

(19)



(11)

EP 4 566 468 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.06.2025 Bulletin 2025/24

(51) International Patent Classification (IPC):
A24F 40/46 ^(2020.01)

(21) Application number: **23214692.8**

(52) Cooperative Patent Classification (CPC):
A24F 40/46; A24F 40/20

(22) Date of filing: **06.12.2023**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(71) Applicant: **Imperial Tobacco Limited
Bristol, BS3 2LL (GB)**

(72) Inventor: **The designation of the inventor has not
yet been filed**

(74) Representative: **Mewburn Ellis LLP
Aurora Building
Counterslip
Bristol BS1 6BX (GB)**

(54) HEATING SYSTEM FOR AN AEROSOL GENERATING APPARATUS

(57) The present disclosure relates to an aerosol generating apparatus. A drawback with known aerosol generating apparatuses is that a uniform heating of consumable material may be difficult to achieve. Accordingly, there is provided a heating system (52) for an aerosol generating apparatus, comprising a heating element (54) adapted for insertion into a consumable (70) for the aerosol generating apparatus, having a central part (54a) having a longitudinal extension essentially along

the longitudinal axis of the heating element, and a plurality of heating arms (54b), wherein the plurality of heating arms (54b) protrude radially outward from the central part (54a) along the longitudinal extension the heating element (54), wherein each heating arm (54a) comprises two sides surfaces (22a,b), and wherein the two side surfaces (22a,b) of each heating arm (54b) are non-parallel.

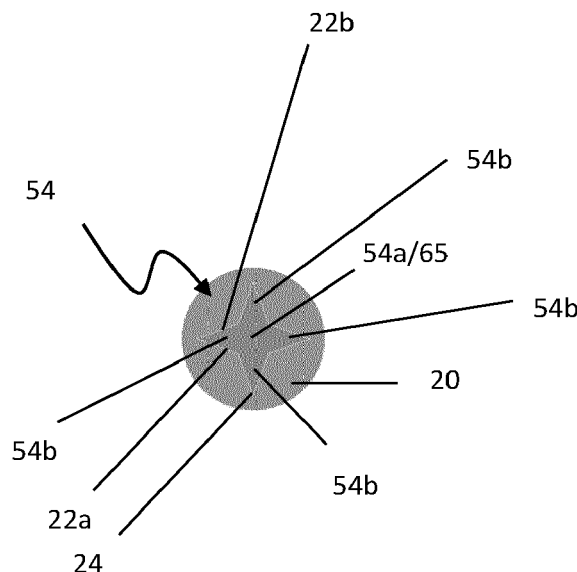


Fig. 2

Description

FIELD

[0001] The present disclosure relates to a heating system for an aerosol generating apparatus.

BACKGROUND

[0002] A typical aerosol generating apparatus may comprise a power supply, an aerosol generating unit that is driven by the power supply, an aerosol precursor, which in use is aerosolised by the aerosol generating unit to generate an aerosol, and a delivery system for delivery of the aerosol to a user.

[0003] A drawback with known aerosol generating apparatuses is that a uniform heating of consumable material may be difficult to achieve.

[0004] In spite of the effort already invested in the development of aerosol generating apparatuses/systems further improvements are desirable.

SUMMARY

[0005] In a first aspect, the present disclosure provides a heating system for an aerosol generating apparatus that comprises a heating element adapted for insertion into a consumable for the aerosol generating apparatus. In some examples, the heating system has a central part having a longitudinal extension essentially along the longitudinal axis of the heating element, and a plurality of heating arms, wherein the plurality of heating arms protrude radially outward from the central part along the longitudinal extension the heating element, wherein each heating arm comprises two sides surfaces, and wherein the two side surfaces of each heating arm are non-parallel.

[0006] In a second aspect, the present disclosure provides a set of an aerosol generating apparatus, comprising a heating system according to the present disclosure, with a heating element, and a consumable, wherein the aerosol generating apparatus is arranged for heating the consumable with the heating system, wherein the volume ratio of the heating element to the consumable material is between 5% and 40%, more particularly between 10% and 30%, more particularly between 15% and 25%, more particularly between 17,5% and 22,5%, more particularly between 18% and 22%, more particularly between 19% and 21%, more particularly 19%, 20% or 21%.

[0007] In a third aspect, the present disclosure provides a set of an aerosol generating apparatus, comprising a heating system according to the present disclosure with a heating element, and a consumable, wherein the aerosol generating apparatus is arranged for heating the consumable with the heating system, wherein the contact surface area between the heating element and the consumable material is between 100 mm² and 300 mm², more particularly between 120 mm² and 280 mm², more

particularly between 120 mm² and 280 mm², more particularly between 130 mm² and 270 mm², more particularly between 140 mm² and 260 mm², more particularly between 150 mm² and 250 mm², more particularly between 160 mm² and 240 mm², more particularly between 170 mm² and 230 mm², more particularly between 180 mm² and 220 mm², more particularly between 190 mm² and 210 mm², more particularly between 195 mm² and 205 mm², more particularly 195 mm², 200 mm² or 205 mm².

[0008] In a fourth aspect, the present disclosure provides a set of an aerosol generating apparatus, comprising a heating system according to the present disclosure with a heating element, and a consumable, wherein the aerosol generating apparatus is arranged for heating the consumable with the heating system, wherein the ratio of the heating element cross sectional area and the consumable material cross sectional area is between 5% and 40%, more particularly between 10% and 30%, more particularly between 15% and 25%, more particularly between 17,5% and 22,5%, more particularly between 18% and 22%, more particularly between 19% and 21%, more particularly 19%, 20% or 21%.

[0009] In a fifth aspect, the present disclosure provides a set of an aerosol generating apparatus, comprising a heating system according to the present disclosure with a heating element, and a consumable, wherein the aerosol generating apparatus is arranged for heating the consumable with the heating system, wherein heating element and the consumable are arranged such that the difference in local temperature is such that the lowest consumable part temperature is 50% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 55% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 60% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 60% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 70% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 75% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 80% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 85% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 90% or more than the highest consumable part temperature in the heated state.

[0010] In a sixth aspect, the present disclosure provides a set of an aerosol generating apparatus, comprising a heating system according to the present disclosure, and a consumable, wherein the aerosol generating ap-

paratus is arranged for heating the consumable with the heating system, in particular for consumption of the consumable by a user.

[0011] In a seventh aspect, the present disclosure provides a set of an aerosol generating apparatus, comprising a heating system according to the present disclosure with a heating element, and a consumable, wherein the aerosol generating apparatus (1) is arranged for heating the consumable (70) with the heating system (52). The heating element and the consumable are arranged such that the difference in local temperature is such that the lowest consumable part temperature is 50% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 55% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 60% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 60% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 70% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 75% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 80% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 85% or more than the highest consumable part temperature in the heated state, more particularly that the lowest consumable part temperature is 90% or more than the highest consumable part temperature in the heated state.

[0012] By providing a heating element that sufficiently protrudes into the interior of the consumable with heatable elements spreading out from the central region of the consumable, spreading out from the central part of the heating element, a preferable heat transfer may be provided into the outer regions of the consumable material. The outer regions are regions adjacent to or in the vicinity of the outer surface of the consumable. By providing sufficient heating arms, the heating element may provide a uniform heating of the consumable material.

[0013] In conventional aerosol generating apparatus, a pin-shaped or blade-shaped heater is used to heat the aerosol generating material of a consumable. The heater is inserted into the interior of the consumable so to make contact with the consumable material, to facilitate heat transfer from the heater surface to the consumable material. Current heater designs may be limited in the amount of energy that can be transferred towards the consumable material by their size and shape. E.g., a pin heater regularly has a rather small surface area that is in contact with the consumable material only in a central part of the consumable interior. Likewise, a blade-shaped heater provides a surface contacting the consumable

material that is only unevenly heating the consumable material.

[0014] One option to increase the heat transfer may be to increase the temperature of the heater. This however may result in an unacceptably high temperature, at least in a part of the consumable material close to the heater, which may cause the release of unwanted substances from the consumable material. Alternatively, the dimensions of the pin-shaped heater or blade-shaped heater may be increased to increase its surface area so that more consumable material is in contact with the heater. However, considering the conventional shape of a consumable, increasing the dimensions of a pin-shaped heater or blade-shaped heater may be limited.

[0015] In order to better and more uniformly heat the consumable material, the present disclosure proposes a heating element shaped so to further protrude into the consumable material in a defined manner, so to provide an improved heat transfer to the interior of the consumable.

[0016] For example, a heating element according to the present disclosure comprises a central part with arms protruding radially outward from said central part into the consumable material. The heating arms have in particular a varying thickness along its radial extension from the central part. The thickness is progressively reduced with an increase in radial distance from the centre of the heating element. Such a heating element may provide a faster and more uniform heating throughout the volume of the consumable material and may also provide an improved use of outer zones of the consumable which conventionally appears to participate marginally in the smoking process.

[0017] Essentially the heating element may be seen as extending the surface of a centrally arranged heating element like a pin-shaped heater to reach more of the consumable material by adding the heating arms. In addition to an improved heat transfer and spread within the consumable material and thus a more uniform heating of the consumable material, the heating element can have an increased stiffness in its arms due to their non-parallel side surfaces, thereby facilitating insertion and removal of the heating element from the consumable. This increased rigidity may also provide a heating element that is more robust to withstand cleaning.

[0018] According to examples of the present disclosure, the distance between the two sides surfaces of a heating arm at the same radial extension may progressively reduce with an increase in the radial distance from the central part.

[0019] For example, the two sides surfaces of each heating arm at the farthest radial extension may meet in a single edge.

[0020] Providing a heating element with a progressive reduction in the thickness of a heating arm at a specific radial extension going out towards and in particular resulting in a single edge at the end of the two side surfaces constituting a heating arm may better facilitate the inser-

tion and removal of the heating element. The heating arms may thus act as a guiding element, guiding or directing the heating element into the interior of the consumable while facilitating the moving away or moving out of the path of consumable material during the insertion process.

[0021] The heating element may be arranged so as to generate heat for a consumable arranged, in use, adjacent to the heating element or surrounding the heating element, and the heating element may be arranged to generate the heat in its central part and/or in its heating arms.

[0022] Having a central part and/or heating arms exhibiting a particular thickness and thus one volume may allow arranging a heating track or the like in the interior of the central part and/or the heating arms. Such would allow the heating of the heating element from within its exterior, to provide a uniform distribution of heat generated to the volume of the heating element and thus to the surface of the central part and/or the heating arms. With a uniform heating of the central part and/or the heating arms a uniform heat transfer from the heating element into the consumable material may be facilitated.

[0023] The heating element may be, on a transverse cross section to the longitudinal axis, a star shaped heating element.

[0024] A star-shaped heating element may protrude from the central part into the consumable material in a preferable way, thereby uniformly heating the consumable material. At the same time a star-shaped heating element may facilitate insertion and removal of the heating element from the consumable material.

[0025] The angle between the side surfaces of any one but preferably each heating arm may be between 10° and 30° , more particularly between 11° and 29° , more particularly between 12° and 28° , more particularly between 13° and 27° , more particularly between 14° and 26° , more particularly between 15° and 25° , more particularly between 16° and 24° , more particularly between 17° and 23° , more particularly between 18° and 22° , more particularly between 19° and 21° , more particularly 20° .

[0026] Having such an angle between the side surfaces of each heating arm can further facilitate insertion and removal of the heating element from the consumable material and/or provide a preferred heater transfer from the heating element or parts of the heating element to the consumable material.

[0027] The volume ratio of the heating element to the consumable material may be between 5% and 40%, more particularly between 10% and 30%, more particularly between 15% and 25%, more particularly between 17,5% and 22,5%, more particularly between 18% and 22%, more particularly between 19% and 21%, more particularly 19%, 20% or 21%.

[0028] The contact surface area between the heating element and the consumable material may be between 100 mm^2 and 300 mm^2 , more particularly between 120 mm^2 and 280 mm^2 , more particularly between 120 mm^2

and 280 mm^2 , more particularly between 130 mm^2 and 270 mm^2 , more particularly between 140 mm^2 and 260 mm^2 , more particularly between 150 mm^2 and 250 mm^2 , more particularly between 160 mm^2 and 240 mm^2 , more particularly between 170 mm^2 and 230 mm^2 , more particularly between 180 mm^2 and 220 mm^2 , more particularly between 190 mm^2 and 210 mm^2 , more particularly between 195 mm^2 and 205 mm^2 , more particularly 195 mm^2 , 200 mm^2 or 205 mm^2 .

[0029] The ratio of the heating element cross sectional area and the consumable material cross sectional area may be between 5% and 40%, more particularly between 10% and 30%, more particularly between 15% and 25%, more particularly between 17,5% and 22,5%, more particularly between 18% and 22%, more particularly between 19% and 21%, more particularly 19%, 20% or 21%.

[0030] Providing a heating element to correspond to one of the measures or ratios may provide a preferred shape for the heating arm and/or the heating element to facilitate insertion and removal of the heating element from the consumable material and/or provide a preferred heat transfer from the heating element or parts of the heating element to the consumable material. In particular, the thermal capacity of the heating element, its individual parts, may be preferably adapted to the consumable material so to provide sufficient heat energy and/or surface contact to transfer the heat generated by the heating element, its individual parts or the heating tracks thereof, to the tobacco material to allow a uniform heating of the consumable material.

[0031] The aerosol generating apparatus of a set of the present disclosure may comprise a cavity for receiving the consumable, wherein the heating element may be arranged within the cavity, and wherein the cavity may be dimensioned such that the consumable is insertable and removable substantially without obstruction of and/or damage to the exterior of the consumable when the heating element penetrates the consumable material during the insertion process of the consumable into the cavity.

[0032] Thus, the cavity may be adapted in its dimensions to correspond to the outer dimensions of the consumable including an assumed change in shape, e.g., increase in diameter or circumference, when the heating element is inserted into the consumable material. Such an insertion may displace consumable material, thereby shifting the consumable material within the consumable, potentially increasing the volume of the consumable or at least its diameter, e.g. in case the consumable is a cylindrically shaped consumable. The diameter or generally the geometrical shape of the cavity may thus be adapted to conform with a consumable having an increased volume/diameter due to the insertion of the heating element. Specifically, with the heating element fully inserted into the interior of the consumable, the inner diameter of the cavity may correspond to the outer diameter of the consumable, so that the outer surface of the consumable rest or is in contact with the inner surface of

the cavity.

[0033] The consumable material may be provided such that the heating element is insertable into the consumable material during the insertion process of the consumable into the cavity without a substantial increase of the consumable diameter or consumable volume.

[0034] Thus, it may be conceivable that the consumable material comprises a density that allows insertion of the heating element, thereby shifting and/or compressing consumable material in the vicinity of the inserted heating element without significantly shifting and/or compressing consumable material distant from the heating element, e.g., at the outer circumference of the consumable. Additionally or alternatively, the consumable may comprise an outer packing or wrapping that is sufficiently rigid so that an inserted heating element and the resulting shifting and or compressing of consumable material does not alter the outer surface area, e.g., circumference or diameter of the consumable.

[0035] The preceding summary is provided for purposes of summarizing some examples to provide a basic understanding of aspects of the subject matter described herein. Accordingly, the above-described features should not be construed to narrow the scope or spirit of the subject matter described herein in any way. Moreover, the above and/or proceeding examples may be combined in any suitable combination to provide further examples, except where such a combination is clearly impermissible or expressly avoided. Other features, aspects, and advantages of the subject matter described herein will become apparent from the following text and the accompanying drawings.

BRIEF DESCRIPTION OF THE FIGURES

[0036] Aspects, features and advantages of the present disclosure will become apparent from the following description of examples in reference to the appended drawings in which like numerals denote like elements.

Fig. 1 is a block system diagram showing an example aerosol generating apparatus.

Fig. 2 is a cross sectional shape of a heating element according to the present disclosure.

Fig. 3 is a diagram showing the heat distribution during use in a consumable using a heating element according to the present disclosure.

Fig. 4 is a block system diagram showing an example implementation of the apparatus of Fig. 1, where the aerosol generating apparatus is configured to generate aerosol from a solid precursor.

Fig. 5 is a schematic diagram showing an example implementation of the apparatus of Fig. 4.

Figs. 6A to D show exemplary embodiments of a heating element according to the present disclosure having four heating arms.

Figs. 7A to C show exemplary embodiments of a heating element according to the present disclosure

having three heating arms.

Figs. 8A to C show exemplary embodiments of a heating element according to the present disclosure having five heating arms.

DETAILED DESCRIPTION OF EMBODIMENTS

[0037] Before describing several examples implementing the present disclosure, it is to be understood that the present disclosure is not limited by specific construction details or process steps set forth in the following description and accompanying drawings. Rather, 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 could be embodied differently and/or be practiced or carried out in various alternative ways.

[0038] 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.

[0039] Any patents, published patent applications, and non-patent publications mentioned in the specification are hereby incorporated by reference in their entirety.

[0040] All examples implementing the present disclosure can be made and executed without undue experimentation in light of the present disclosure. While particular examples have been described, 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.

[0041] 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.

[0042] 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).

[0043] 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," "includes" and "include," or "contains" and "contain," respectively) are inclusive or open-ended and do not exclude additional, unrecited elements or method steps.

[0044] Unless otherwise explicitly stated as incompatible, or the physics or otherwise of the embodiments, examples, or claims prevent such a combination, the features of examples disclosed herein, and of the 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 example(s), embodiment(s), or dependency of 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.

[0045] 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, an **"aerosol generating apparatus"** (or **"electronic(e)-cigarette"**) may be an apparatus configured to deliver an aerosol to a user for inhalation by the user. The apparatus may additionally/alternatively be referred to as a "smoking substitute apparatus", if it is intended to be used instead of a conventional combustible smoking article. As used herein a combustible "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). An aerosol generated by the apparatus 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: heating temperature; cooling rate as the vapour condenses to an aerosol; flow properties including turbulence and velocity. The generation of aerosol by the aerosol generating apparatus 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 an actuator (e.g. actuation button) and/or an airflow sensor.

[0046] Each occurrence of the aerosol generating ap-

paratus being caused to generate aerosol for a period of time (which may be variable) may be referred to as an **"activation"** of the aerosol generating apparatus. The aerosol generating apparatus may be arranged to allow an amount of aerosol delivered to a user to be varied per activation (as opposed to delivering a fixed dose of aerosol), e.g. by activating an aerosol generating unit of the apparatus for a variable amount of time, e.g. 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).

[0047] The aerosol generating apparatus may be portable. As used herein, the term **"portable"** may refer to the apparatus being for use when held by a user.

[0048] As used herein, an **"aerosol generating system"** may be a system that includes an aerosol generating apparatus and optionally other circuitry/components associated with the function of the apparatus, e.g. one or more external devices and/or one or more external components (here "external" is intended to mean external to the aerosol generating apparatus). As used herein, an "external device" and "external component" may include one or more of a: a charging device, 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.

[0049] An example aerosol generating system may be a system for managing an aerosol generating apparatus. Such a system may include, for example, a mobile device, a network server, as well as the aerosol generating apparatus.

[0050] As used herein, an **"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. An aerosol herein may generally refer to/include a vapour. An aerosol may include one or more components of the precursor.

[0051] As used herein, a **"precursor"** or **"consumable material"** may include one or more of a: liquid; solid; gel; loose leaf material; other substance. The precursor may be processed by an aerosol generating unit of an aerosol generating apparatus to generate 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.

[0052] As used herein, a **"storage portion"** may be 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.

[0053] As used herein, a **"flow path"** may refer to a path or enclosed passageway through an aerosol generating apparatus, e.g. for delivery of an aerosol to a user. 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. with an outlet being downstream of an inlet.

[0054] As used herein, a **"delivery system"** may be a system operative to deliver an aerosol to a user. The delivery system may include a mouthpiece and a flow path.

[0055] As used herein, a **"flow"** may refer to a flow in a flow path. A flow may include aerosol generated from the precursor. The flow may include air, which may be induced into the flow path via a puff by a user.

[0056] As used herein, a **"puff"** (or **"inhale"** or **"draw"**) by a user may refer to expansion of lungs and/or oral cavity of a user to create a pressure reduction that induces flow through the flow path.

[0057] As used herein, an **"aerosol generating unit"** may refer to a device configured to generate an aerosol from a 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 an aerosol generating apparatus.

[0058] As used herein, a **"heating system"** may refer to an arrangement of at least one heating element, which is operable to aerosolise a precursor once heated. The at least one heating element may be electrically resistive to produce heat from the flow of electrical current there-through. The at least one heating element may be arranged as a susceptor to produce heat when penetrated by an alternating magnetic field. The heating system may be configured to heat a precursor to below 300 or 350 degrees C, including without combustion.

[0059] As used herein, a **"consumable"** may refer to a unit that includes a precursor. The consumable may include an aerosol generating unit, e.g. it may be arranged as a cartomizer. The consumable may include a mouthpiece. The consumable may include an 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 an **"e-liquid consumable"**. The capsule/pod may include a storage portion, e.g. a reservoir or tank, for storage of the pre-

cursor. 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.

[0060] As used herein, an **"information carrying medium"** may include one or more arrangements for storage of information on any suitable medium. Examples include: a computer readable medium; a Radio Frequency Identification (RFID) transponder; codes encoding information, such as optical (e.g. a bar code or QR code) or mechanically read codes (e.g. a configuration of the absence or presents of cut-outs to encode a bit, through which pins or a reader may be inserted).

[0061] As used herein **"heat-not-burn"** (or **"HNB"** 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).

[0062] Referring to Fig. 1, an example aerosol generating apparatus 1 includes a power supply 2, for supply of electrical energy. The apparatus 1 includes an aerosol generating unit 4 that is driven by the power supply 2. The power supply 2 may include an electric power supply in the form of a battery and/or an electrical connection to an external power source. The apparatus 1 includes a precursor 6, which in use is aerosolised by the aerosol generating unit 4 to generate an aerosol. The apparatus 2 includes a delivery system 8 for delivery of the aerosol to a user.

[0063] Electrical circuitry (not shown in Fig. 1) may be implemented to control the interoperability of the power supply 4 and aerosol generating unit 6.

[0064] In variant examples, which are not illustrated, the power supply 2 may be omitted since, e.g. an aerosol generating unit implemented as an atomiser with flow expansion may not require a power supply.

[0065] Fig. 2 shows a cross sectional shape of a heating element according to the present disclosure.

[0066] Fig. 2 can also be seen as a view into the interior of cavity 20 as seen from the outside of the aerosol generating apparatus 1, when seen from the direction of the top end 53 of Fig. 5. The embodiment in Fig. 2 exemplarily is a heating element 54 comprising a central part 54a and exemplarily four heating arms 54b. Each heating arm consists of two side surfaces 22a, 22b. The heating arms 54b are arranged in a star shape with essentially a 90° angle between two adjacent heating arms 54b, when considering a centrally aligned vector in each heating arm 54b arranged centrally between the two side surfaces 22a, 22b of a heating arm 54b. The distance between two side surfaces 22a, 22b of one heating arm 54b may be seen as the distance between

the two points where a vector arranged at a 90° angle relative to the centrally aligned vector of each heating element 54b meets the respective side surface 22a, 22b. At the same time, these points are at the same radial distance from the centre of the heating element 54, i.e., from the centre of the central part 54a. The further away from the centre, the smaller the distance between the two side surfaces 22a, 22b gets. At the far end, the most distal end of a heating arm seen from the central part 54a, the two side surfaces meet in a point, essentially forming a edge. The edge is pointing outwards when seen from the central part 54a.

[0067] The heating element 54 may comprise a central tip 65 also in the central part 54a and pointing outwards from the cavity 70. This central tip 65 is not visible in Fig. 2 and may be cone shaped. The central tip 65 in the central part 54a may facilitate insertion of a consumable into the cavity 70. In other words, the central tip 65 may facilitate the insertion of the heating element 54 into the consumable material. By exerting pressure on the consumable 70 when pushing the consumable 70 into the cavity 20 of the aerosol generating apparatus 1, the central tip 65 may pierce the exterior of the consumable, thereby opening up the consumable and in particular provide access to the consumable material. By continuing to apply pressure, the central tip 65 of the heating element 54 may be seen as pushing aside the consumable material when the heating element 54 progressively moved into the consumable 70, thereby making room in the interior of the consumable 70 to accommodate the heating element 54. The pushing aside of the consumable material may at the same time assure a sufficient contact between the heating element 54, in particular the heating arms 54b, and the consumable material, to enable heat transfer from the heating element 54 into the consumable material, to heat the consumable material for consumption by a user. Fig. 3 shows a diagram showing the heat distribution in a consumable using a heating element according to the present disclosure.

[0068] In particular, Fig. 3 may show the temperature distribution in a consumable after a smoking session for a star-shaped heating element. By using a star-shaped heating element, heat energy may be provided further into the interior of the consumable material and thus may heat the consumable material more uniformly, as may be taken from the temperature distribution shown in Fig. 3. In particular higher temperatures at the outside surface and a more uniform temperature distribution throughout the consumable material may be achievable.

[0069] Exemplarily, the consumable material in direct contact with the surface of the heating element 54 exhibits a temperature of around or slightly exceeding 300°C, while the consumable material at the outer circumference of the consumable 70 exhibits a temperature of around 200°C. As such, the temperature ratio between the innermost, hottest part of the consumable material and the outermost, coldest part of the consumable material exemplarily is 3:2.

[0070] Fig. 4 shows an implementation of the apparatus 1 of Fig. 1, where the aerosol generating apparatus 1 is configured to generate aerosol by a heat not-burn process.

[0071] In this example, the apparatus 1 includes a device body 50 and a consumable 70.

[0072] In this example, the body 50 includes the power supply 4 and a heating system 52. The heating system 52 includes at least one heating element 54. The body may additionally include any one or more of electrical circuitry 56, a memory 58, a wireless interface 60, one or more other components 62.

[0073] The electrical circuitry 56 may include a processing resource for controlling one or more operations of the body 50, e.g. based on instructions stored in the memory 58.

[0074] The wireless interface 60 may be configured to communicate wirelessly with an external (e.g. mobile) device, e.g. via Bluetooth.

[0075] The other component(s) 62 may include an actuator, one or more user interface devices configured to convey information to a user and/or a charging port, for example (see e.g. Fig. 5).

[0076] The body 50 is configured to engage with the consumable 70 such that the at least one heating element 54 of the heating system 52 penetrates into the solid precursor 6 of the consumable. In use, a user may activate the aerosol generating apparatus 1 to cause the heating system 52 of the body 50 to cause the at least one heating element 54 to heat the solid precursor 6 of the consumable (without combusting it) by conductive heat transfer, to generate an aerosol which is inhaled by the user.

[0077] Fig. 5 shows an example implementation of the aerosol generating apparatus 1 of Fig. 4.

[0078] As depicted in Fig. 5, the consumable 70 is implemented as a stick, which is engaged with the body 50 by inserting the stick into an aperture at a top end 53 of the body 50, which causes the at least one heating element 54 of the heating system 52 to penetrate into the solid precursor 6.

[0079] The consumable 70 includes the solid precursor 6 proximal to the body 50, and a filter distal to the body 50. The filter serves as the mouthpiece of the consumable 70 and thus the apparatus 1 as a whole. The solid precursor 6 may be a reconstituted tobacco formulation.

[0080] In this example, the at least one heating element 54 is a rod-shaped element with a circular transverse profile. Other heating element shapes are possible, e.g. the at least one heating element may be blade-shaped (with a rectangular transverse profile) or tube-shaped (e.g. with a hollow transverse profile).

[0081] In this example, the body 50 includes a cap 51. In use the cap 51 is engaged at a top end 53 of the body 50. Although not apparent from Fig. 5, the cap 51 is moveable relative to the body 50. In particular, the cap 51 is slidable and can slide along a longitudinal axis of the body 50.

[0082] The body 50 also includes an actuator 55 on an outer surface of the body 50. In this example, the actuator 55 has the form of a button.

[0083] The body 50 also includes a user interface device configured to convey information to a user. Here, the user interface device is implemented as a plurality of lights 57, which may e.g. be configured to illuminate when the apparatus 1 is activated and/or to indicate a charging state of the power supply 4. Other user interface devices are possible, e.g. to convey information haptically or audibly to a user.

[0084] The body may also include an airflow sensor which detects airflow in the aerosol generating apparatus 1 (e.g. caused by a user inhaling through the consumable 70). This may be used to count puffs, for example. In this example, the consumable 70 includes a flow path which transmits aerosol generated by the at least one heating element 54 to the mouthpiece of the consumable.

[0085] In this example, the aerosol generating unit 4 is provided by the above-described heating system 52 and the delivery system 8 is provided by the above-described flow path and mouthpiece of the consumable 70. Figs. 6A to D show exemplary embodiments of a heating element according to the present disclosure having four heating arms.

[0086] Fig. 6 shows a star shaped heating element 54 in four different embodiments. The general star-shaped appearance may be seen in Fig. 6A. The star-shaped heating element 54 in Fig. 6A is depicted with flat top and bottom surfaces. The star-shaped heating element 54 comprises a central part 54a and four heating arms 54b, extending radially outward from the central part 54a. Each of the four heating arms 54b comprises two side surfaces 22a,b. The side surfaces 22a,b are nonparallel, thereby forming an angle 64 between the two side surfaces 22a,b of a single heating arm 54b, and including a volume of heating arm material, that is arranged to transmit heat energy from the central part of the heating element to its peripheral edges, and thus to its periphery, e.g., a consumable surrounding the heating element. The two side surfaces 22a,b of a single heating element 54 meet radially outward in an edge 24 along the longitudinal extension of the heating element 54.

[0087] In the exemplary embodiment of Figs. 6A to D, the heating element 54 comprises rotational symmetry about the central part 54a, or rather its longitudinal axis. The four heating arms 54b distribute evenly about a 360° circle, and thus, each edge 24 of each of the four heating elements 54 is at an 90° angle to its adjacent edges 24 when considering rotation about the longer to a denial axis of the heating element 54, about the central part 54a. Other embodiments are conceivable which do not comprise rotational symmetry, so that the angles between adjacent heating arms are not uniform.

[0088] In comparison to the embodiment of Figs. 6A, the embodiments of Fig. 6B and 6C comprise a differently shaped central tip 65 of the heating element 54, while the embodiment of Fig. 6D comprises differently shaped

edges 24.

[0089] The central tip 65 in Fig. 6B is a circular chamfered tip. Thereby, the tip surface does not exhibit any sharp lines or edges apart from the edges of the heating arms 54b. The central tip 65 in Fig. 3C is a straight chamfered tip. Here, the central tip 65 comprises exemplarily four tip surfaces, which are the top or upper surfaces of the respective heating arms 54b. Adjacent heating arm top surfaces meet by forming an edge. Both the circular chamfered tip and the straight chamfered tip may facilitate the insertion of the heating element 54 into the interior of a consumable.

[0090] The embodiment of Fig. 6D essentially corresponds to the embodiment of Fig. 6A, however, the edges 24 are slightly rounded. Due to the dimension depicted in Fig. 6D, the actual rounding of the edges 24 is not visible. The round edges of the embodiment of Fig. 6D may of course be combined with any of the tips of Figs. 6B,C.

[0091] Figs. 7A to C show exemplary embodiments of a heating element according to the present disclosure having three heating arms.

[0092] The embodiments in Figs. 7A to 7C essentially correspond to the embodiments as shown in Figs. 6A to C, apart from that the embodiments in Figs. 7A to 7C exemplarily comprise only three heating arms 54b. The angle between the radial extension of each heating arm relative to the adjacent heating arms is exemplarily 120°, considering rotational symmetry about the longitudinal axis or the central part 54a. Again, rotational symmetry is not mandatory. As in Fig. 6B, the central tip 65 in Fig. 7B is a circular chamfered tip, while the central tip 65 in Fig. 7C is a straight chamfered tip comparable to the central tip 65 in Fig. 6C. While not depicted in Figs. 7A to C, it is conceivable that the edges 24 are sharp edges as depicted in Figs. 7A to C or are rounded comparable to the edges of Fig. 6D.

[0093] Figs. 8A to C shows exemplary embodiments of a heating element according to the present disclosure having five heating arms.

[0094] The embodiments in Figs. 8A to 8C essentially correspond to the embodiments as shown in Figs. 6A to C, apart from that the embodiments in Figs. 8A to 8C exemplarily comprise five heating arms 54b. The angle between the radial extension of each heating arm relative to the adjacent heating arms is exemplarily 72°, considering rotational symmetry about the longitudinal axis or the central part 54a. Again, rotational symmetry is not mandatory. As in Fig. 6B or 7B, the central tip 65 in Fig. 8B is a circular chamfered tip, while the central tip 65 in Fig. 8C is a straight chamfered tip comparable to the central tip 65 in Fig. 6C. While not depicted in Figs. 8A to C, it is conceivable that the edges 24 are sharp edges as depicted in Figs. 6A to C or are rounded comparable to the edges of Fig. 6D.

[0095] The embodiments shown in Figs. 6A to 8C utilize a defined number of heating arms 54b, here exemplarily three, four or five heating arms. It is apparent that the number of heating arms can be lower, e.g., two

heating arms, or higher, e.g., six, seven, eight, nine, ten, eleven, twelve, or more heating arms.

Claims

1. Heating system (52) for an aerosol generating apparatus (1), comprising

a heating element (54) adapted for insertion into a consumable (70) for the aerosol generating apparatus, having
a central part (54a) having a longitudinal extension essentially along the longitudinal axis of the heating element, and
a plurality of heating arms (54b),
wherein the plurality of heating arms (54b) protrude radially outward from the central part (54a) along the longitudinal extension the heating element (54),
wherein each heating arm (54b) comprises two sides surfaces (22a,b), and
wherein the two side surfaces (22a,b) of each heating arm (54b) are non-parallel.

2. Heating system according to the preceding claim, wherein the distance between the two sides surfaces (22a,b) of a heating arm (54b) at the same radial extension progressively reduces with an increase in the radial distance from the central part (54a).

3. Heating system according to any one of the preceding claims, wherein the two sides surfaces (22a,b) of each heating arm (54b) at the farthest radial extension meet in a single edge (24).

4. Heating system according to any one of the preceding claims,

wherein the heating element (54) is arranged so as to generate heat for a consumable (70), in use, adjacent to the heating element (54) or surrounding the heating element (54), and
wherein the heating element (54) is arranged to generate the heat in its central part (54a) and/or in its heating arms (54b).

5. Heating system according to any one of the preceding claims, wherein the heating element (54) is, on a transverse cross section to the longitudinal axis, a star shaped heating element.

6. Heating system according to any one of the preceding claims, wherein the angle (64) between the side surfaces (22a,b) of a heating arm is between 10° and 30°,

more particularly between 11° and 29°, more particularly between 12° and 28°, more particularly between 13° and 27°, more particularly between 14° and 26°, more particularly between 15° and 25°, more particularly between 16° and 24°, more particularly between 17° and 23°, more particularly between 18° and 22°, more particularly between 19° and 21°, more particularly 20°.

7. Set of an aerosol generating apparatus (1), comprising a heating system (52) with a heating element (54), and a consumable (70),

wherein the aerosol generating apparatus (1) is arranged for heating the consumable (70) with the heating system (52),
wherein the volume ratio of the heating element (54) to the consumable material is between 5% and 40%, more particularly
between 10% and 30%, more particularly
between 15% and 25%, more particularly
between 17,5% and 22,5%, more particularly
between 18% and 22%, more particularly
between 19% and 21%, more particularly
19%, 20% or 21%.

8. Set of an aerosol generating apparatus (1), comprising a heating system (52) with a heating element (54), and a consumable (70),

wherein the aerosol generating apparatus (1) is arranged for heating the consumable (70) with the heating system (52),
wherein the contact surface area between the heating element (54) and the consumable material is between 100 mm² and 300 mm², more particularly
between 120 mm² and 280 mm², more particularly
between 120 mm² and 280 mm², more particularly
between 130 mm² and 270 mm², more particularly
between 140 mm² and 260 mm², more particularly
between 150 mm² and 250 mm², more particularly
between 160 mm² and 240 mm², more particularly
between 170 mm² and 230 mm², more particularly
between 180 mm² and 220 mm², more particularly
between 190 mm² and 210 mm², more particularly
between 195 mm² and 205 mm², more particularly
195 mm², 200 mm² or 205 mm².

9. Set of an aerosol generating apparatus (1), comprising a heating system (52) with a heating element (54), and a consumable (70),

wherein the aerosol generating apparatus (1) is arranged for heating the consumable (70) with the heating system (52),
 wherein the ratio of the heating element transverse cross sectional area and the consumable material cross sectional area is between 5% and 40%, more particularly
 between 10% and 30%, more particularly
 between 15% and 25%, more particularly
 between 17,5% and 22,5%, more particularly
 between 18% and 22%, more particularly
 between 19% and 21%, more particularly
 19%, 20% or 21%.

10. Set of an aerosol generating apparatus (1), comprising a heating system (52) with a heating element (54), and a consumable (70),

wherein the aerosol generating apparatus (1) is arranged for heating the consumable (70) with the heating system (52),
 wherein heating element (54) and the consumable (20) are arranged such that the difference in local temperature is such that the lowest consumable part temperature is 50% or more than the highest consumable part temperature in the heated state, more particularly
 that the lowest consumable part temperature is 55% or more than the highest consumable part temperature in the heated state, more particularly
 that the lowest consumable part temperature is 60% or more than the highest consumable part temperature in the heated state, more particularly
 that the lowest consumable part temperature is 60% or more than the highest consumable part temperature in the heated state, more particularly
 that the lowest consumable part temperature is 70% or more than the highest consumable part temperature in the heated state, more particularly
 that the lowest consumable part temperature is 75% or more than the highest consumable part temperature in the heated state, more particularly
 that the lowest consumable part temperature is 80% or more than the highest consumable part temperature in the heated state, more particularly
 that the lowest consumable part temperature is 85% or more than the highest consumable part temperature in the heated state, more particu-

larly
 that the lowest consumable part temperature is 90% or more than the highest consumable part temperature in the heated state.

11. Set of an aerosol generating apparatus (1), comprising a heating system (52) according to any one of claims 1 to 6, and a consumable (70), wherein the aerosol generating apparatus (1) is arranged for heating the consumable (70) with the heating system (52).

12. Set according to any one of claims 7 to 11,

wherein the aerosol generating apparatus comprises a cavity (20) for receiving the consumable (70),
 wherein the heating element (54) is arranged within the cavity (20), and
 wherein the cavity (20) is dimensioned such that the consumable (70) is insertable and removable substantially without obstruction of and/or damage to the exterior of the consumable when the heating element penetrates the consumable material during the insertion process of the consumable (70) into the cavity (20).

13. Set according to any one of claims 7 to 12, wherein the consumable material is provided such that the heating element (54) is insertable into the consumable material during the insertion process of the consumable into the cavity without a substantial increase of the consumable diameter or consumable volume.

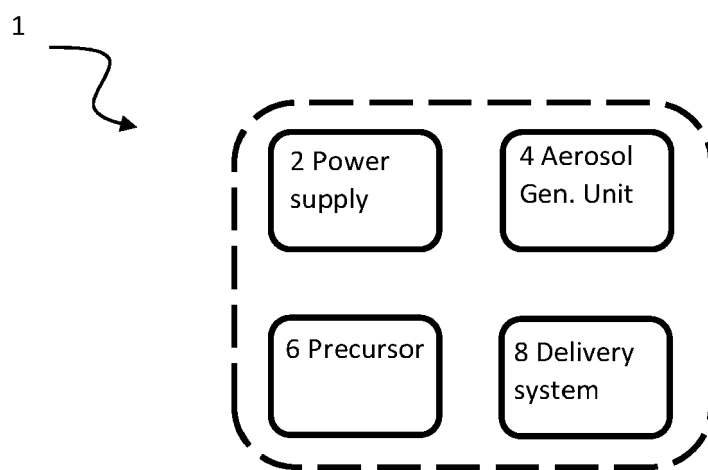


Fig. 1

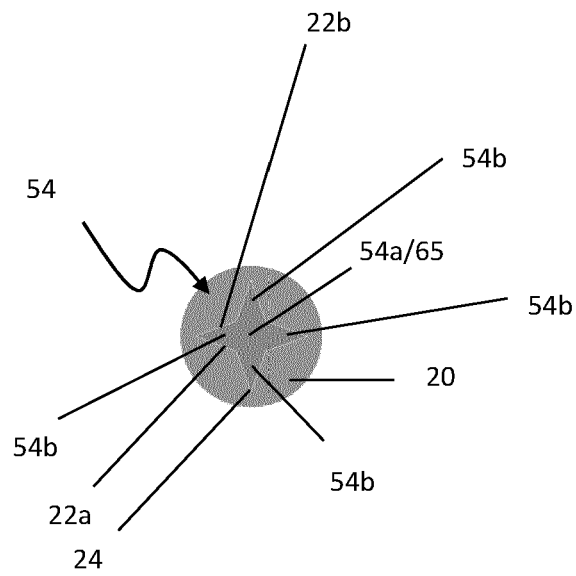


Fig. 2

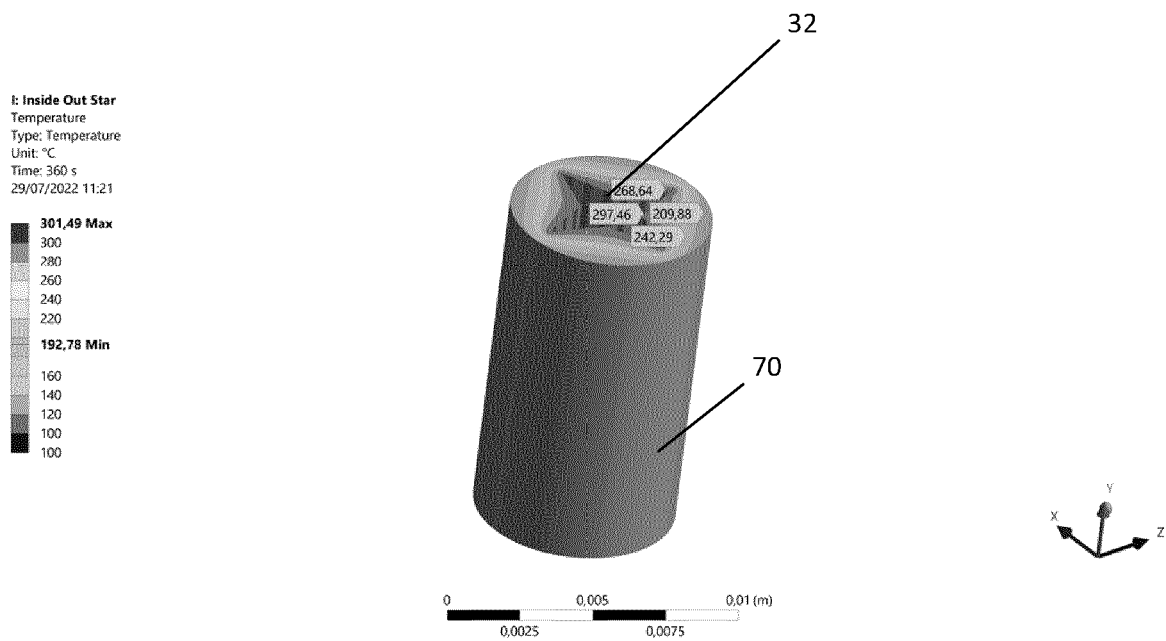


Fig. 3

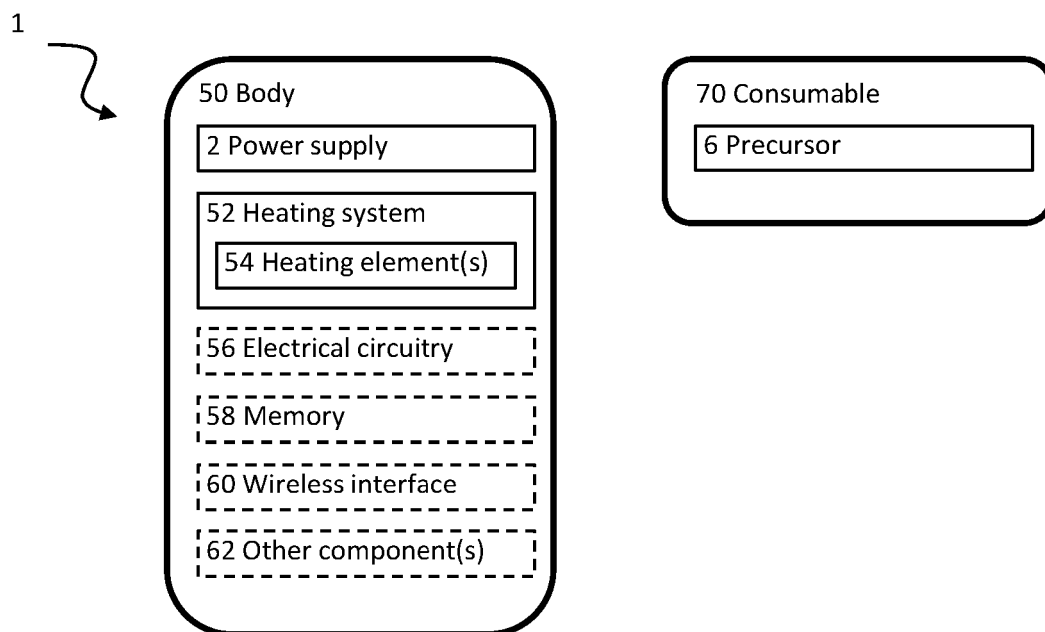


Fig. 4

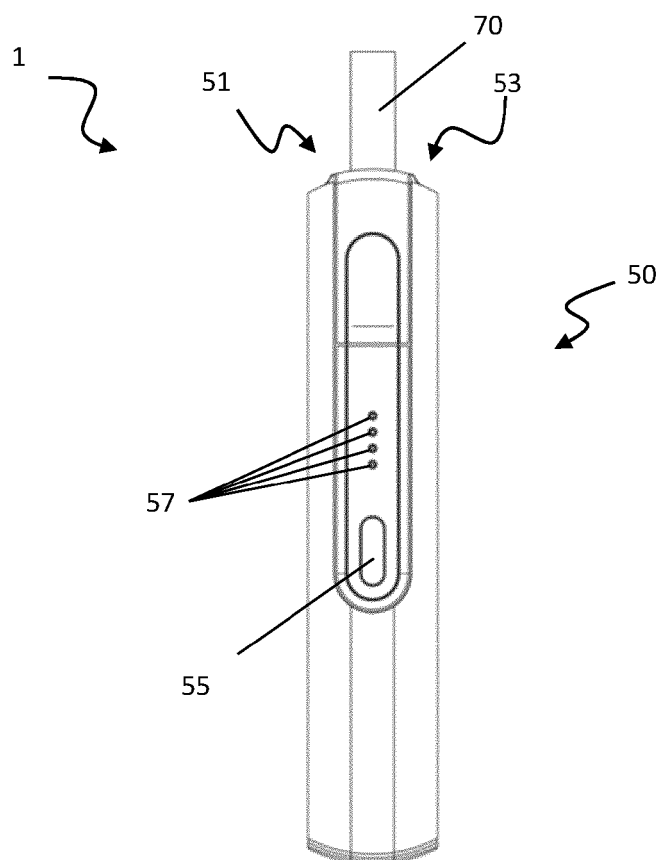


Fig. 5

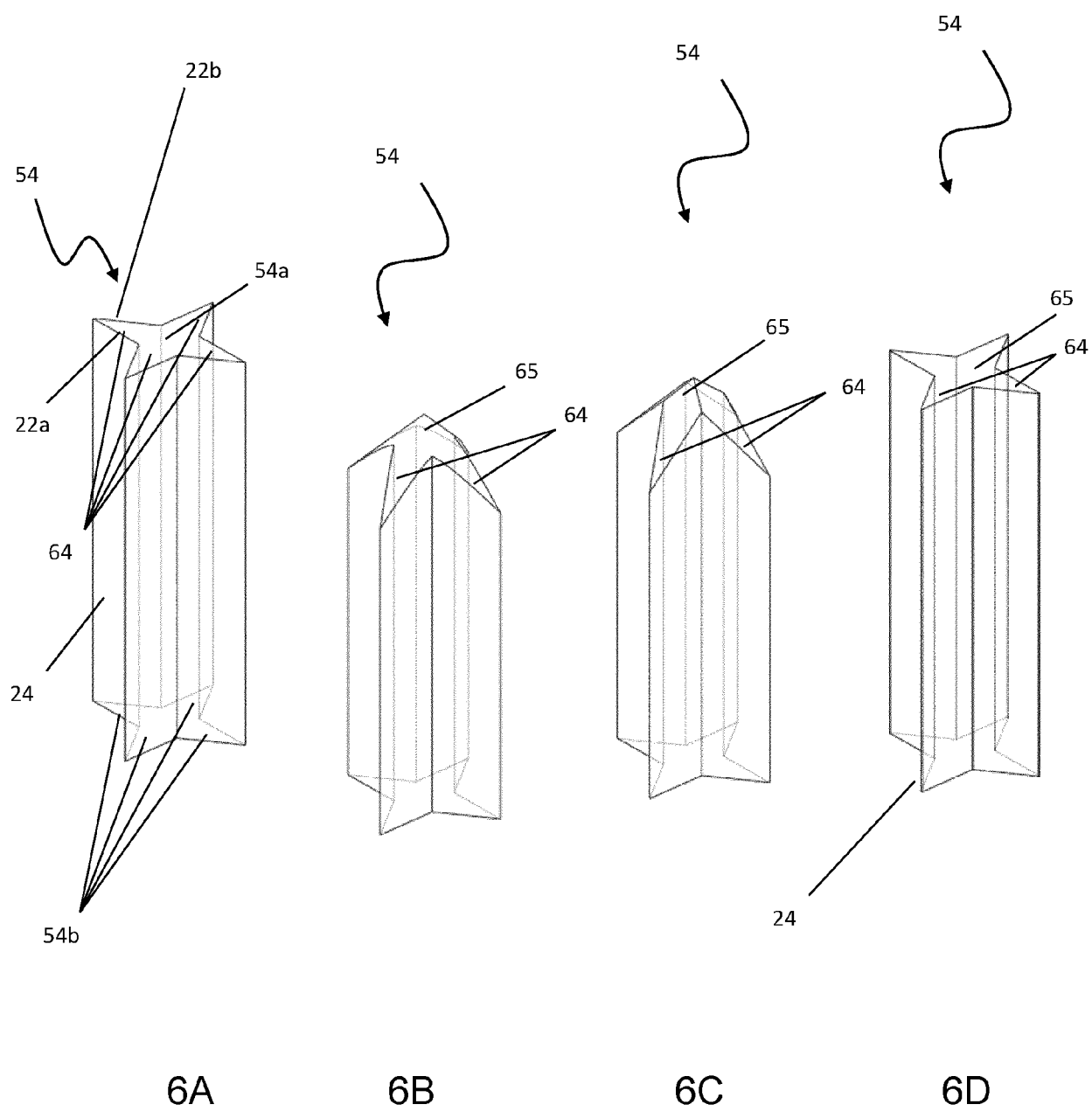
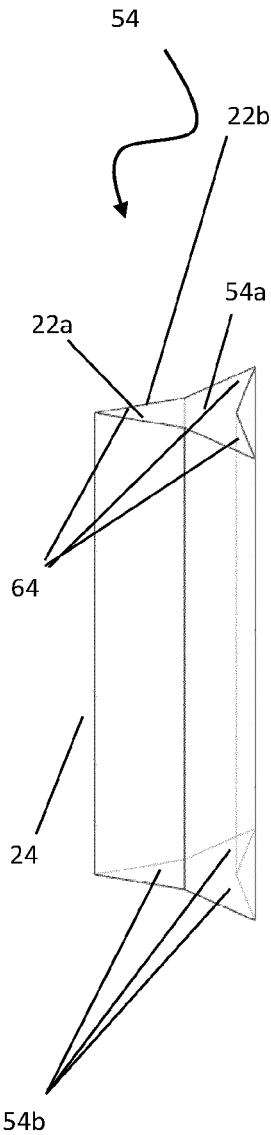
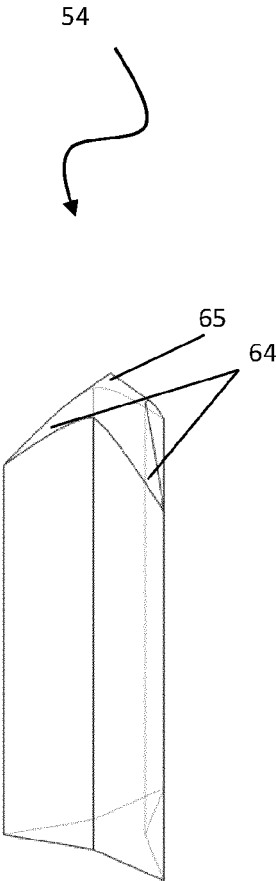


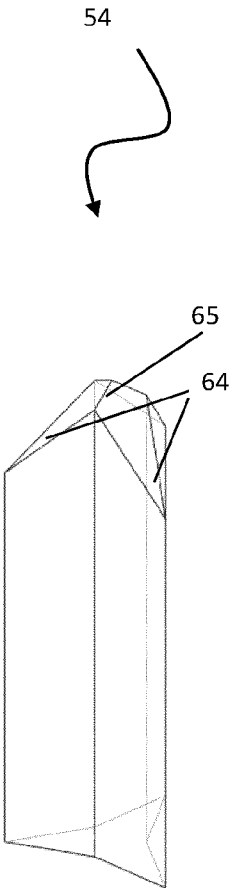
Fig. 6



7A



7B



7C

Fig. 7

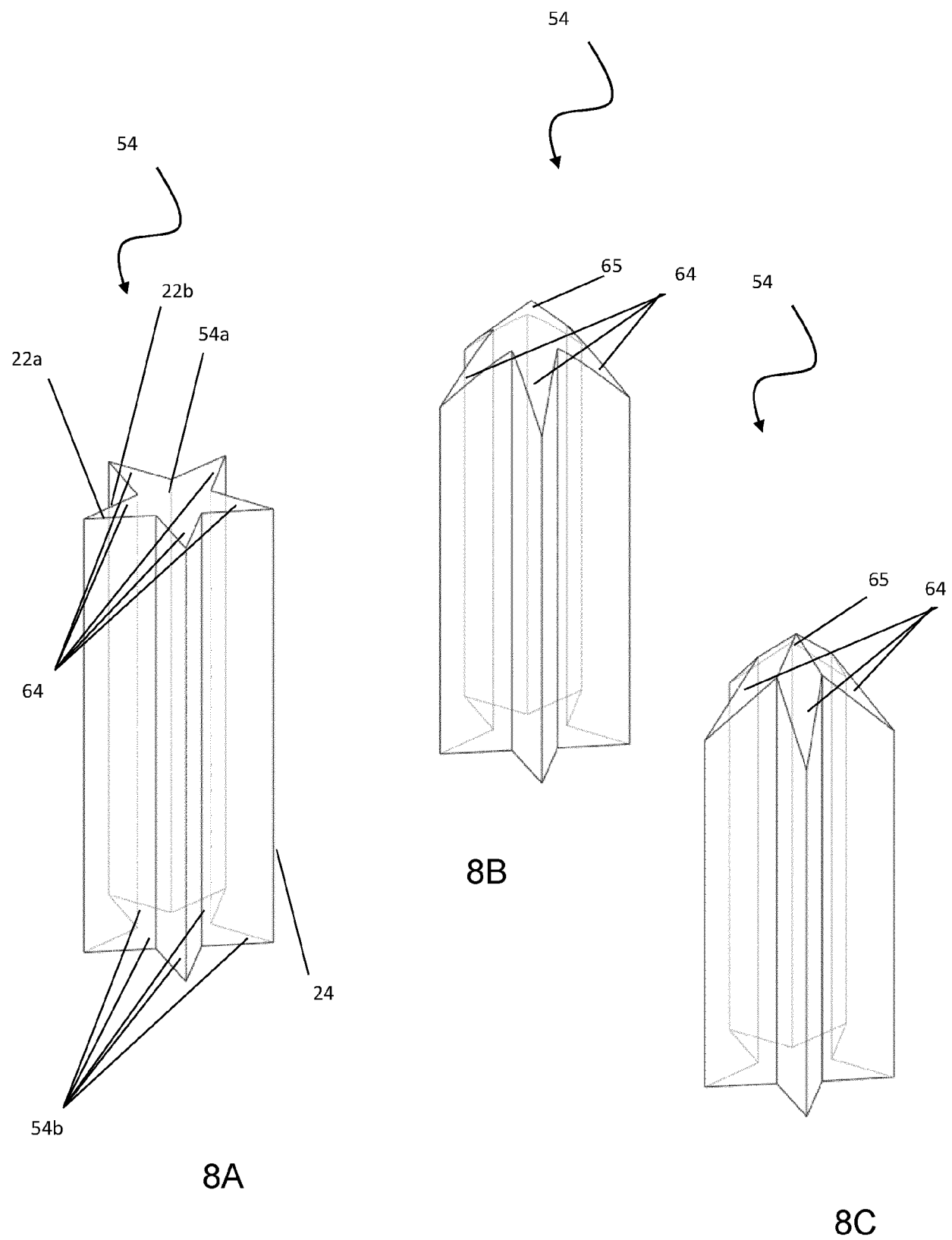


Fig. 8



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Application Number

EP 23 21 4692

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Munich			Klintebäck, Daniel
Date of completion of the search			
17 May 2024			
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