

Figure 6A is a diagram of a recon sheet in accordance with an embodiment of the present invention;

Figure 6B is a diagram of a recon strip in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0035] Before describing several embodiments of aerosol generating system and apparatus, it is to be understood that the system and apparatus is not limited to the details of construction or process steps set forth in the following description. It will be apparent to those skilled in the art having the benefit of the present disclosure that the systems, apparatuses and/or methods described herein and apparatus could be embodied differently and/or be practiced or carried out in various ways.

[0036] Unless otherwise defined herein, scientific and technical terms used in connection with the presently disclosed inventive concept(s) shall have the meanings that are commonly understood by those of ordinary skill in the art, and known techniques and procedures may be performed according to conventional methods well known in the art and as described in various general and more specific references that may be cited and discussed in the present specification.

[0037] Any patents, published patent applications, and non-patent publications mentioned in the specification may be taken as indicative of the level of skill of those skilled in the art to which the inventive concept(s) pertains and are herein expressly incorporated by reference in their entirety to the same extent as if each individual patent or publication was specifically and individually indicated to be incorporated by reference.

[0038] All of the systems, apparatus, and/or methods disclosed herein can be made and executed without undue experimentation in light of the present disclosure. While they have been described in terms of particular embodiments, it will be apparent to those of skill in the art that variations may be applied to the systems, apparatus, and/or methods and in the steps or in the sequence of steps of the methods described herein without departing from the concept, spirit, and scope of the inventive concept(s). All such similar substitutions and modifications apparent to those skilled in the art are deemed to be within the spirit, scope, and concept of the inventive concept(s) as defined by the appended claims.

[0039] The use of the term "a" or "an" in the claims and/or the specification may mean "one," as well as "one or more," "at least one," and "one or more than one." As such, the terms "a," "an," and "the," as well as all singular terms, include plural referents unless the context clearly indicates otherwise. Likewise, plural terms shall include the singular unless otherwise required by context.

[0040] The use of the term "or" in the present disclosure (including the claims) is used to mean an inclusive "and/or" unless explicitly indicated to refer to alternatives only or unless the alternatives are mutually exclusive. For example, a condition "A or B" is satisfied by any of the following: A is true (or present) and B is false (or not present), A is false (or not present) and B is true (or present), and both A and B are true (or present).

[0041] As used in this specification and claim(s), the words
"comprising, "having," "including," or "containing" (and any forms thereof, such as "comprise" and "comprises," "have" and "has," "incl

udes" and "include," or "contains" and "contain," respe ctively) are inclusive or open-ended and do not exclude additional, unrecited elements or method steps.

[0042] Unless otherwise explicitly stated as incompatible, or the physics or otherwise of the embodiments, example, or claims prevent such a combination, the features of the foregoing embodiments and examples, and of the following claims may be integrated together in any suitable arrangement, especially ones where there is a beneficial effect in doing so. This is not limited to only any specified benefit, and instead may arise from an "ex post facto" benefit. This is to say that the combination of features is not limited by the described forms, particularly the form (e.g. numbering) of the example(s), embodiment(s), or dependency of the claim(s). Moreover, this also applies to the phrase "in one embodiment," "according to an embodiment," and the like, which are merely a stylistic form of wording and are not to be construed as limiting the following features to a separate embodiment to all other instances of the same or similar wording. This is to say, a reference to 'an,' 'one,' or 'some' embodiment(s) may be a reference to any one or more, and/or all embodiments, or combination(s) thereof, disclosed. Also, similarly, the reference to "the" embodiment may not be limited to the immediately preceding embodiment. Further, all references to one or more embodiments or examples are to be construed as non-limiting to the claims.

[0043] The present disclosure may be better understood in view of the following explanations, wherein the terms used that are separated by "or" may be used interchangeably:

As used herein, the term **"aerosol generating apparatus"** or **"aerosol delivery apparatus"** or **"apparatus"** or **"electronic(e)-cigarette"** may include apparatus to deliver an aerosol to a user for inhalation. The apparatus may also be referred to as a "smoking substitute apparatus", which may refer to apparatus intended to be used instead of a conventional combustible smoking article. As used herein a "smoking article" may refer to a cigarette, cigar, pipe or other article, that produces smoke (an aerosol comprising solid particulates and gas) via heating above the thermal decomposition temperature (typically by combustion and/or pyrolysis). The apparatus may include an aerosol generating unit that may generate a vapour that may subsequently condense into the aerosol before delivery to an outlet, which may be arranged as a mouthpiece. The apparatus may be configured to deliver an aerosol for inhalation, which may comprise an aerosol with particle sizes of 0.2 - 7 microns, or less than 10 microns, or less than 7 microns. This particle size may be achieved by control of one or more of: heater temperature; cooling rate as the vapour condenses to an aerosol; flow properties including turbulence and velocity. The apparatus may be portable. As used herein, the term **"Portable"** may refer to the apparatus being for use when held by a user. The apparatus may be adapted to generate a variable amount of aerosol, e.g. by activating an aerosol generating unit of the apparatus for a variable amount of time, (as opposed to a metered dose of aerosol), which may be controlled by an input device. The input device may be configured to be user activated, and may for example include or take the form of a vaping button and/or inhalation sensor. Each occurrence of the aerosol generating apparatus being caused to generate aerosol for a period of time (which may be variable, see above) may be referred to as an "activation" of the aerosol generating apparatus. The aerosol generating apparatus may be arranged to vary an amount of aerosol delivered to a user based on the strength/duration of a draw of a user through a flow path of the apparatus (to replicate an effect of smoking a conventional combustible smoking article).

[0044] As used herein, the term **"aerosol generating system"** or **"aerosol delivery system"** or **"system"** may include the apparatus and optionally other circuitry/componentry associated with the function of the apparatus, e.g. an external device and/or a external component (here "external" is intended to mean external to the aerosol generating apparatus). As used herein, the terms "external device" and "external component" may include one or more of a: a mobile device (which may be connected to the aerosol generating apparatus, e.g. via a wireless or wired connection); a networked-based computer (e.g. a remote server); a cloud-based computer; any other server system.

[0045] As used herein, the term **"aerosol"** may include a suspension of precursor, including as one or more of: solid particles; liquid droplets; gas. Said suspension may be in a gas including air. Aerosol herein may generally refer to/include a vapour. Aerosol may include one or more components of the precursor.

[0046] As used herein, the term **"aerosol-forming precursor"** or **"precursor"** or **"aerosol-forming substance"** or **"aerosol-forming substrate"** may refer to one or more of a: liquid; solid; gel; loose leaf material; other substance. The precursor may be processable by an aerosol generating unit of the apparatus to form an aerosol. The precursor may include one or more of: an active component; a carrier; a flavouring. The active component may include one or more of nicotine; caffeine; a cannabidiol oil; a non-pharmaceutical formulation, e.g. a formulation which is not for treatment of a disease or physiological malfunction of the human body. The active component may be carried by the carrier, which may be a liquid, including propylene glycol and/or glycerine. The term "flavouring" may refer to a component that provides a taste and/or a smell to the user. The flavouring may include one or more of: Ethylvanillin (vanilla); menthol, Isoamyl acetate (banana oil); or other. The precursor may include a substrate, e.g. reconstituted tobacco to carry one or more of the active component; a carrier; a flavouring.

[0047] As used herein, the term **"storage portion"** may refer to a portion of the apparatus adapted to store the precursor, it may be implemented as fluid holding reservoir or carrier for solid material depending on the implementation of the precursor as defined above.

[0048] As used herein, the term **"flow path"** may refer to a path or enclosed passageway through the apparatus, through which the user may inhale for delivery of the aerosol. The flow path may be arranged to receive aerosol from an aerosol generating unit. When referring to the flow path, upstream and downstream may be defined in respect of a direction of flow in the flow path, e.g. the outlet is downstream of the inlet.

[0049] As used herein, the term **"delivery system"** may refer to a system operative to deliver an aerosol to a user. The delivery system may include a mouthpiece/a mouthpiece assembly and the flow path.

[0050] As used herein, the term **"flow"** may refer to a flow in the flow path. The flow may include aerosol generated from the precursor. The flow may include air, which may be induced into the flow path via a puff.

[0051] As used herein, the term **"inhale"** or **"puff"** or **"draw"** may refer to a user expansion of the lungs and/or oral cavity to create a pressure reduction that induces flow through the flow path.

[0052] As used herein, the term **"aerosol generating unit"** may refer to a device to form the aerosol from the precursor. The aerosol generating unit may include a unit to generate a vapour directly from the precursor (e.g. a heating system or other system) or an aerosol directly from the precursor (e.g. an atomiser including an ultrasonic system, a flow expansion system operative to carry droplets of the precursor in the flow without using electrical energy or other system). A plurality of aerosol generating units to generate a plurality of aerosols (for example, from a plurality of different aerosol precursors) may be present in the apparatus.

[0053] As used herein, the term **"heating system"** may refer to an arrangement of one or more heating elements, which are operable to aerosolise the precursor once heated. The heating elements may be electrically resistive to produce heat from electrical current therethrough. The heating elements may be arranged as susceptors to produce heat when penetrated by an alternating magnetic field. The heating system may heat the precursor to below 300 or 350 degrees C, including without combustion.

[0054] As used herein, the term **"consumable"** may refer to a unit that includes or consists of the precursor. The consumable may include the aerosol generating unit, e.g. it is arranged as a cartomizer. The consumable may include the mouthpiece. The consumable may include the information carrying medium. With liquid or gel implementations of the precursor, e.g. an E-liquid, the consumable may be referred to as a "capsule" or a "pod" or "E-liquid consumable". The capsule may include the storage portion, e.g. a reservoir, for storage of the precursor. With solid material implementations of the precursor, e.g. tobacco or reconstituted tobacco formulation, the consumable may be referred to as a "stick" or "package" or "heat not burn consumable". In a heat not burn consumable the mouthpiece may be implemented as a filter and the consumable may be arranged to carry the precursor. The consumable may be implemented as a dosage or pre-portioned amount of material, including a loose-leaf product.

[0055] As used herein the term **"heat not burn"** or **"heated precursor"** may refer to the heating of a precursor, typically tobacco, without combustion, or without substantial combustion (i.e. localised combustion may be experienced of limited portions of the precursor, including of less than 5% of the total volume).

[0056] Referring to Figure 1A, an embodiment aerosol generating apparatus **2** includes a power supply **4,** for supply of electrical energy. The apparatus **2** includes an aerosol generating unit **6** that is driven by the power supply **4.** The power supply **4** may include an electric power supply in the form of a battery and/or an electrical connection to an external power source. The apparatus includes precursor **8,** which in use is aerosolised by the aerosol generating unit **6.** The apparatus **2** includes a delivery system **10** for delivery of aerosolised precursor to a user (not shown in Figure 1A).

[0057] Electrical circuitry (not illustrated in Figure 1A) may be implemented to control the interoperability of the power supply **4** and aerosol generating unit **6.**

[0058] In variant embodiments, which are not illustrated, the power supply may be omitted, e.g. an aerosol generating unit implemented as an atomiser with flow expansion may not require a power supply.

[0059] Referring to Figure 1B, the aerosol generating apparatus **2** is an implementation of the embodiment of Figure 1A and/or other embodiments disclosed herein typically for generation of an aerosol from a solid precursor. A heating system **16** of the aerosol generating unit **6** interacts with the precursor **8** to generate vaporised and/or aerosol precursor. The precursor **8** is typically arranged as a solid and is arranged to receive thermal energy via conductive heat transfer from the aerosol generating unit **6,** e.g. the heating system **16** is arranged as a rod (not illustrated in figure 1B), which is inserted into the precursor. The delivery system **10** includes a flow path **12** that transmits flow **14** through (or in operative proximity to) the precursor **8** to carry the vapour and/or aerosol to an outlet **20** of the flow path **12.**

[0060] Referring to figure 2, which is a specific implementation of the embodiment of figures 1A and 1B, a consumable **22** is implemented as a stick. The stick **22** is separably connectable to a body **21** that comprises the power supply **4** and aerosol generating unit **6.** The stick **22** includes proximal the body **21** the precursor **8** (not shown in figure 2) as a reconstituted tobacco formulation and distal the body **21** a mouthpiece **20** arranged as a filter.

[0061] As shown in Figures 3 and 4, an HNB consumable **22** in accordance with the present invention is shown. The consumable **22** is an example of an aerosol forming article according to the present invention. The consumable **22** comprises an aerosol-forming precursor

23 towards the upstream end of the consumable **22.** In Figure 3 the consumable **22** is shown alone, in Figure 4 the consumable **22** is shown engaged with a representative section of the apparatus body **21.**

[0062] The aerosol-forming precursor **23** comprises reconstituted ("recon") tobacco which includes nicotine as a volatile compound.

[0063] The aerosol-forming precursor **23** comprises 65 wt% tobacco which is provided in the form of gathered strips produced from a sheet of slurry or paper recon tobacco. The tobacco is dosed with 20wt% of a humectant such as propylene glycol (PG) or vegetable glycerine (VG) and has a moisture content of between 7-9 wt%. In other embodiments, the humectant content may be up to 25%. The aerosol-forming substrate further comprises cellulose pulp filler and guar gum binder. In some embodiments, a cellulose powder may be used as an alternative to cellulose pulp. In some embodiments no binder (i.e. 0% binder) may be included. Decreasing the binder and / or pulp content may correspondingly increase the tobacco content.

[0064] Although not apparent from Figures 3 and 4, the precursor **23** is formed of a plurality of elongate strips of plant material. For example, the precursor **23** may include 125 strips, where each strip is 1 millimetre wide. In some embodiments, different strip width and / or number of strips are possible. In some embodiments, the total transverse width of the sheet is an integer multiple of the strip width. In some embodiments, the strip width may for example be between 1.0 and 3.0 millimetres, for example between 1.0 and 2.0 millimetres. In some embodiments, the strip width may be substantially equal to 1.4 millimetres. In some embodiments, the strip width may be substantially equal to 1.0 millimetres. In some embodiments, the strip width may be substantially equal to 2.0 millimetres. In some embodiments, the strip width may be substantially equal to 1.2 millimetres. In some embodiments, the strip width may be substantially equal to 1.35 millimetres. In embodiments, the total transverse width of the sheet may be selected such that the total transverse width of the sheet is an integer multiple of the strip width. In some embodiments, the total number of strips across the sheet may be between 70 and 125, for example between 75 and 90.

[0065] Each strip of plant material is a longitudinally elongate ribbon of tobacco having generally rectangular, planar form. The strips within the precursor **23** are gathered together to be substantially, though not necessarily exactly, aligned along the long axis of the consumable **22** and of the precursor **23.** In some embodiments, each strip has a length that is substantially equal to the length of the precursor **23.**

[0066] As described in connection with later figures, each strip of plant material has a series of embossed regions. An embossed region is an area of the strip that stands out in relief from the surrounding area of the strip. In other words, in an embossed region, an embossed area of the strip is pushed out from the plane of the immediately surrounding strip surface.

[0067] For the avoidance of doubt, it is considered that in the context of the present invention embossing and debossing are interchangeable and similar concepts.

[0068] The precursor **23** is formed in a substantially cylindrical shape such that the consumable resembles a conventional cigarette. The precursor **23** has diameter of around 7mm and an axial length of around 12 mm. In other embodiments, different size and shape of the precursor **23** is possible, for example different length and / or diameter.

[0069] The precursor **23,** and in particular the gathered strips of tobacco, is / are circumscribed by a paper wrapping layer **24.** The paper wrapping layer **24** may include an inflammable layer or coating, for example a metallic foil layer (not shown in Figures). The foil layer may be on the inside of the paper wrapping layer **24,** facing the precursor **23.** Such an inflammable layer may have a lower coefficient of friction than an uncoated paper layer, so embossing the strips in combination with such an embossing layer may beneficially increase friction between precursor and the coated / lined internal surface of the paper wrapping layer **24,** as well as increasing interstrip friction in the precursor **23.**

[0070] The consumable **22** also comprises an upstream filter element **25** and a downstream (terminal) filter element **26.** The two filter elements **25, 26** and spaced by a cardboard spacer tube **27.** Both filter elements **25, 26** are formed of cellulose acetate tow and wrapped with a respective paper plug layer (not shown).

[0071] Both upstream and downstream filter elements **25, 26** have a substantially cylindrical shape. The diameter of the upstream filter **25** matches the diameter of the aerosol-forming substrate **23.** The diameter of the terminal filter element **26** is slightly larger and matches the combined diameter of the aerosol-forming substrate **23** and the wrapping layer **24.**

[0072] In some embodiments, the downstream filter element **26** may be a solid monoacetate filter. That is a filter without any through bores. In some other embodiments, the downstream filter element **26** may include a plurality of parallel bores formed therethrough - a so-called multibore filter. For example, the downstream filter element **26** may include three parallel longitudinal bores passing therethrough. The diameter of each of the multiple bores may be substantially equal to 1.0 millimetre.

[0073] The upstream filter element **25** is slightly shorter in axial length than the terminal filter element **26** at an axial length of 10mm compared to 12mm for the terminal filter element **26.**

[0074] The upstream filter element **25** has a bore **25a** formed through it. The bore 25a has an upstream lumen or opening **25b,** which is directly adjacent the downstream end the precursor **23.** The embossed regions of the strips in the precursor **23** increase friction between the strips. Accordingly, when the heater **16** penetrates the precursor **23,** the risk that some strips of the precursor **23** may be pushed in a downstream direction, by the heater **16,** through the lumen **25a,** may be mitigated. This may improve the user experience since strips pushed into the lumen **25a** can alter detrimentally the airflow through the consumable **22.**

[0075] The cardboard spacer tube **27** is longer than each of the two filter portions having an axial length of around 14mm.

[0076] Each filter element **25, 26** is a hollow bore filter element with a hollow, longitudinally extending bore. The diameter of the bore in the upstream filter **25** is slightly larger than the diameter of the bore in the terminal filter **26** having a diameter of 3mm compared to 2 mm for the terminal filter element **26.**

[0077] The cardboard spacer tube **27** and the upstream filter portion **25** are circumscribed by the wrapping layer **24.**

[0078] The terminal filter element **26** is joined to the upstream elements forming the consumable by a circumscribing paper tipping layer **28.** The tipping layer **28** encircles the terminal filter portion **26** and has an axial length of around 20mm such that it overlays a portion of the cardboard tube spacer **27.**

[0079] Referring to Figure 4, the consumable **22** of Figure 3 is shown inserted into an heated tobacco ("HT") device **21.** The combination of consumable **22** and HT device **21** is an example of aerosol generating system according to the present invention. The HT device **21** includes a rod-shaped heating element **16** (shown in dashed lines). The heating element **16** projects into a cavity **29** within the main body **30** of the device.

[0080] In use (and as shown in Figure 4), the consumable **22** is inserted into the cavity **29** of the main body **30** of the device **21** such that the heating rod element **16** penetrates the precursor **23.** In general, the rod heater **16** locates between the strips of tobacco of the precursor **23.** In some embodiments (and as shown in Figure 4), the rod heater **16** has a pointed distal end. The pointed end of the rod heater **16** may ease the penetration of the rod heater **16** into the precursor **23.** In some other embodiments, the heater **16** may be a flat, blade-shaped, heater. Again, such a blade shaped heater may include a pointed distal end to aid penetration into the precursor. Heating of the strips in the precursor **23** is effected by powering the heating element **16** (e.g. with a rechargeable battery (not shown)).

[0081] In some other embodiments, the heating element **16** may be inductively coupled to an inductive coil, which causes the heater to heat inductively. In such embodiments, the inductive coil may surround at least a portion of the cavity **29** in which the heater **16** is located.

[0082] As the tobacco strips of the precursor **23** are heated, moisture and volatile compounds (e.g. nicotine) within the tobacco and the humectant are released as a vapour and entrained within an airflow generated by inhalation by the user at the terminal filter portion **26.**

[0083] As the vapour cools within the upstream filter element **25** and the cardboard spacer tube **27,** it condenses to form an aerosol containing the volatile compounds for inhalation by the user.

[0084] Further details of the precursor **23** will now be described.

[0085] Referring to Figure 5A, a top down view of a portion of a sheet **40** of recon tobacco is shown. The sheet **40** is generally elongate. The sheet **40** has a sheet length in a longitudinal dimension **41** and a sheet width in a transverse dimension **42.** The sheet length is many times larger than that the sheet width. The sheet **40** is provided on a roll where the roll has the rotational axis along the transverse dimension **42.** The dotted lines at the upper and lower edges of the sheet in Figure 5A are intended to indicate that sheet **40** continues beyond those dotted lines in the longitudinal dimension **41.**

[0086] The precursor **23** may be formed according to the following process / method.

[0087] In a first manufacturing process step, the sheet is embossed with a 2-dimensional embossing pattern of embossed regions **43.** Only a subset of the embossed regions **43** are labelled in Figure 5A for clarity. In the embodiment of Figure 5A, each embossed region **43** is generally circular. It will be appreciated that the pattern of embossing is 2-dimensional across the plane of the sheet. The embossed regions themselves rise out from / into the plane of the sheet in a third orthogonal dimension. The embossing may be formed by an embossing roller with the inverse of the 2-dimensional embossing pattern to the formed on the sheet. That is the embossing pattern is formed in relief on the embossing roller. The sheet **40** passes between the embossing roller and a second cooperating roller to impart the embossing pattern to the sheet **40.**

[0088] In a second manufacturing process step, the sheet **40** is separated (e.g. cut) into a plurality of strips **44.** Only a subset of the strips **44** are labelled in Figure 5A for clarity. The cuts are made along the cut lines **45** extending along the longitudinal dimension **41** of the sheet **40.** Only a subset of the cut lines **45** are labelled in Figure 5A for clarity. Each strip **44** has a strip width **46** in the transverse dimension **42.** In the embodiment of Figure 5A, all strips **44** have the same strip width **46.** In other embodiments, the sheet **40** may be separated into a plurality of strips **44** in which there is a plurality of different strip widths **46.** In some embodiments the embossing and the separation are performed simultaneously. The sheet may be separated into strips via a pair of cooperating rollers. The rollers may include a plurality of cooperating and interlocking channels that separate the sheet into strips via cutting or shearing the sheets. In some embodiments, a single pair of cooperating rollers imparts the embossing pattern and separates the sheet into strips.

[0089] The sheet **40** of Figure 5A is intended to illustrate of the principles of the present invention. In other embodiments, the number of strips **44** across the transverse dimension **42** may be different from that shown in the Figure 5A. In some embodiments, the strip width **46** of each strip **44** as a fraction of the total transverse width of the sheet **40,** may be different. For example, the sheet **40** may have 125 strips **44,** each of a 1 millimetre strip width **46,** provided across a sheet **40** having a transverse total width of 125 millimetres. In some embodiments, different strip width and / or number of strips are possible. In some embodiments, the total transverse width of the sheet is an integer multiple of the strip width. In some embodiments, the strip width **46** may for example be between 1.0 and 3.0 millimetres, for example between 1.0 and 2.0 millimetres. In some embodiments, the strip width **46** may be substantially equal to 1.4 millimetres. In some embodiments, the strip width may be substantially equal to 1.0 millimetres. In some embodiments, the strip width may be substantially equal to 2.0 millimetres. In some embodiments, the strip width may be substantially equal to 1.2 millimetres. n some embodiments, the strip width may be substantially equal to 1.35 millimetres. In embodiments, the total transverse width of the sheet may be selected such that the total transverse width of the sheet is an integer multiple of the strip width **46.** In some embodiments, the total number of strips across the sheet may be between 70 and 125, for example between 75 and 90.

[0090] When the sheet **40** is considered as whole, the embossed regions **43** form a 2-dimensional pattern across the sheet **40.** The pattern may have a transverse periodicity across the transverse dimension **42** and a longitudinal periodicity along the longitudinal dimension **42.** The transverse periodicity may be the distance along the transverse dimension between two immediately adjacent embossed regions **43.** The longitudinal periodicity may be the distance along the longitudinal dimension between two immediately adjacent embossed regions **43.** In some embodiments, the longitudinal periodicity is different from the transverse periodicity. In some embodiments, the longitudinal periodicity is larger than the transverse periodicity. In some embodiments, the transverse periodicity is generally equal to the strip width **46.**

[0091] In some embodiments, the longitudinal periodicity is between 1.0 and 5.0 millimetres. In some embodiments, the longitudinal periodicity is between 1.5 and 5.0 millimetres. In some embodiments, the longitudinal periodicity is between 2.0 and 4.0 millimetres. In some embodiments, the longitudinal periodicity is between 2.0 and 3.0 millimetres. In some embodiments, the longitudinal periodicity is substantially equal to 2.15 millimetres. In some embodiments the longitudinal periodicity is greater than or equal to a longitudinal extent of an embossed region **43.**

[0092] Referring to Figure 5B, a top down view of a portion of a sheet **50** of recon tobacco is shown. The sheet **50** is similar in most respects to the sheet 40 of Figure 5A. The same references numerals are used where appropriate. The sheet **50** of Figure 5B differs from the sheet **40** of Figure 5A because the 2-dimensional pattern of embossed regions **43** is different. In particular, the embossed pattern includes a plurality of longitudinal repeating units **47.** In the embodiment of Figure 5B, each repeating unit **47** comprises two longitudinal sequences of embossed regions **43.** Each longitudinal sequence within the unit **47** is longitudinally offset from the other longitudinal sequences of the repeating unit **47.** This longitudinal offset may also be considered a phase offset between adjacent longitudinal sequences. The strip cuts **45** may be made between longitudinal sequences within the repeating unit **47.** This means that, when the strips **44** are gathered together into the precursor **23,** the embossed regions **43** between strips may at least partially interdigitate with one another. In other words, an embossed region **43** on a first strip **44** is located between a pair of adjacent embossed regions **43** on a second, adjacent strip **44** when gathered into the precursor **23.** Again, this may increase the longitudinal friction between strips **44** in the precursor **23.**

[0093] Embossing the strips **44** effectively increases the volume of a particular strip **44** relative to an unembossed strip. This means that less recon material is needed to fill a precursor **23** of a particular size. For example, the present invention may result in a reduction of recon content in the precursor **23** of around 10 to 15%, relative to precursor **23** formed of unembossed recon.

[0094] Figure 5C shows a longitudinal cross section through a portion of one strip **44** from the sheet **40** of Figure 5A or sheet **50** of Figure 5B. Two embossed regions **43** are illustrated as regions of the strip **44** that protrude from the surrounding surface of the strip **44.** The longitudinal dimension **41** of the sheet strip **44** is shown, which corresponds to the longitudinal dimension **41** shown in Figures 5A and 5B. The embossed regions **43** protrude in a positive vertical dimension **48.** The vertical dimension **48** is perpendicular to the plane of the strip **44.** It will be appreciated that the embossed regions **43** could equally protrude in the negative vertical dimension, which may be considered "debossing". Embossing and debossing are considered equivalent in the context of the present invention.

[0095] In the embodiment of Figures 5A, 5B, and 5C the embossed regions **43** each have a generally circular shape in the plane of the sheet **40** or sheet **50.** The diameter of each embossed region **43** may be between 0.5 and 2.0 millimetres, for example between 0.5 and 1.5 millimetres, for example substantially 0.5 millimetres. The diameter of each embossed region **22** may alternatively be expressed as a fraction of the strip width **46.** For example, in some embodiments, the embossed region **43** has a diameter that is less than 90% of the strip width, for example, less than 80% of the strip width, for example less than 70% of the strip width, for example less than 60% of the strip width, for example less than 50% of the strip width. In some embodiments, the strip width is substantially equal to 1.4 millimetres, and the embossed regions **43** have a diameter of 1.0 millimetres. In some embodiments, the strip width is substantially equal to 1.4 millimetres, and the embossed regions **43** have a diameter of approximately 0.5 millimetres.

[0096] Referring to Figure 6A a top down view of a portion of a sheet **60** of recon tobacco is shown. The sheet **60** is similar in most respects to the sheet **40** of Figure 5A and sheet **50** of Figure 5B. The same reference numerals are used for corresponding features. The sheet **60** of Figure 6A differs from the sheet **40** of Figure 5B and sheet **50** of Figure 5C because the shape of the embossed regions **43** is different. In particular, in the embodiment of Figure 6A, each embossed region **43** has a non-circular shape in the plane of the sheet **60** / strip **44.** More specifically, the shape of each embossed region **43** is elongate, for example an ovoid shape. The example transverse and longitudinal periodicities for the embodiment of Figures 5A, 5B and 5C are equally applicable to the embodiments of Figures 6A and 6B.

[0097] In the embodiment of Figure 6A, each repeating unit 47 comprises two longitudinal sequences of embossed regions **43.** Similarly to the embodiment of Figure 5B, each longitudinal sequence within the repeating unit **47** is longitudinally offset from the other longitudinal sequences of the repeating unit **47.** This longitudinal offset may also be considered a phase offset between adjacent longitudinal sequences. The strip cuts **45** may be made between longitudinal sequences within the repeating unit **47.** In the embodiment of Figure 6A, the embossed regions **43** of a first strip within the repeating unit **47** have a first orientation; the embossed regions 43 of a second, adjacent, strip **44** have a second orientation, different from the first orientation. In some embodiments, along the transverse dimension **42,** the orientations of sequential strips **44** alternate between the first and second orientations.

[0098] This means that, when the strips are gathered together into the precursor **23,** the embossed regions **43** of adjacent strips **44** may interdigitate with one another. In other words, an embossed region **43** on a first strip **44** is located between a pair of adjacent embossed regions **43** on a second adjacent strip **44** when gathered into the precursor **23.** Again, this may increase the longitudinal friction between strips **44** in the precursor **23.**

[0099] Referring to Figure 6B, a portion of a strip **44** from the sheet **60** of Figure 6A is shown. Three embossed regions **43** are illustrated as regions of the strip **44** that protrude from the surrounding surface of the strip **44.** The embossed regions **43** protrude in a positive vertical dimension **48** (out of the page, in the context of Figure 6B). The vertical dimension **48** is perpendicular to the plane of the strip **44.** It will be appreciated that the embossed regions **43** could equally protrude in the negative vertical dimension, which may be considered "debossing". Embossing and debossing are considered equivalent in the context of the present invention.

[0100] The three embossed regions **43** of Figure 6B are substantially identical in size and shape. Each embossed region **43** has a major axis length **52,** a minor axis width **53** and an orientation angle **54.** The major axis length **52** is greater than the minor axis width **53,** as such the embossed regions **43** are elongate. In the embodiment of Figures 6A and 6B, the embossed regions have an oval shape. Other elongate shapes are also possible. In the case that the major axis length **52** is equal to the minor axis width **53,** the embossed regions are circular, and as such correspond to the embossed regions shown in Figs. 5A, B and C.

[0101] In some embodiments, the minor axis width **53** may be less than or equal to 90% of the major axis length **52;** in other embodiments the minor axis width **53** may be less than or equal to 80% of the major axis length **52;** the minor axis width **53** may be less than or equal to 70% of the major axis length **52;** the minor axis width **53** may be less than or equal to 60% of the major axis length **52;** the minor axis width **53** may be less than or equal to 50% of the major axis length **52.**

[0102] Each embossed region **43** is inclined relative to the longitudinal dimension **41** of the strip **44.** That is, the major axis **52** of the embossed region **43** forms an orientation angle **54** with the longitudinal axis / dimension of the strip **44.** The orientation angle **44** may be any angle. In the embodiment of Figures 6A and 6B, the orientation angle **54** is substantially equal to **45** degrees. In other embodiments, the orientation may be between 0 and 180 degrees. An orientation angle of 0 degrees or 180 degrees means that the major axis **52** of the elongate embossed region **43** is substantially aligned with the longitudinal axis **41** of the strip **44.** An orientation angle **54** of 90 degrees means that the major axis **52** of the elongate embossed region **43** is perpendicular to the longitudinal axis **41** of the strip **44.**

[0103] Referring back to Figure 6A, the embossed regions **43** of a first strip within the repeating unit **47** have a first orientation angle **54;** the embossed regions **43** of a second, adjacent, strip **44** have a second orientation angle **54,** different from the first orientation angle. Along the transverse dimension **42,** the orientation angles **54** of the embossed regions **43** of sequential strips 44 alternate between the first and second embossed region orientation angles **54.** In some embodiments, as shown in Figure 6A, the embossed regions **43** on adjacent strips **44** have embossed region **43** orientation angles **54** that are substantially 90 degrees different from one another.

[0104] In some embodiments, the sheet or strips may have a thickness in the vertical dimension **48** of between 100 and 600 micrometres. For example, between 100 and 500 micrometres, for example between 150 and 400 micrometres, for example between 200 and 300 micrometres. In some embodiments, the thickness is may be approximate 250 micrometres.

[0105] Each embossed region **43** has an embossing depth **49** in the vertical dimension **48.** In any embodiment, the embossing depth **49** may be between 50 and 500 micrometres. For example, between 100 and 400 micrometres, for example between 200 and 300 micrometres. In some embodiments, the embossing depth **49** may be approximately 250 micrometres.

[0106] In an embodiment, the embossing **49** depth is between 50 and 200% of the thickness of the sheet or strips.

[0107] In any embodiment, the sheet or strips may be formed from recon (aerosol forming substrate) having a sheet weight greater than or equal to 100 g/m2, e.g. greater than or equal to 110 g/m2 such as greater than or equal to 120 g/m2. The sheet 40 or sheet 50 or sheet 60, or the strip 44, may have a sheet weight less than or equal to 300 g/m2 e.g. less than or equal to 250 g/m2 or less than or equal to 200 g/m2. The sheet **40** or sheet **50** or sheet **60,** or the strip **44,** may have a sheet weight of between 120 and 190 g/m2.

Claims

1. A solid aerosol precursor for an aerosol forming article, the precursor comprising:

   a sheet of aerosol forming substrate, the sheet having a longitudinal length and transverse width;
   wherein the sheet is embossed with a 2-dimensional pattern of embossed regions; wherein the sheet is separated along the longitudinal dimension into a plurality of strips;
   and wherein the strips are gathered together thereby forming the solid aerosol precursor.

2. A precursor according to claim 1 wherein the 2-dimensional pattern of embossed regions has a transverse periodicity in the transverse dimension, and a longitudinal periodicity in the longitudinal dimension.

3. A precursor according to claim 2, wherein the transverse periodicity is different from the longitudinal periodicity.

4. A precursor according to claim 2 wherein the transverse periodicity is substantially equal to the longitudinal periodicity.

5. A precursor according to any of claims 2 to 4, wherein the transverse periodicity is substantially equal to the width of each of the plurality of strips.

6. A precursor according to according to any preceding claim each embossed region has a generally circular shape.

7. A precursor according to any of claims 1 to 5, wherein each embossed region has a generally elongate shape.

8. A precursor according to claim 7, wherein at least one of the elongate embossed regions is inclined at an orientation angle to the longitudinal axis of the strip, wherein the orientation angle is between 0 and 180 degrees.

9. A precursor according to claim 8, wherein a first embossed region is orientated at a first orientation angle to the longitudinal axis of the respective strip, and a second embossed region is orientated at a second orientation angle to the longitudinal axis of the respective strip, wherein the first and second orientation angles are different.

10. A precursor according to claim 9, wherein the first and second embossed regions are located on adjacent strips of the sheet.

11. A precursor according to any preceding claim wherein a first strip includes a first sequence of embossed regions and a second strip includes a second sequence of embossed regions, and wherein the first sequence is longitudinally offset from the second sequence.

12. A precursor according to claim 11, wherein the first and second strips are comprised within a repeating unit, wherein the repeating unit is repeated across a transverse dimension of the sheet.

13. An aerosol forming article including an aerosol precursor according to any preceding claim.

14. The aerosol forming article of claim 13, including an aperture located immediately downstream of the precursor.

15. A aerosol forming article according to claim 14 wherein the aperture is an upstream lumen of a bore.

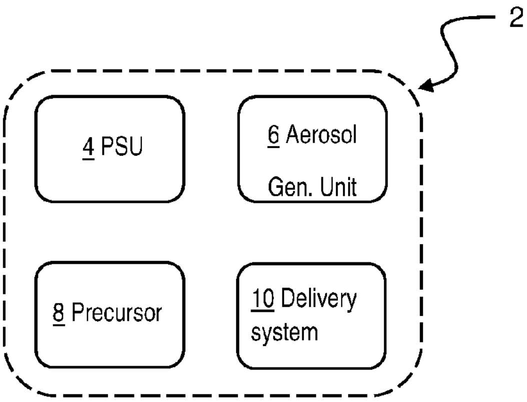
2
4 PSU
6 Aerosol Gen. Unit
8 Precursor
10 Delivery system

FIG 1A

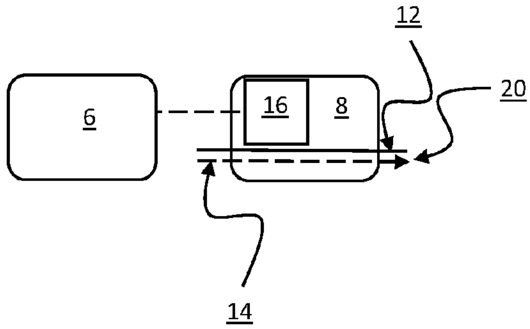
12
20
6
16
8
14

FIG 1B

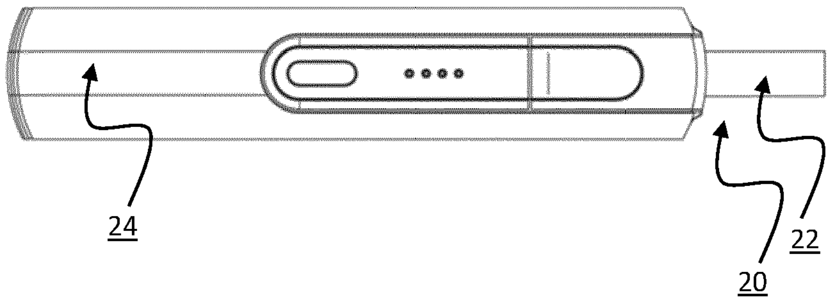

FIG 2

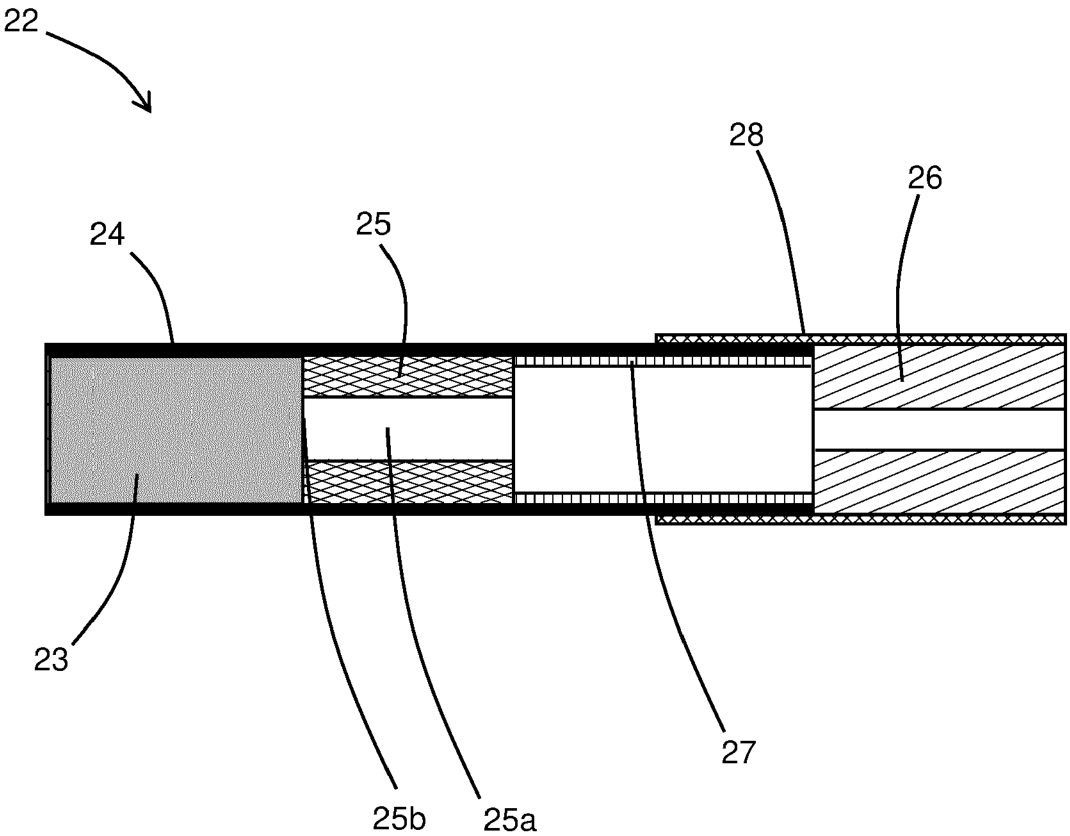

FIG 3

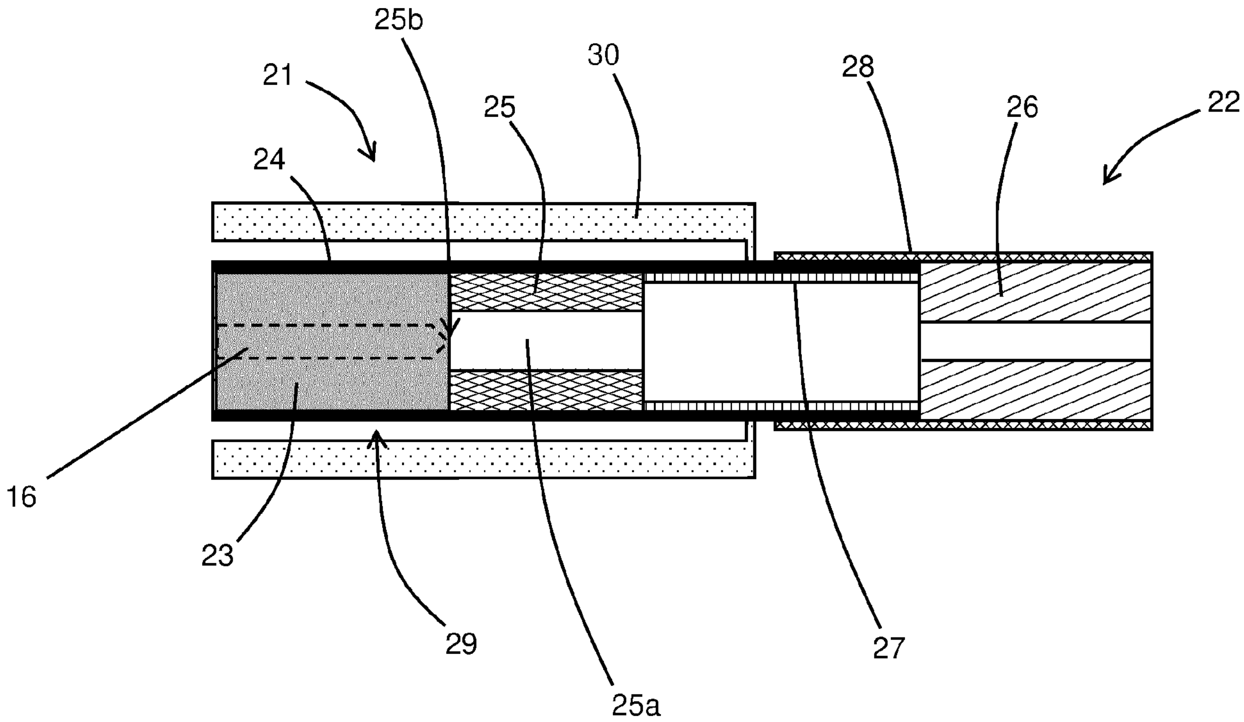

FIG 4

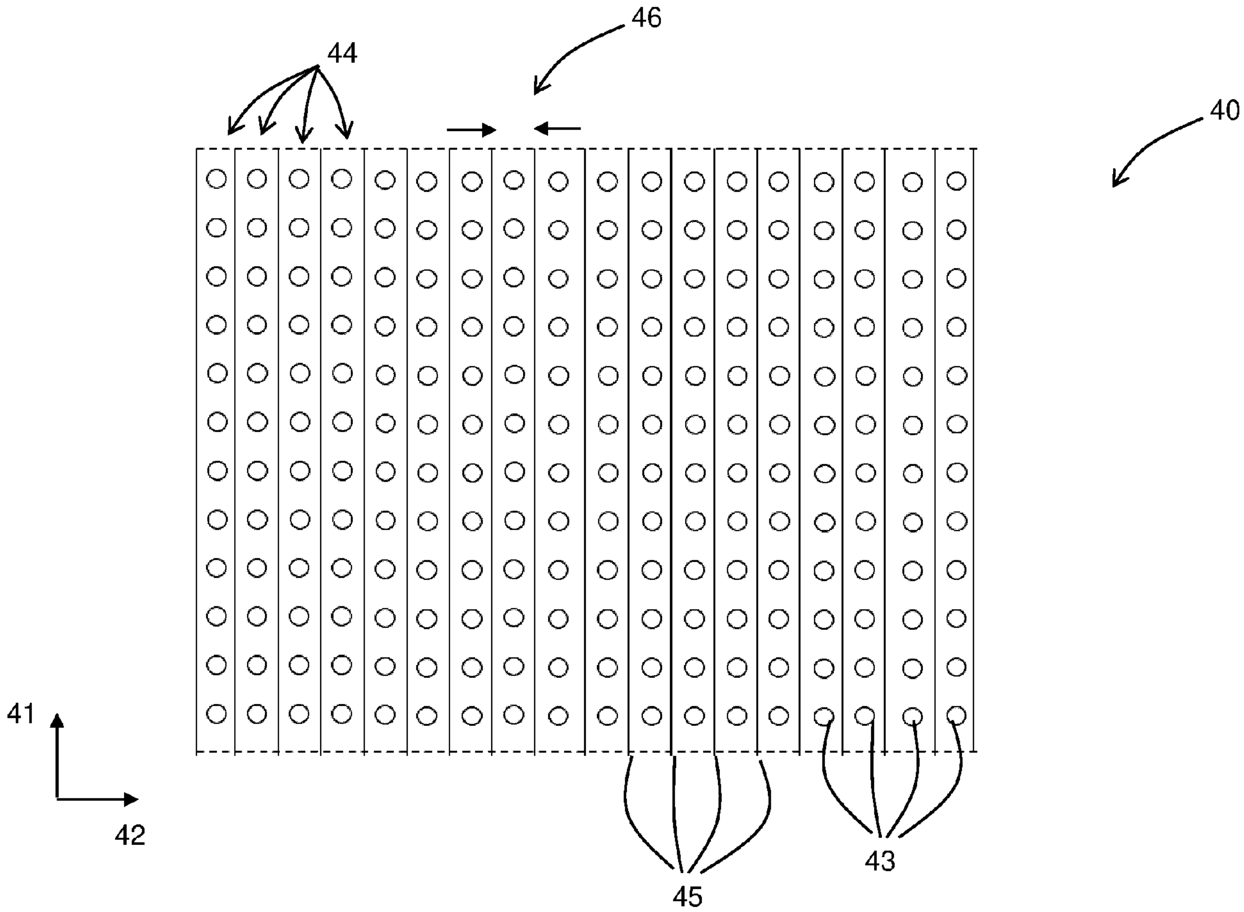

FIG 5A

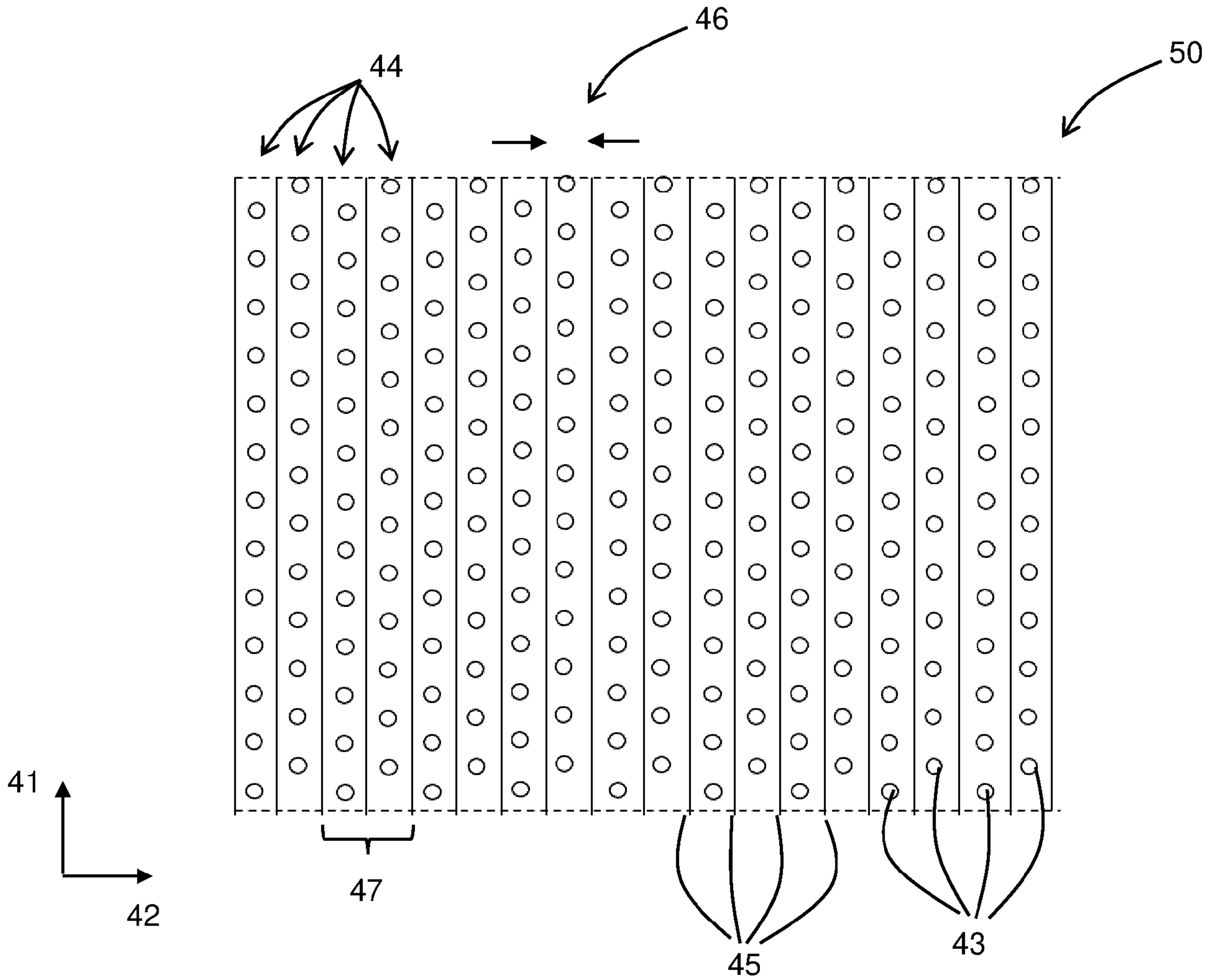

FIG 5B

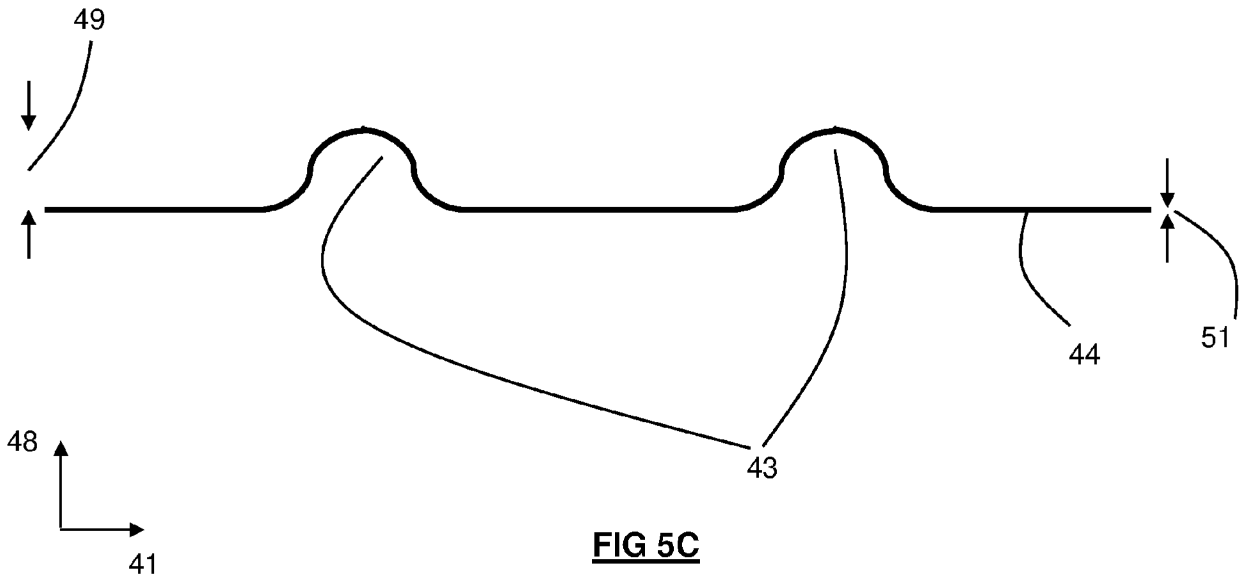

FIG 5C

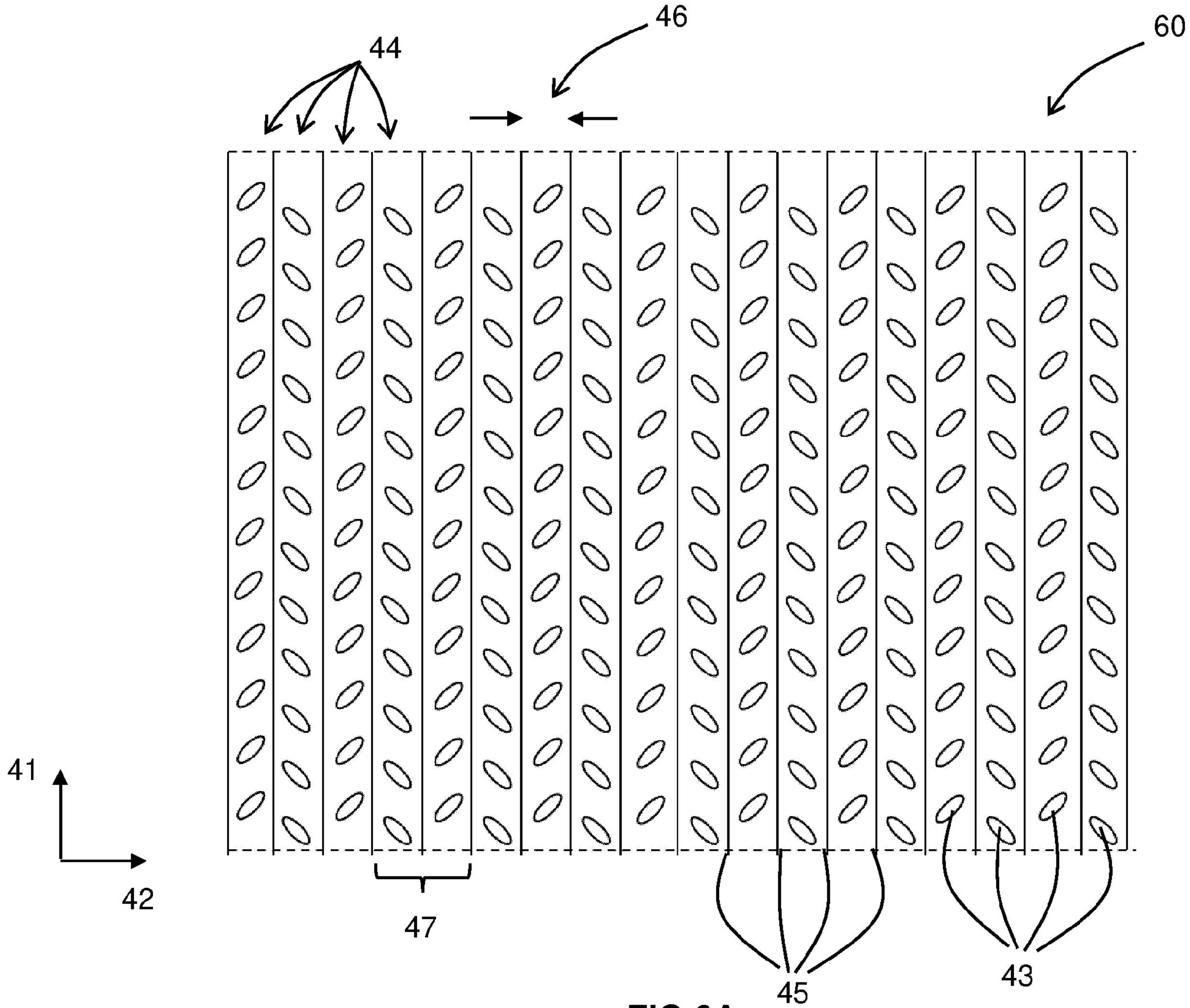

FIG 6A

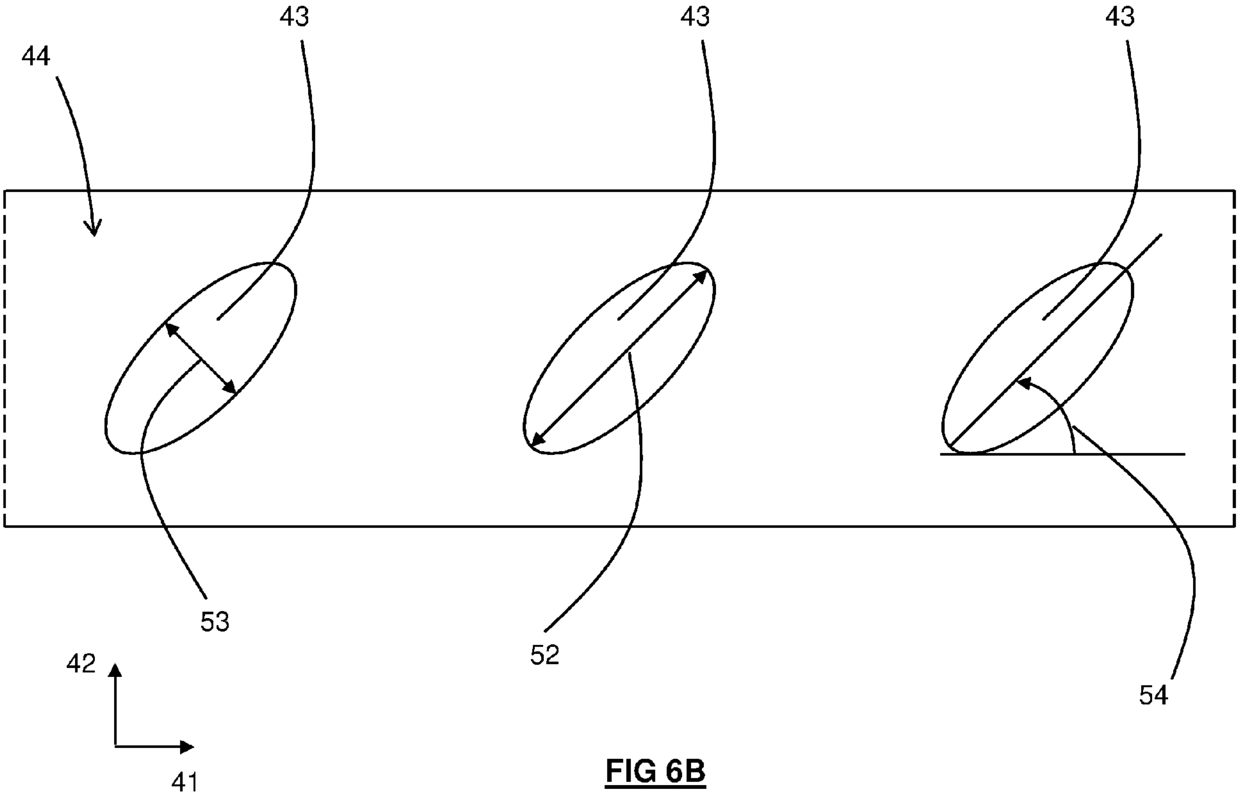

FIG 6B

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EUROPEAN SEARCH REPORT

Application Number
EP 21 18 0941

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2021/078683 A1 (PHILIP MORRIS PRODUCTS SA [CH]) 29 April 2021 (2021-04-29) * page 31, lines 1-15, 29-31 * -----	1-15	INV. A24B3/14 A24B15/12 A24D1/20
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	9 November 2021	Galleiske, Anke

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 21 18 0941

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