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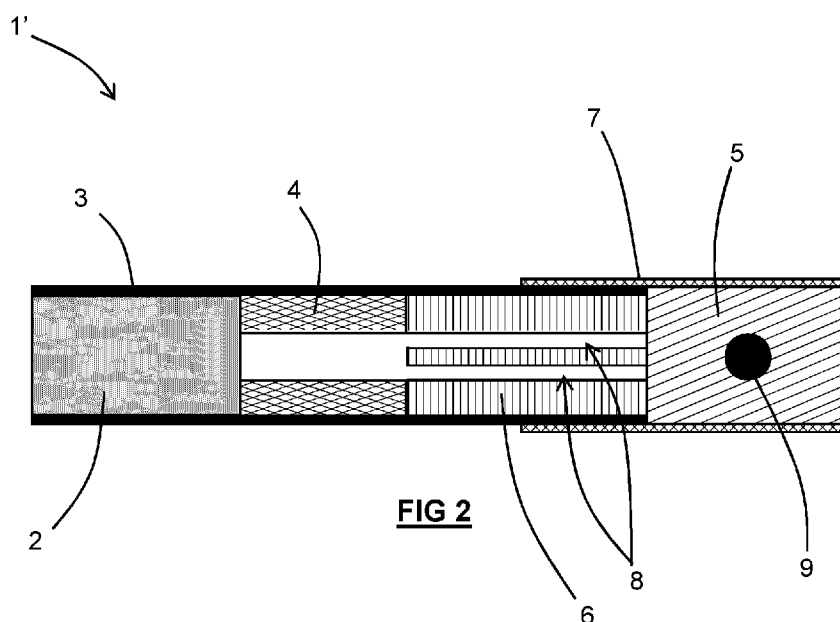
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(54) Title: SMOKING SUBSTITUTE CONSUMABLE



(57) Abstract: The present disclosure relates to an aerosol-forming article (1) comprising a cooling element (6). The cooling element (6) comprises a solid body formed of a plastics material and defining one or more bores (8) extending through the cooling element (6).

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## ***Smoking substitute consumable***

### ***Field of the Disclosure***

The present disclosure relates to a consumable for use in a smoking substitute system and particularly, although not exclusively, to a heat-not-burn (HNB) consumable.

### ***Background***

The smoking of tobacco is generally considered to expose a smoker to potentially harmful substances. It is generally thought that a significant amount of the potentially harmful substances are generated through the heat caused by the burning and/or combustion of the tobacco and the constituents of the burnt tobacco in the tobacco smoke itself.

10 Conventional combustible smoking articles, such as cigarettes, typically comprise a cylindrical rod of tobacco comprising shreds of tobacco which is surrounded by a wrapper, and usually also a cylindrical filter axially aligned in an abutting relationship with the wrapped tobacco rod. The filter typically comprises a filtration material which is circumscribed by a plug wrap. The wrapped tobacco rod and the filter are joined together by a wrapped band of tipping paper that circumscribes the entire length of the filter and an adjacent  
15 portion of the wrapped tobacco rod. A conventional cigarette of this type is used by lighting the end opposite to the filter, and burning the tobacco rod. The smoker receives mainstream smoke into their mouth by drawing on the mouth end or filter end of the cigarette.

Combustion of organic material such as tobacco is known to produce tar and other potentially harmful by-products. There have been proposed various smoking substitute systems (or "substitute smoking systems")  
20 in order to avoid the smoking of tobacco.

Such smoking substitute systems can form part of nicotine replacement therapies aimed at people who wish to stop smoking and overcome a dependence on nicotine.

Smoking substitute systems include electronic 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  
25 (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.

In general, smoking substitute systems are intended to provide a substitute for the rituals of smoking, whilst providing the user with a similar experience and satisfaction to those experienced with traditional smoking and with combustible tobacco products. Some smoking substitute systems use smoking substitute articles

that are designed to resemble a traditional cigarette and are cylindrical in form with a mouthpiece at one end.

The popularity and use of smoking substitute systems has grown rapidly in the past few years. Although originally marketed as an aid to assist habitual smokers wishing to quit tobacco smoking, consumers are increasingly viewing smoking substitute systems as desirable lifestyle accessories.

There are a number of different categories of smoking substitute systems, each utilising a different smoking substitute approach.

One approach for a smoking substitute system is the so-called "heat not burn" ("HNB") approach in which tobacco (rather than an "e-liquid") 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 HNB approach the intention is that the tobacco is heated but not burned, i.e. the tobacco does not undergo combustion.

A typical HNB smoking substitute system may include a device and a consumable. The consumable may include the tobacco material. The device and consumable may be configured to be physically coupled together. In use, heat may be 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.

As the vapour passes through the consumable (entrained in the airflow) from an inlet to a mouthpiece (outlet), the vapour cools and condenses to form an aerosol for inhalation by the user. The aerosol will normally contain the volatile compounds.

In HNB smoking substitute systems, heating as opposed to burning the tobacco material is believed to cause fewer, or smaller quantities, of the more harmful compounds ordinarily produced during smoking. Consequently, the HNB approach may reduce the odour and/or health risks that can arise through the burning, combustion and pyrolytic degradation of tobacco.

In some cases, the aerosol passing from the mouthpiece (i.e. being inhaled by a user) may not be in a desirable state. Thus, it may be desirable to alter one or more characteristics of the aerosol before it is inhaled by the user.

There is a need for an improved design of HNB consumables to enhance the user experience and improve the function of the HNB smoking substitute system.

The present disclosure has been devised in the light of the above considerations.

### ***Summary of the Disclosure***

At its most general, the present disclosure relates to an aerosol-forming article e.g. a smoking substitute article such as an HNB consumable

- 5 According to a first aspect, there is provided an aerosol-forming article (e.g. a smoking substitute article such as an HNB consumable) comprising a cooling element, the cooling element comprising a solid body, formed of a plastics material, defining one or more axial bores extending through the cooling element.

A solid body may be formed in a single-step process, which may facilitate manufacture of the article. Further, a cooling element formed of a solid body may provide structural support (e.g. rigidity) to the aerosol-  
10 forming article.

Optional features will now be set out. These are applicable singly or in any combination with any aspect.

In some embodiments the solid body may be one of injection moulded, extruded or additive manufactured. Each of these processes may involve forming the cooling element in a single-step process. That is, the bores may be formed concurrently with the body (rather than e.g. machined/cut-out out of the body in a  
15 separate process).

In some embodiments the plastics material comprises polylactic acid (PLA) e.g. biodegradable polylactic acid. In this respect, the plastics material (and consequently, the cooling element) may be biodegradable. The cooling element may solely be formed of PLA, or may be formed of PLA in combination with another material (e.g. another plastics material).

- 20 The cooling element may alternatively or additionally be formed of a plastics material selected from the group consisting of polyvinyl chloride (PVC), polyethylene (PE), polypropylene (PP), and polyethylene terephthalate (PET).

In some embodiments the body is substantially tubular. That is, the cooling element may be substantially cylindrical with a bore extending therethrough. The bore may have a substantially circular transverse  
25 profile. Alternatively, the bore may have a transverse profile that is e.g. rectangular, triangular, elliptical, etc. The bore may extend along a central longitudinal axis of the body.

The cooling element may have an external diameter of between 5 and 10mm e.g. between 6 and 9mm or 6 and 8mm e.g. around 7 mm. It may have an axial length of between 10 and 15mm e.g. between 12 and 14 mm or 13 and 14mm e.g. around 14mm. The bore of the cooling element may have a diameter of

between 1 and 5 mm, e.g. between 2 and 4 mm or between 2 and 3 mm. Alternatively, the bore may have a diameter of between 3 and 7 mm, e.g. between 4 and 6 mm.

In some embodiments, the body may define a plurality of bores (e.g. two, three, four etc. bores). The bores may be arranged in a predetermined manner. The term 'predetermined' means the bores are formed (and  
5 arranged) in a deliberate manner, rather than being formed simply as a consequence of the nature of the material of the cooling element (e.g. such as pathways being formed between fibres of a fibrous material).

The or each bore may extend so as to be substantially parallel to the longitudinal axis. Alternatively, the or each bore may extend at an angle relative to a longitudinal axis, or may e.g. have a curved (rather than linear) path. The use of injection moulding or additive manufacturing may be conducive to the inclusion of  
10 bores that extend non-longitudinally (e.g. in a curvilinear or at an angle to the longitudinal axis). The plurality of bores may be arranged so as to maximise the surface area of the bores in the cooling element (i.e. to maximise heat exchange between vapour flowing through the cooling element and the body of the cooling element).

In some embodiments the cooling element may comprise an additive. The additive may comprise a  
15 flavourant. In this respect, the flavourant may be dispersed from the cooling element to vapour flowing through the cooling element. The flavourant that is dispersed to the vapour may thus alter the flavour of the vapour prior to it being inhaled by a user. The flavourant may be provided in solid or liquid form. It may include menthol, liquorice, chocolate, fruit flavour (including e.g. citrus, cherry etc.), vanilla, spice (e.g. ginger, cinnamon) and tobacco flavour. The flavourant may be evenly dispersed throughout the cooling  
20 element or may be provided in isolated locations and/or varying concentrations throughout the cooling element.

In some embodiments the additive may be sprayed onto, or coated on, the cooling element. The additive may be added to the plastics material prior to e.g. injection moulding, extrusion or additive manufacturing of the body of the cooling element.

25 In some embodiments the additive may be in the form of a thread passed through the cooling element. The thread may be formed into the cooling element (e.g. during the injection moulding, extrusion or additive manufacturing process).

In some embodiments the aerosol-forming article may further comprise an aerosol-forming substrate. The cooling element may be located downstream of the aerosol-forming substrate.

30 As used herein, the terms "upstream" and "downstream" are intended to refer to the flow direction of the vapour/aerosol i.e. with the downstream end of the article being the mouth end or outlet where the aerosol

exits the article for inhalation by the user. The upstream end of the article is the opposing end to the downstream end.

The aerosol-forming article is preferably a heat-not-burn (HNB) consumable.

5 The aerosol-forming substrate is capable of being heated to release at least one volatile compound that can form an aerosol. The aerosol-forming substrate may be located at the upstream end of the article/consumable.

10 In order to generate an aerosol, the aerosol-forming substrate comprises at least one volatile compound that is intended to be vaporised/aerosolised and that may provide the user with a recreational and/or medicinal effect when inhaled. Suitable chemical and/or physiologically active volatile compounds include the group consisting of: nicotine, cocaine, caffeine, opiates and opioids, cathine and cathinone, kavalactones, mysticin, beta-carboline alkaloids, salvinorin A together with any combinations, functional equivalents to, and/or synthetic alternatives of the foregoing.

15 The aerosol-forming substrate may comprise plant material. The plant material may comprise least one plant material selected from the list including *Amaranthus dubius*, *Arctostaphylos uva-ursi* (Bearberry), *Argemone mexicana*, *Amica*, *Artemisia vulgaris*, Yellow Tees, *Galea zacatechichi*, *Canavalia maritima* (Baybean), *Cecropia mexicana* (Guamora), *Cestrum nocturnum*, *Cynoglossum virginianum* (wild comfrey), *Cytisus scoparius*, *Damiana*, *Entada rheedii*, *Eschscholzia californica* (California Poppy), *Fittonia albivenis*, *Hippobroma longiflora*, *Humulus japonica* (Japanese Hops), *Humulus lupulus* (Hops), *Lactuca virosa* (Lettuce Opium), *Laggera alata*, *Leonotis leonurus*, *Leonurus cardiaca* (Motherwort), *Leonurus sibiricus* (Honeyweed), *Lobelia cardinalis*, *Lobelia inflata* (Indian-tobacco), *Lobelia siphilitica*, *Nepeta cataria* (Catnip), *Nicotiana species* (Tobacco), *Nymphaea alba* (White Lily), *Nymphaea caerulea* (Blue Lily), Opium poppy, *Passiflora incarnata* (Passionflower), *Pedicularis densiflora* (Indian Warrior), *Pedicularis groenlandica* (Elephant's Head), *Salvia divinorum*, *Salvia dorrii* (Tobacco Sage), *Salvia species* (Sage), *Scutellaria galericulata*, *Scutellaria lateriflora*, *Scutellaria nana*, *Scutellaria species* (Skullcap), *Sida acuta* (Wireweed), *Sida rhombifolia*, *Silene capensis*, *Syzygium aromaticum* (Clove), *Tagetes lucida* (Mexican Tarragon), *Tarhonanthus camphoratus*, *Tumera diffusa* (Damiana), *Verbascum* (Mullein), *Zamia latifolia* (Maconha Brava) together with any combinations, functional equivalents to, and/or synthetic alternatives of the foregoing.

30 Preferably, the plant material is tobacco. Any type of tobacco may be used. This includes, but is not limited to, flue-cured tobacco, burley tobacco, Maryland Tobacco, dark-air cured tobacco, oriental tobacco, dark-fired tobacco, perique tobacco and rustica tobacco. This also includes blends of the above mentioned tobaccos.

Any suitable parts of the tobacco plant may be used. This includes leaves, stems, roots, bark, seeds and flowers.

The tobacco may comprise one or more of leaf tobacco, stem tobacco, tobacco powder, tobacco dust, tobacco derivatives, expanded tobacco, homogenised tobacco, shredded tobacco, extruded tobacco, cut  
5 rag tobacco and/or reconstituted tobacco (e.g. slurry recon or paper recon).

The aerosol-forming substrate may comprise a gathered sheet of homogenised (e.g. paper/slurry recon) tobacco or gathered shreds/strips formed from such a sheet.

In some embodiments, the sheet used to form the aerosol-forming substrate has a grammage greater than or equal to 100 g/m<sup>2</sup>, e.g. greater than or equal to 110 g/m<sup>2</sup> such as greater than or equal to 120 g/m<sup>2</sup>.

10 The sheet may have a grammage of less than or equal to 300 g/m<sup>2</sup> e.g. less than or equal to 250 g/m<sup>2</sup> or less than or equal to 200 g/m<sup>2</sup>.

The sheet may have a grammage of between 120 and 190 g/m<sup>2</sup>.

The aerosol-forming substrate may comprise at least 50 wt% plant material, e.g. at least 60 wt% plant material e.g. around 65 wt% plant material. The aerosol-forming substrate may comprise 80 wt% or less  
15 plant material e.g. 75 or 70 wt% or less plant material.

The aerosol-forming substrate may comprise one or more additives selected from humectants, flavourants, fillers, aqueous/non-aqueous solvents and binders.

Humectants are provided as vapour generators – the resulting vapour helps carry the volatile active compounds and increases visible vapour. Suitable humectants include polyhydric alcohols (e.g. propylene glycol (PG), triethylene glycol, 1,2-butane diol and vegetable glycerine (VG)) and their esters (e.g. glycerol  
20 mono-, di- or tri-acetate). They may be present in the aerosol-forming substrate in an amount between 1 and 50 wt%.

The humectant content of the aerosol-forming substrate may have a lower limit of at least 1 % by weight of the plant material, such as at least 2 wt %, such as at least 5 wt %, such as at least 10 wt %, such as  
25 at least 20 wt %, such as at least 30 wt %, or such as least 40 wt %.

The humectant content of the aerosol-forming substrate may have an upper limit of at most 50 % by weight of the plant material, such as at most 40 wt %, such as at most 30 wt %, or such as at most 20 wt %.

Preferably, the humectant content is 1 to 40 wt % of the aerosol-forming substrate, such as 1 to 20 wt %

Suitable binders are known in the art and may act to bind together the components forming the aerosol-forming substrate. Binders may comprise starches and/or cellulosic binders such as methyl cellulose, ethyl cellulose, hydroxypropyl cellulose, hydroxyethyl cellulose and methyl cellulose, gums such as xanthan, guar, arabic and/or locust bean gum, organic acids and their salts such as alginic acid/ sodium alginate, agar and pectins.

Preferably the binder content is 5 to 10 wt% of the aerosol-forming substrate e.g. around 6 to 8 wt%.

Suitable fillers are known in the art and may act to strengthen the aerosol-forming substrate. Fillers may comprise fibrous (non-tobacco) fillers such as cellulose fibres, lignocellulose fibres (e.g. wood fibres), jute fibres and combinations thereof.

Preferably, the filler content is 5 to 10 wt% of the aerosol-forming substrate e.g. around 6 to 9 wt%.

The aerosol-forming substrate may comprise an aqueous and/or non-aqueous solvent. In some embodiments, the aerosol forming substrate has a water content of between 5 and 10 wt% e.g. between 6-9 wt% such as between 7-9 wt%.

As discussed above, with respect to the cooling element, the flavourant of the substrate may be provided in solid or liquid form. It may include menthol, liquorice, chocolate, fruit flavour (including e.g. citrus, cherry etc.), vanilla, spice (e.g. ginger, cinnamon) and tobacco flavour. The flavourant may be evenly dispersed throughout the aerosol-forming substrate or may be provided in isolated locations and/or varying concentrations throughout the aerosol-forming substrate.

The aerosol-forming substrate may be formed in a substantially cylindrical shape such that the article/consumable resembles a conventional cigarette. It may have a diameter of between 5 and 10mm e.g. between 6 and 9mm or 6 and 8mm e.g. around 7 mm. It may have an axial length of between 10 and 15mm e.g. between 11 and 14mm such as around 12 or 13mm.

The aerosol-forming substrate may be at least partly circumscribed by a wrapping layer e.g. a paper wrapping layer. The wrapping layer may overlie an inner foil layer or may comprise a paper/foil laminate (with the foil innermost). The cooling element may be at least partly (e.g. completely) circumscribed by the (paper) wrapping layer.

The article/consumable may comprise at least one filter element. There may be a terminal filter element at the downstream/mouth end of the article/consumable. The cooling element may be located between the terminal filter element and the substrate. There may be an upstream filter element (upstream of the downstream axial end).

There may be a plurality of e.g. two filter elements which may be adjacent one another or which may be spaced apart. Any filter element(s) upstream of the terminal filter element may be at least partly (e.g. entirely) circumscribed by the (paper) wrapping layer.

5 The or at least one of the filter element(s) (e.g. the terminal filter element/upstream filter element) may be comprised of cellulose acetate or polypropylene tow. The at least one filter element (e.g. the terminal filter element/upstream filter element) may be comprised of activated charcoal. The at least one filter element (e.g. the terminal element/upstream filter element) may be comprised of paper. The at least one filter element (e.g. the terminal element/upstream filter element) may be comprised of plant material e.g. extruded plant material. The or each filter element may be circumscribed with a plug wrap e.g. a paper  
10 plug wrap.

The or each filter element may have a substantially cylindrical shape with a diameter substantially matching the diameter of the aerosol-forming substrate (with or without its associated wrapping layer). The axial length of the or each filter element may be less than 20mm, e.g. between 8 and 15mm, for example between 9 and 13 mm e.g. between 10 and 12mm.

15 The or at least one of the filter element(s) (e.g. the terminal filter element/upstream filter element) may be a solid filter element. The or at least one of the filter element(s) (e.g. the terminal filter element/upstream filter element) may be a hollow bore filter element. The or each hollow bore filter element may have a bore diameter of between 1 and 5 mm, e.g. between 2 and 4 mm or between 2 and 3 mm.

20 The terminal filter element (at the downstream end of the article/consumable) may be joined to the upstream elements forming the article/consumable by a circumscribing tipping layer e.g. a tipping paper layer. The tipping paper may have an axial length longer than the axial length of the terminal filter element such that the tipping paper completely circumscribes the terminal filter element plus the wrapping layer surrounding any adjacent upstream element.

25 The or at least one of the filter elements e.g. the terminal filter element may include a capsule e.g. a crushable capsule (crush-ball) containing a liquid flavourant e.g. any of the flavourants listed above. The capsule can be crushed by the user during smoking of the article/consumable to release the flavourant. The capsule may be located at the axial centre of the filter element.

30 The article/consumable may comprise a spacer element that defines a space or cavity or chamber between the aerosol-forming substrate and the downstream end of the article/consumable. For example, it may be provided between the aerosol-forming substrate and the upstream filter element and/or between the two filter elements. The spacer acts to allow both cooling and mixing of the aerosol. The spacer element may

be a tubular spacer element e.g. it may comprise a cardboard tube. The spacer element may be at least partly (e.g. entirely) circumscribed by the (paper) wrapping layer.

The spacer element may have an external diameter of between 5 and 10mm e.g. between 6 and 9mm or 6 and 8mm e.g. around 7 mm. It may have an axial length of between 10 and 15mm e.g. between 12 and 14 mm or 13 and 14mm e.g. around 14mm.

In a second aspect, there is provided a method for forming a cooling element for an aerosol-forming article, the method comprising providing an at least partially molten plastics material, forming the plastics material into a solid body defining one or more bores.

In some embodiments, the method may comprise one of injection moulding, extrusion or additive manufacturing. In this respect, the forming of the solid body may be a single-step process.

The method may comprise melting, or at least partially melting, the plastics material.

In some embodiments the bores may be formed in the injection moulding, extrusion, or additive manufacturing process (i.e. concurrently as the body is formed).

Where the method comprises injection moulding, the method may comprise injecting the at least partially molten plastics material into a mould. The mould may comprise one or more portions (e.g. core plates or portions) defining the one or more bores. Where the method comprises extrusion, the method may comprise passing the at least partially molten material through a die. The one or more bores may be formed by e.g. a mandrel located in the die. Where the method comprises additive manufacturing, the additive manufacturing may be in the form of 3d printing. In this respect, the one or more bores may be formed in the process of printing the body (e.g. each printed layer may include a non-printed space that defines a portion of a bore).

In a third aspect, there is provided a smoking substitute system comprising an aerosol-forming article according to the first aspect and a device comprising a heating element.

The device may be a HNB device i.e. a device adapted to heat but not combust the aerosol-forming substrate.

The device may comprise a main body for housing the heating element. The heating element may comprise an elongated e.g. rod, tube-shaped or blade heating element. The heating element may project into or surround a cavity within the main body for receiving the article/consumable described above.

The device (e.g. the main body) may further comprise an electrical power supply e.g. a (rechargeable) battery for powering the heating element. It may further comprise a control unit to control the supply of power to the heating element.

5 In a fourth aspect, there is provided a method of using a smoking substitute system according to the third aspect, the method comprising inserting the article/consumable into the device, and heating the article/consumable using the heating element.

10 In some embodiments, the method comprises inserting the article/consumable into a cavity within the main body and penetrating the article/consumable with the heating element upon insertion of the article/consumable. For example, the heating element may penetrate the aerosol-forming substrate in the article/consumable.

The skilled person will appreciate that except where mutually exclusive, a feature or parameter described in relation to any one of the above aspects may be applied to any other aspect. Furthermore, except where mutually exclusive, any feature or parameter described herein may be applied to any aspect and/or combined with any other feature or parameter described herein.

## 15 ***Summary of the Figures***

So that the invention may be understood, and so that further aspects and features thereof may be appreciated, embodiments illustrating the principles of the invention will now be discussed in further detail with reference to the accompanying figures, in which:

Figure 1 shows a first embodiment of an HNB consumable;

20 Figure 2 shows a second embodiment of an HNB consumable

Figure 3 shows a third embodiment of an HNB consumable; and

Figure 4 shows the first embodiment within a device forming an HNB system.

## ***Detailed Description of the Figures***

25 As shown in Figure 1, the HNB consumable 1 comprises an aerosol-forming substrate 2 at the upstream end of the consumable 1.

The aerosol-forming substrate 2 comprises reconstituted tobacco which includes nicotine as a volatile compound.

The aerosol-forming substrate 2 comprises 65 wt% tobacco which is provided in the form of gathered shreds produced from a sheet of slurry/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%. The aerosol-forming substrate further comprises cellulose pulp filler and guar gum binder.

The aerosol-forming substrate 2 is formed in a substantially cylindrical shape such that the consumable resembles a conventional cigarette. It has diameter of around 7mm and an axial length of around 12 mm.

The aerosol-forming substrate 2 is circumscribed by a paper wrapping layer 3.

The consumable 1 comprises an upstream filter element 4 and a downstream (terminal) filter element 5.

The two filter elements 4, 5 and spaced by a cooling element 6. Both filter elements 4, 5 are formed of cellulose acetate tow and wrapped with a respective paper plug layer (not shown).

Both filter elements have a substantially cylindrical shape. The diameter of the upstream filter element 4 matches the diameter of the aerosol-forming substrate 2. The diameter of the terminal filter element 5 is slightly larger and matches the combined diameter of the aerosol-forming substrate 2 and the wrapping layer 3. The upstream filter element 4 is slightly shorter in axial length than the terminal filter element 5 at an axial length of 10 mm compared to 12 mm for the terminal filter element 5.

The cooling element 6 is longer than each of the two filter elements 4, 5 having an axial length of around 14mm. The cooling element 6 is formed of injection moulded polylactic acid (PLA) and comprises a tubular body defining a bore 8 having a circular transverse profile and extending longitudinally through the cooling element. In use, the vapour formed by the aerosol-forming substrate may cool and condense by way of heat exchange with the body of the cooling element 6. The diameter of the bore 8 of the cooling element is around 4 mm.

Each filter element 4, 5 is a hollow bore filter element with a hollow, longitudinally extending bore. The diameter of the bore in the upstream filter element 4 is slightly larger than the diameter of the bore in the terminal filter element 5 having a diameter of 3 mm compared to 2 mm for the terminal filter element 5.

The cooling element 6 and the upstream filter element 4 are circumscribed by the wrapping layer 3.

The terminal filter element 5 is joined to the upstream elements forming the consumable by a circumscribing paper tipping layer 7. The tipping layer 7 encircles the terminal filter element 5 and has an axial length of around 20mm such that it overlays a portion of the cooling element 6.

Figure 2 shows a second embodiment of a consumable 1' which is the same as that shown in Figure 1 except for the cooling element 6 and the terminal filter element 5.

The terminal filter element 5 is a solid filter element and comprises a crushable capsule 9 (crush-ball) having a shell wall containing a liquid menthol or cherry or vanilla flavourant. The capsule 9 is spherical and has a diameter of 3.5mm. It is positioned within the axial centre of the terminal filter element 5.

The cooling element 6 is formed by additive manufacturing (i.e. 3d printing) and comprises four bores 8 (only two are apparent from the cross-section). Each bore 8 has a circular transverse profile with a diameter of 1 mm, and extends longitudinally through the cooling element 6.

Figure 3 shows a third embodiment of a consumable 1'' which is the same as the first embodiment except for the cooling element 6 and the further inclusion of a cardboard spacer tube 10.

The cardboard spacer tube 10 is located between the cooling element 6 and the upstream filter 4. The spacer element 10 defines a space in which vapour (formed by the substrate 2) may mix and condense. The spacer tube 10 has a length of 6 mm. Due to the presence of the spacer tube 10, the cooling element 6 is shorter than in previously described embodiments, and has a length of 8 mm. The cooling element 6 is similar to that shown in Figure 1, except it is formed of extruded PLA.

Figure 4 shows the first embodiment inserted into an HNB device 11 comprising a rod-shaped heating element 20. The heating element 20 projects into a cavity 12 within the main body 13 of the device.

The consumable 1 is inserted into the cavity 12 of the main body 3 of the device 11 such that the heating rod 20 penetrates the aerosol-forming substrate 2. Heating of the reconstituted tobacco in the aerosol-forming substrate 2 is effected by powering the heating element (e.g. with a rechargeable battery (not shown)). As the tobacco is heated, moisture and volatile compound (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 element 5.

As the vapour cools within the upstream filter element 4 and the cardboard tube spacer 6, it condenses to form an aerosol containing the volatile compounds for inhalation by the user.

The features disclosed in the foregoing description, or in the following claims, or in the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for obtaining the disclosed results, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

While the invention has been described in conjunction with the exemplary embodiments described above, many equivalent modifications and variations will be apparent to those skilled in the art when given this disclosure. Accordingly, the exemplary embodiments of the invention set forth above are considered to be illustrative and not limiting. Various changes to the described embodiments may be made without departing  
5 from the scope of the invention.

For the avoidance of any doubt, any theoretical explanations provided herein are provided for the purposes of improving the understanding of a reader. The inventors do not wish to be bound by any of these theoretical explanations.

Any section headings used herein are for organizational purposes only and are not to be construed as  
10 limiting the subject matter described.

Throughout this specification, including the claims which follow, unless the context requires otherwise, the words "have", "comprise", and "include", and variations such as "having", "comprises", "comprising", and "including" will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

15 It must be noted that, as used in the specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise. Ranges may be expressed herein as from "about" one particular value, and/or to "about" another particular value. When such a range is expressed, another embodiment includes from the one particular value and/or to the other particular value. Similarly, when values are expressed as approximations, by the use of the antecedent "about," it will  
20 be understood that the particular value forms another embodiment. The term "about" in relation to a numerical value is optional and means, for example, +/- 10%.

The words "preferred" and "preferably" are used herein refer to embodiments of the invention that may provide certain benefits under some circumstances. It is to be appreciated, however, that other embodiments may also be preferred under the same or different circumstances. The recitation of one or  
25 more preferred embodiments therefore does not mean or imply that other embodiments are not useful, and is not intended to exclude other embodiments from the scope of the disclosure, or from the scope of the claims.

**Claims:**

1. An aerosol-forming article comprising a cooling element, the cooling element comprising a solid body, formed of a plastics material, defining one or more bores extending through the cooling element.
2. An aerosol-forming article according to claim 1 wherein the body is one of injection moulded,  
5 extruded or additive manufactured.
3. An aerosol-forming article according to claim 1 or 2 wherein the plastics material comprises polylactic acid (PLA).
4. An aerosol-forming article according to any one of the preceding claims wherein the body is substantially tubular.
- 10 5. An aerosol-forming article according to any one of claims 1 to 3 wherein the body defines a plurality of bores arranged in a predetermined manner.
6. An aerosol-forming article according to any one of the preceding claims wherein the cooling element comprises an additive.
7. An aerosol-forming article according to any one of the preceding claims comprising an aerosol-  
15 forming substrate, the cooling element located downstream of the aerosol-forming substrate.
8. An aerosol-forming article according to claim 6 comprising a hollow bore terminal filter element at a downstream end of the article, the cooling element located between the aerosol-forming substrate and the terminal filter.
9. A method for forming a cooling element for an aerosol-forming article, the method comprising:  
20 providing an at least partially molten plastics material;  
forming the plastics material into a solid body defining one or more bores.
10. A method according to claim 9 wherein the step of forming the plastics material comprises one of injection moulding, extrusion or additive manufacturing.
11. A method according to claim 10 wherein the bores are formed in the injection moulding, extrusion, or  
25 additive manufacturing process.
12. A system comprising an aerosol-forming article according to any one of the preceding claims and a device comprising a heating element.

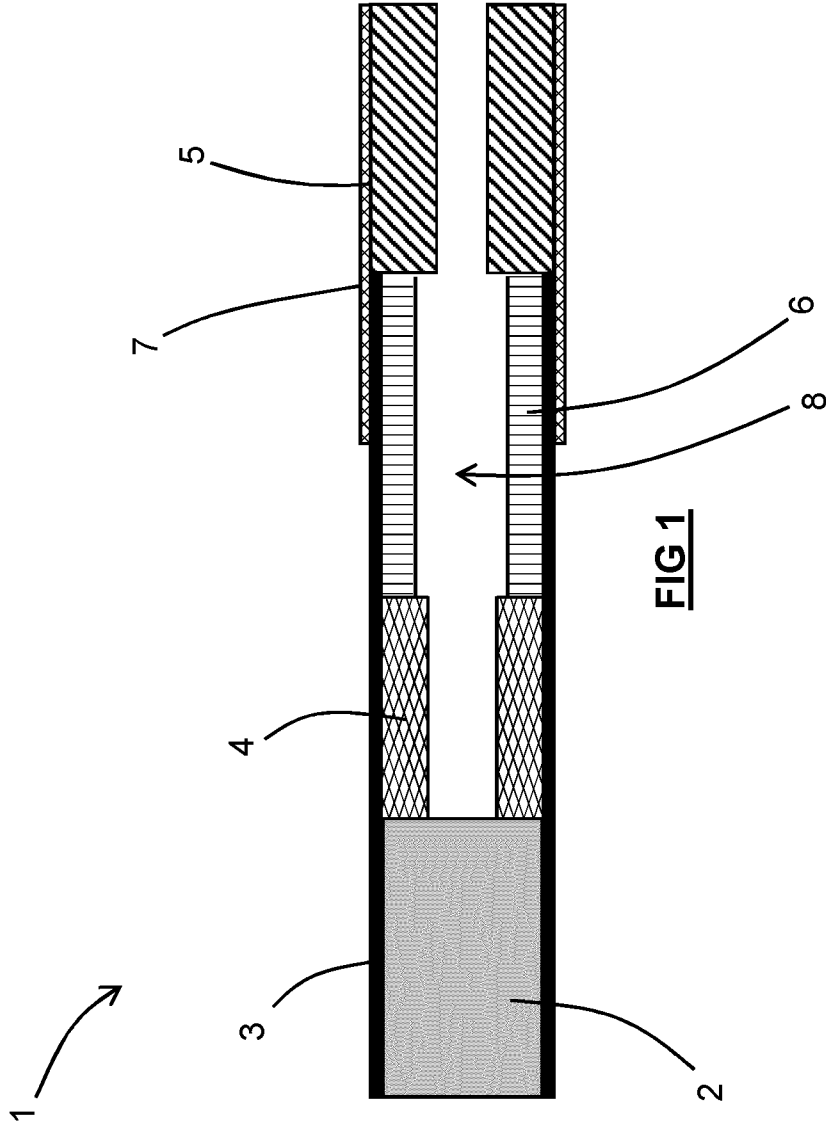
13. A system according to claim 12 wherein the device comprises a main body for housing the heating element and the heating element comprises an elongated heating element.

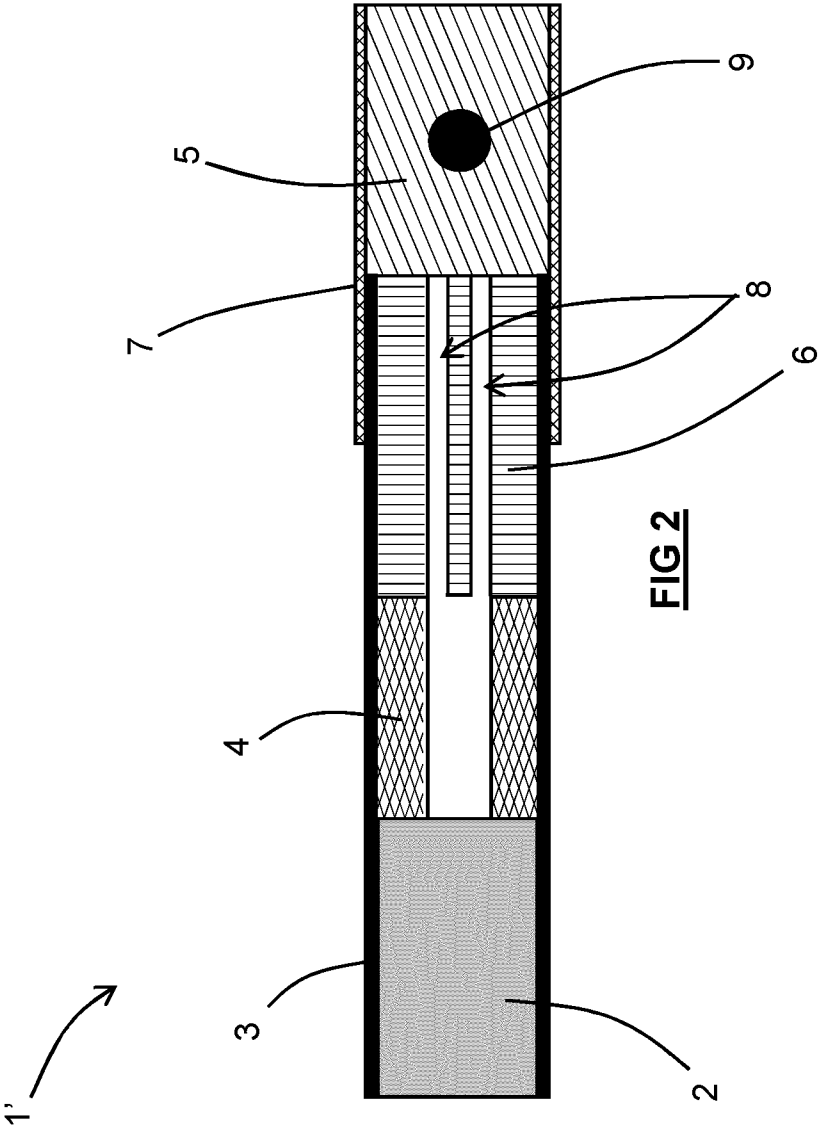
14. A method of using the system according to claim 12 or 13, the method comprising:

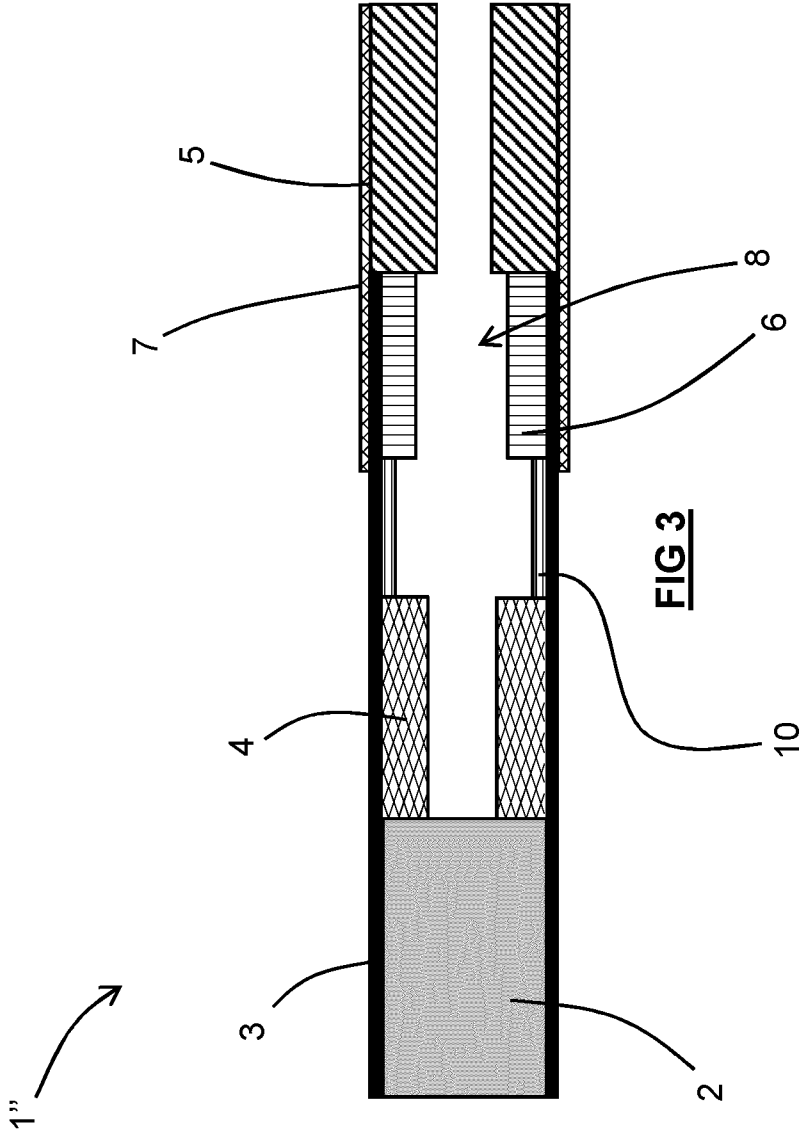
inserting the article into the device; and

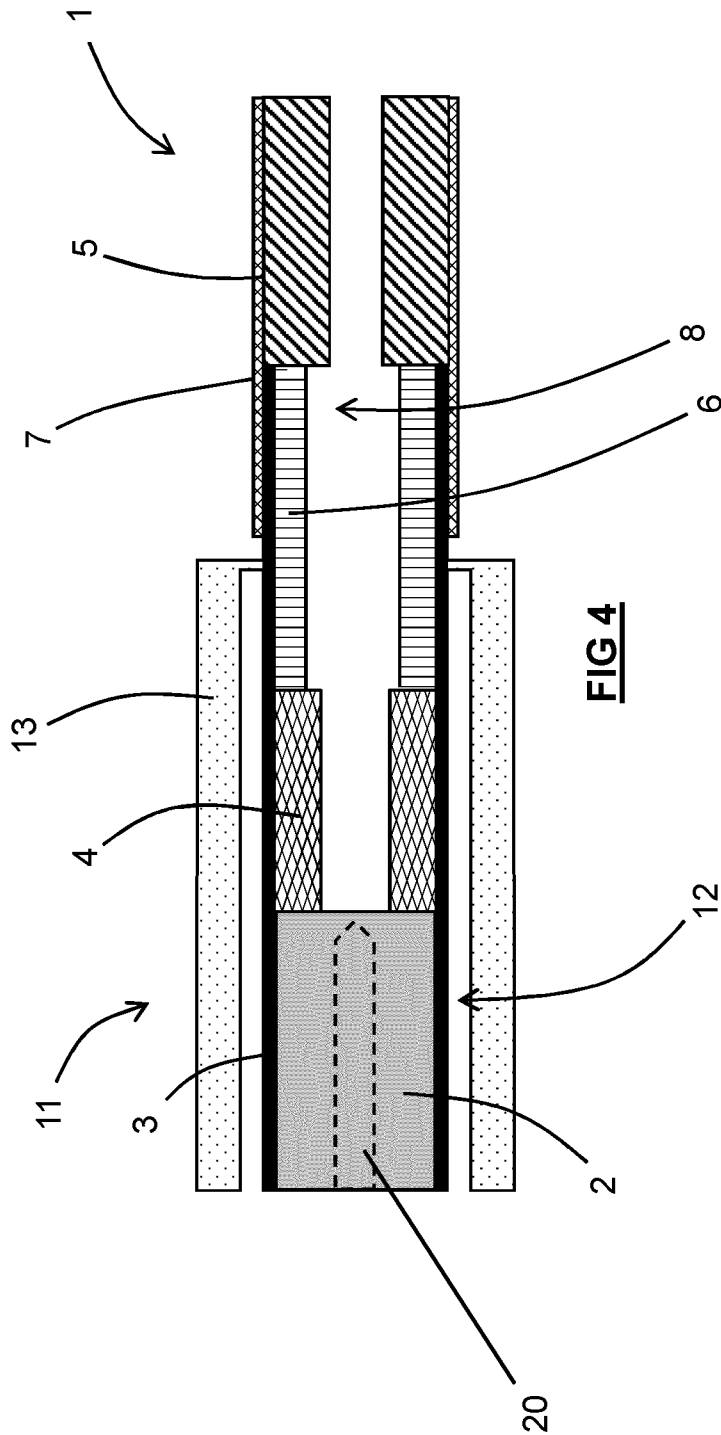
5 heating the article using the heating element.

15. A method according to claim 14 comprising inserting the article into a cavity within a main body of the device and penetrating the article with the heating element upon insertion of the article.









## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2019/079230

A. CLASSIFICATION OF SUBJECT MATTER  
INV. A24D1/20 A24F40/46  
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
A24D A24F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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| A         | paragraphs [0004], [0011], [0056],<br>[0057], [0061], [0088], [0091],<br>[0097], [0098], [0100]; figures<br>1,2,5,10,13,14                                                                                        | 15                    |
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Further documents are listed in the continuation of Box C.



See patent family annex.

\* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

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## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2019/079230

| C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                                                                                                           |                       |
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Information on patent family members

International application No

PCT/EP2019/079230

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