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(54) **AEROSOL GENERATION DEVICE**

(57) A heating element (20) for an aerosol generation device is disclosed comprising a first electrically conductive component (28) and a second electrically conductive component (30), where the second component (30) has a higher electrical conductivity than the first component (28) and where the first and second components are arranged such that, in use, the second component (30) provides a preferential current path between electrical contact points of the heating element (20).

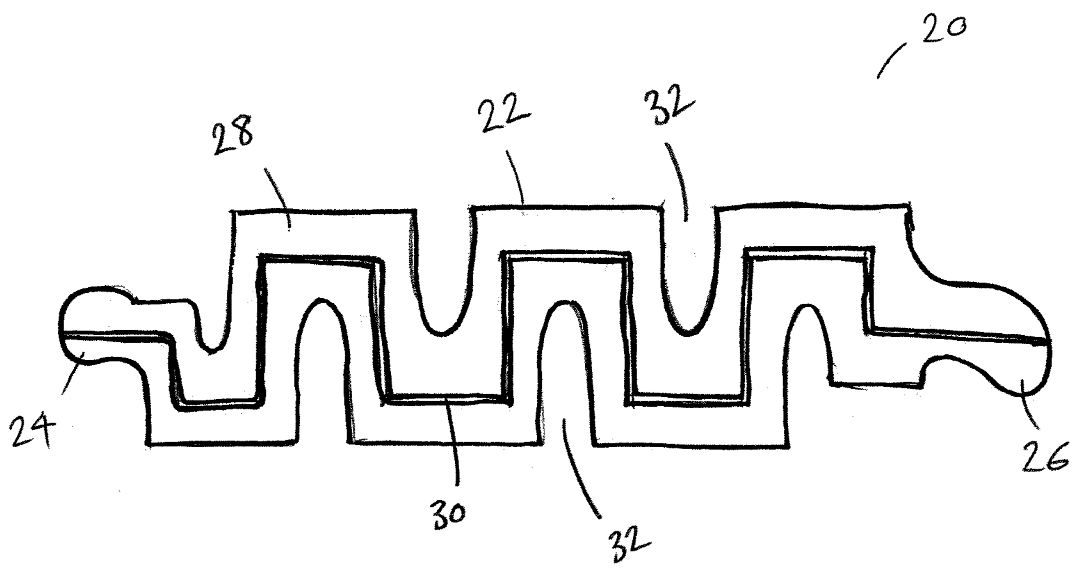

FIG. 2

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Description

[0001] The present invention relates to a heating element for an aerosol generation device or system, such as an electronic cigarette.

[0002] Known aerosol generation devices often use a heating component, or heater, to heat an aerosol generating liquid in order to generate an aerosol, or vapour, for inhalation by a user. The heating component is typically made of a conductive material which allows an electric current to flow through it when electrical energy is applied across the heating component. The electrical resistance of the conductive material causes heat to be generated as the electric current passes through the material, a process commonly known as resistive heating.

[0003] Heating components in the art include a metal wire or a fibre mesh array formed into different shapes, for example a coil wire. In use the heater is typically in contact or in close proximity to a wicking element that draws aerosol generating liquid from a reservoir or supply in the device to be vaporised. The wicking element commonly has a fibrous or porous structure which causes liquid to be drawn from the liquid supply by capillary action.

[0004] Some heating elements, in particular fibre mesh array heaters, combine the heating and wicking functions, where for example a sheet of electrically conductive porous material uses capillary action to draw the aerosol generating liquid from the reservoir into the heating component, which also provides heat when electrical energy is passed through it. The sheet of electrically conductive porous material can be shaped to optimise the synergy between heating and wicking functions.

[0005] An object of the invention is to provide a more reliable and effective heating element for an aerosol generation device.

[0006] According the present invention there is provided a heating element for an aerosol generation device, the heating element comprising: two contact points arranged to allow a current to be applied to the heating element in use; a first electrically conductive component; and a second electrically conductive component, the second component having a higher electrical conductivity than the first component, wherein the first and second components are arranged such that, in use, the second component provides a preferential current path across the heating element between the contact points.

[0007] In this way the current flow and temperature distribution of a heating element are more reproducible, thereby providing a more reliable and effective heater response. In use a higher current density passes through the second component compared to the first component due to its higher conductivity, which provides a region of increased temperature along the second component. The first component (which has a lower conductivity than the second component) provides heat when current passes through it, and the first component can also be heated via thermal conduction with heat received from the second component. A reliable temperature gradient can therefore be established across the heating element from the second component to the first component, which can be controlled in order to optimise the heating and vaporisation performance of the heater. For example the temperature gradient can be controlled by varying the structure of the heating element, the materials and properties of the components, or the applied electrical energy.

[0008] The heating element preferably comprises a sheet of electrically conductive material. In some examples of the invention the heating element is configured to transport liquid by capillary action in use.

[0009] The first and second electrically conductive components are preferably portions or regions of the heating element which have differing conductivity. The differing conductivity may be provided by using different materials or using the same material with different properties, for example one or more of: a differing structure, density or thickness. The density of the mesh may be from about 10^{-6} to 10^{-2} g/mm^3, preferably in a range between $5x10^{-4}$ to $5x10^{-3}$ g/mm^3, and more preferably approximately $8.5x10^{-4}$ g/mm^3.

[0010] The second component may be one or more regions arranged within the first component. For example the second component may form a path across and/or through the first component. In this way the current may be directed through a preferential path between the contact points.

[0011] The contact points may be positioned at opposite sides of the heating element (preferably a heating sheet) such that the preferential path runs across the heating element from one side to another. Alternatively the contact points may be provided in the same side such that the preferential path travels out from one side across the heating element and turns to return to the same side.

[0012] The first and/or second component may comprise electrically conductive fibres which are arranged as a woven fabric, such as a mesh, a non-woven fabric, or a bundle of electrically conductive fibres. Preferably the first and/or second components comprise a mesh of electrically conductive fibres configured to transport liquid through the heating element by capillary action in use. In this way the heater mesh provides a wicking function to the heating element such that an aerosol generating liquid can be effectively drawn onto the heating element for vaporisation. Since the differing conductivities of the first and second components provide temperature gradients across the heating element, the wicking action of the heating element can also be configured by controlling the relative heating temperatures in different parts of the heating element. The mesh can be made using electrically conductive fibres of the first component, the second component or a combination of both. For example the first component can be a mesh of fibres which wicks the aerosol generating liquid onto its surface and the second component is a solid wire that is threaded through a central path in the first component mesh. The conductive fibres may be a sintered mesh of metal, preferably steel fibres.

[0013] The first and second components may comprise a mesh of electrically conductive fibres, wherein one or more of the following properties differ between the first and second components to provide the difference in conductivity: fibre thickness; porosity of the mesh; material of the electrically conductive fibres; density of the mesh. In this way aerosol generating liquid is wicked onto the both the first and second components of the heating element for vaporisation, and the current flow and temperature distribution can be controlled by altering the fibre thickness, mesh porosity or fibre materials.

[0014] Preferably the first and/or second component comprises a sheet of electrically conductive fibre mesh, the sheet preferably following a serpentine path, i.e. the sheet has a serpentine shape, in other words a meandering, zig-zag, periodic or square-wave shape. In this way the temperature distribution of the heating element can be controlled by varying the structure of the heating element such that the current flows along a meandering or square-wave pattern between the two contact points. As an electrical current travels along the sheet, different concentrations of current would be provided along the length of the heating element. In use, areas of relatively high current density will become hotter than areas of relatively low current density, thus establishing a temperature gradient across the heating element. The temperature distribution of the heating element can therefore be controlled by varying the structure of the heating element such that the current flows along a meandering or square-wave pattern between the contact points of an aerosol generation device.

[0015] The first component may comprise a sheet of electrically conductive fibre mesh and the second component may comprise an electrically conductive wire running through the surrounding mesh. In this way the electrically conductive wire of the second component, having a higher conductivity, provides a path of increased temperature which provides heat and/or electrical energy to the surrounding mesh of the first component.

[0016] The first component may comprise a sheet of electrically conductive fibre mesh and the second component may comprise a fibrous material woven into sheeting of electrically conductive fibre mesh. In this way the first component and second component are interwovenly connected to improve heating and wicking functions of the heating element. By weaving the second component into the sheeting of the first component, multiple points of contact are established between the first and second components. This improves the efficiency and effectiveness of electrical/heat conduction as well as wicking processes.

[0017] Preferably the second component comprises a central layer and the first component comprises two surrounding layers, the central layer of the second component arranged between the surrounding layers of the first component. In this way a sandwich structure of the heating element allows the second component to effectively transfer heat to the upper and lower layers of the first component.

[0018] Preferably the surrounding layers of the first component each comprise a sheet of electrically conductive fibre mesh. In this way the sheets of electrically conductive fibre mesh act as both a heater and a wicking element which surrounds the second component.

[0019] Preferably one or more layers, preferably the central layer, comprise a continuous conductive sheet. In other words one or more layers comprise a solid (or non-porous) conductive sheet. For example one or more layers may comprise a metal sheet. In this way the second component provides a solid and reliable current path that is layered between surrounding mesh layers of the first component. The second component can therefore effectively heat any aerosol generating liquid that has been drawn onto the first component by the wicking function/capillary action of the mesh.

[0020] The first component may comprise a different electrically conductive material to the second component. In this way different materials are used in the heating component to provide different electrical conductivities. For example the first component can be made of stainless steel and the second component can be made of copper.

[0021] The electrically conductive material of the first component may be the same as the electrically conductive material of the second component. In this way the preferential current path of the second component is provided by using a different structure between the first and second components, for example by varying fibre thickness or mesh porosity.

[0022] Preferably the first and/or second electrically conductive component is porous. In this way the first and/or second electrically conductive component can provide a wicking function to draw aerosol generating liquid from a liquid store in the aerosol generation device. The porosity of the mesh may be from 1 to 4%, and preferably is 2%.

[0023] The contact points may be positioned at a same side of the heating element and the second component may be arranged to form a preferential current path which travels out from one contact point over a heating area of the heating element before returning to the other contact point. In this way electrical energy is provided to the same side of the heating element. Two contact points can be placed next to each other at the same side of the heater with the current path heading out from one contact point, travelling over the surface area of the heater and returning to the second contact point. This would reduce the complexity of manufacture and assembly of an aerosol generation device.

[0024] The first component may be arranged at an edge region of the heating element and the second component may be arranged at a central region, such that the preferential current path provides increased heating at a central region relative to an edge region during use. In this way the first and second components can be provided on a single sheet of electrically conductive material. The temperature of the central region would therefore be higher than the edge regions, and the temperature distribution of the heating element can be effectively controlled.

[0025] According to another aspect of the invention there is provided an aerosol generation device, comprising: a heating element according to any of the claims; and a liquid supply configured to supply a liquid to the heating element to form an aerosol during use. Preferably the heating element comprises a sheet of conductive material and the heating element is mounted in the aerosol generating device such that air flows across the heating element in use. Preferably the heating element is mounted in a heater housing with one or more peripheral edges of the heating element interfacing with the liquid store through a gap in the heater housing. In this way a more effective and better controlled heater response can be provided to generate aerosol from liquid taken from the liquid supply, thereby providing an improved aerosol generation device.

[0026] Embodiments of the invention are now described, by way of example, with reference to the drawings, in which:

Figure 1A is a schematic view of a known heating element for an aerosol generation device;

Figure 1B is a schematic view of another known heating element for an aerosol generation device;

Figure 2 is a top view of a heating element in a first embodiment of the invention;

Figure 3A is a perspective view of a heating element in a second embodiment of the invention;

Figure 3B is a schematic view from the side of the heating element in the second embodiment of the invention;

Figure 4A is a top view of a heating element in a third embodiment of the invention;

Figure 4B is a top view of a heating element in a fourth embodiment of the invention;

Figure 4C is a perspective view of a heating element in a fifth embodiment of the invention;

Figure 4D is a top view of a heating element in a sixth embodiment of the invention; and

Figure 5 is a schematic view of a vaporizer with a heating element in an embodiment of the present invention.

[0027] Figure 1A shows a heating element 2 in the art, which includes a coil wire 4 having two ends (not shown) connected to a power source/battery (not shown). The coil wire 4 is wrapped around the outside of a wick 6 that is arranged to draw an aerosol generating liquid from a reservoir (not shown) and to hold the liquid within itself. In use the coil wire 4 is supplied with electrical energy such that current passes through the wire 4 thereby heating the wire 4 by resistive heating. Aerosol is generated by heating the liquid stored in the wick 6 using the heat generated from the coil wire 4.

[0028] Figure 1B shows another heating element 8 in the art, which includes an electrically conductive mesh 10 having two contact ends 12 and 14 which are connected to a power source (not shown). The mesh 10 provides a wicking function to the heating element 8 by drawing liquid from a reservoir by capillary action such that the surface of the mesh 10 is wetted with the liquid. In use an electric current passes through the heating element 8 between the contact ends 12 and 14, which causes the mesh 10 to generate heat. The heating element 8 also includes a plurality of slots 16 in the mesh 10, which are arranged to cause an electric current to follow a serpentine path as it flows between the two ends 12 and 14. The liquid on the surface of the mesh 10 is subsequently heated by the mesh 10 to form an aerosol for inhalation.

[0029] Figure 2 shows a top view of a heating element 20 in a first embodiment of the present invention. The heating element 20 has an electrically conductive mesh array 22 having a first contact end 24 and a second contact end 26. The heating element has a width of approximately 7.5 to 8 mm, a depth of approximately 1.5 to 2 mm and the length between the first contact end 24 and the second contact end 26 is approximately 30 mm. The mesh array 22 provides a wicking function to the heating element 20 and includes a fibre sheet of electrically conductive fibres 28 and a solid wire 30. The fibre sheet 28 is formed in a square-wave or meandering arrangement (similar to the heating element 8 in Figure 1B) and the solid wire 30 is arranged to follow a central path through the fibre sheet 28 between the two ends 24 and 26. A plurality of slots 32 is provided in the mesh array 22 to create the square-wave arrangement. It should be understood that fibre sheet 28 is a woven fabric, but the sheet 28 can also be provided as a non-woven fabric, or a bundle of electrically conductive fibres.

[0030] The solid wire 30 has a higher electrical conductivity than the fibre sheet 28. For example the solid wire 30 is made of copper and the fibre sheet 28 is made of stainless steel fibres. The higher conductivity provides a preferential current path along the solid wire 30 between the contacts 24 and 26 when electrical energy is supplied to the heating element 20. The solid wire 30 is in contact with the fibre sheet 28 and can be placed on top of or below the fibre sheet 28. Alternatively, the solid wire 30 can be threaded through the fibre sheet 28 such that the fibre sheet 28 surrounds the solid wire 30. Contact between the fibre sheet 28 and the solid wire 30 allows electrical and heat conduction to pass between the two components. Furthermore any aerosol generating liquid that has been drawn onto the fibre sheet 28 can also be drawn onto solid wire 30.

[0031] In use electrical energy is provided to the heating element 20 from a battery or other power source, and current preferentially flows between the first contact 24 and the second contact 26 along the solid wire 30. Current will also flow through the electrically conductive fibre sheet 28. In addition, heat generated by the solid wire 30 will also conduct through the fibre sheet 28 toward its edge. A temperature gradient is therefore formed between the solid wire 28 and the edge of the fibre sheet 28. Aerosol generating liquid that has been drawn onto the surface of the mesh array 22 is subsequently heated by the heating element 20 to form an aerosol. Components in an e-liquid with a lower melting temperature will be first vaporized as the e-liquid flows through the centre of the mesh heater. It should be understood that the portions of the fibre sheet 28 in closer proximity to the solid wire 30 will be hotter than the outer edges of the sheet 28 (which are used to wick aerosol generating liquid onto the mesh array 22).

[0032] It should be understood that a higher electrical conductivity path or region in the mesh array 22 can be provided in alternative ways other than a more conductive solid wire 30. For example, a central path of copper fibres can be woven into the fibre sheet 28, or the central path in the fibre sheet 28 could be made of thicker fibres. Another example may be to vary the porosity or density of the mesh, providing less porosity along the preferential current path region and increasing the porosity and spacing between fibres away from the preferential path region.

[0033] A person skilled in the art should also understand that providing a preferential current path in the solid wire 30 means that it is therefore not necessary for the slots 32 to be introduced in the mesh array 22 for a flowing current to follow a serpentine path or square-wave shape. The length of a slot 32 is approximately 4 to 5 mm and greater than half the width of the heating element 20 such that an electrical current must flow in a meandering pattern between the contact ends 24 and 26. Therefore the heating element may comprise a rectangular sheet of fibre mesh with the wire providing a meandering path through the sheet. A meandering current path may also be created through the mesh array 22 by varying the conductivity of the components in the array according to design or operational requirements. By this we mean a higher electrically conductive bundle of fibres (as opposed to a single solid wire) can be woven or otherwise arranged in a meandering configuration (or any other design configuration), and where this higher electrically conductive bundle of fibres is set with a lower electrically conductive fabric sheet. It should be clear that the design of the heating element can be varied to accommodate different aerosol generation devices whilst providing a preferential current path through the heating element.

[0034] Figure 3A shows a perspective view of another embodiment of the invention in which the heating element 40 has a three-layered structure having a central layer 42 sandwiched between two wicking layers 44 and 46. The layered structure is also shown in Figure 3B. The central layer 42 is a continuous planar sheet of electrically conductive material, such as copper, and has a higher conductivity than either of the wicking layers 44 and 46. Each of the wicking layers 44 and 46 is a fibre mesh sheet of electrically conductive material, such as stainless steel, which can generate heat by resistive heating and also act as a wick to draw aerosol generating liquid onto the heating element 40. Slots 48 are provided in the heating element 40 to cause a current flow to following a serpentine path. This improves the current and temperature distribution across the heating element 40. Again, these are optional and the heating element may have a simple shape, e.g. rectangle, etc.

[0035] It is possible for the central layer 42 and the wicking layers 44 and 46 to be made of the same material, whereby the central layer 42 provides a preferential current path via its continuous sheet material as opposed to the fibre mesh arrangement of the wicking layers. It should also be understood that the dimensions of the central layer 42 do not have to match those of the wicking layers 44 and 46. It is possible for the outer edges/boundaries of the central layer 42 to be set within the outer edges of the wicking layers 44 and 46, thereby allowing the edges of wicking layers 44 and 46 to overlap and encompass the central layer 42. It should be understood that the portions of the wicking layers 44 and 46 that are in closer proximity to the central layer 42 will be hotter than the outer portions of the wicking layers (which are used to wick aerosol generating liquid onto the heating element 40). A temperature gradient is therefore formed between the outer portions of the wicking layers 44 and 46 and the central layer 42, and the transport of aerosol generating liquid into the heating element will also follow a similar path to temperature gradient. This means that components in an e-liquid with a lower melting temperature will be first vaporized as the e-liquid flows from the outer portions of the wicking layers toward the central layer.

[0036] In an alternative embodiment the dimensions of the central layer 42 match those of the wicking layers 44 and 46, and the heater 40 can be positioned with respect to the reservoir in a way such that the liquid is drawn from the reservoir by capillary action first to the wicking layers 44 and 46 before reaching the central layer 42. This also allows components of an aerosol generating liquid with lower heating temperature to be vaporized first. The heater 40 may also be provided in a heater housing that is configured to preferentially allow an aerosol generating liquid to be wicked onto the wicking layers 44 and 46 first before reaching the central layer.

[0037] Figure 4A shows a top view of another embodiment of the invention in which the heating element 60 has two contact ends 62 and 64 provided at a same side of the heating element 60. This allows electrical energy to be supplied to the heating element 60 from one side, similar to an incandescent light bulb. A solid wire 66 of an electrically conductive material acts as a preferential current path which passes over or through a mesh 68 of electrically conductive fibres. Slots 70 are also provided in the mesh 68 such that an electric current flowing in the heating element 60 would follow a serpentine path or square-wave shape. In Figure 4A the solid wire 66 is arranged to follow a central path within the serpentine configuration of the heating element 60. This means that the temperature gradient is provided between the outer edges of the mesh 68 and the solid wire 66. A heater housing may therefore be configured to allow an aerosol generating liquid to be wicked from the outer peripheral regions of the mesh 68 as well as a central region down the middle of the heating element 60.

[0038] Providing contact ends 62 and 64 at the same side of the heating element 60 improves the flexibility, design and manufacture of aerosol generation devices according to operational requirements. For example, a battery, and its terminals, may be isolated toward one side of the heating element as opposed to having extended connection that would run along the length of the heater. This may reduce the risk of damage to electronic components in cases of leakage.

[0039] Figure 4B shows a top view of another embodiment of the invention, in which the heating element 80 has a rectangular mesh 82 and a meandering solid wire 84 running through the mesh 82 between two contact ends 86 and 88. Similar to the embodiment described by way of Figure 4A, the two contact ends 86 and 88 are also provided at a same side of the heater 80. The solid wire 84 has a higher conductivity than the mesh 82, and therefore provides a preferential current path when electrical energy is provided to the heating element 80. It should be understood that as a preferential current path is provided in the solid wire 84, slots are not required in the mesh 82 in order for the current to meander through the heating element 80 as it flows between the contact ends 86 and 88.

[0040] Figure 4C shows a perspective view of another embodiment of the invention, in which the heating element 100 has a three-layered structure having a central layer 102 sandwiched between two wicking layers 104 and 106. Similar to the embodiment described by way of Figures 4A and 4B, two contact ends 108 and 110 are also provided at a same side of the heating element 100.

[0041] The layered structure is similar to the structure shown in Figure 3B. The central layer 102 is a continuous planar sheet of electrically conductive material having a higher conductivity than either of the wicking layers 104 and 106. Each of the wicking layers 104 and 106 is a fibre mesh sheet of electrically conductive material, which can generate heat by resistive heating and also act as a wick to draw aerosol generating liquid onto the heating element 100.

[0042] Figure 4D shows a top view of another embodiment of the invention. The heating element 112 has a similar serpentine shape to that of Figure 4A and comprises a fibre sheet 114 and a solid wire 116. The solid wire 116 is arranged along an inner edge of the fibre sheet 114 such that in use the temperature gradient of the heating element 112 runs from the outer edge of the sheet 114 to the inner edge of the sheet 114. It should be understood that the outer edge of the fibre sheet 114 is used as a wick to draw aerosol generating liquid from a reservoir onto the sheet 114 and further toward the solid wire 116 by capillary action. A heater housing may therefore be configured to allow an aerosol generating liquid to be wicked from only the outer edge of the fibre sheet 114.

[0043] Figure 5 shows a schematic view of a vaporizer 120 comprising a heating element 122, a liquid store 124 and a heater housing 126. The vaporizer 120 is configured to be set in an aerosol generation device comprising a battery and a mouthpiece.

[0044] In use the heating element 122 is arranged to receive electrical energy from the battery in order to generate an aerosol by heating an aerosol generating liquid that is drawn onto the heating element 122 from the liquid store 124 via capillary action. The heater housing 126 is arranged to collect aerosol generated from the heating element 122. One or more airflow channels 128 is also provided in the heater housing 126, where the airflow channel 128 is configured to, on user inhalation, direct air from outside the vaporizer 120 through the channel 128 and toward the mouthpiece of the aerosol generation device. This means that aerosol that has been generated by heating aerosol generating liquid on the heating element 122 will thereby be carried along the channel 128 to exit the device.

[0045] The heating element 122 may be any of the heaters of the present invention described above, and is mounted in the heater housing 126. The heater housing 126 includes an upper housing part 130 placed above the top major side of the heating element 122 and a lower housing part 132 placed below the lower major side of the heating element 122 such that the heating element 122 is held between the two housing parts. The housing 126 acts as a vaporisation chamber which is configured to collect generated aerosol within the inner spaces of the two housing parts 130 and 132.

[0046] One or more edges of the heating element 122 are exposed to the liquid store 124 which surrounds the heater housing 126 and heating element 122. The edges of the heating element 122 may extend beyond the outer limits of the heater housing 126, or alternatively the upper and lower housing parts 130 and 132, when constructed, form a gap between the two housing parts which allows aerosol generating liquid from the liquid store 124 to come into contact with the heating element edge, whereby the liquid is drawn further across the heating element 122 via capillary action.

Claims

1. A heating element for an aerosol generation device, the heating element comprising:

   two contact points arranged to allow a current to be applied to the heating element in use;
   a first electrically conductive component; and
   a second electrically conductive component, the second component having a higher electrical conductivity than the first component,

   wherein the first and second components are arranged such that, in use, the second component provides a preferential current path across the heating element between the contact points.

2. The heating element according to claim 1 wherein the first and/or second components comprise a mesh of electrically conductive fibres configured to transport liquid through the heating element by capillary action in use.

3. The heating element according to claim 2 where both the first and second components comprise a mesh of electrically conductive fibres and wherein one or more of the following properties differ between the first and second components to provide the difference in conductivity:

   fibre thickness;
   porosity of the mesh;
   material of the electrically conductive fibres;
   density of the mesh.

4. The heating element according to claim 2 or 3 wherein the first and/or second component comprises a sheet of electrically conductive fibre mesh, the sheet following a serpentine path.

5. The heating element according to any of claims 2 to 4 wherein the first component comprises a sheet of electrically conductive fibre mesh and the second component comprises an electrically conductive wire running through the surrounding mesh.

6. The heating element according to any of claims 2 to 4 wherein the first component comprises a sheet of electrically conductive fibre mesh and the second component comprises a fibrous material woven into sheeting of electrically conductive fibre mesh.

7. The heating element according to any preceding claim, wherein the second component comprises a central layer and the first component comprises two surrounding layers, the central layer of the second component arranged between the surrounding layers of the first component.

8. The heating element according to claim 7 wherein surrounding layers of the first component each comprise a sheet of electrically conductive fibre mesh.

9. The heating element according to claim 8 wherein the central layer comprises a continuous conductive sheet.

10. The heating element according to any of the preceding claims, wherein the first component comprises a different electrically conductive material to the second component.

11. The heating element according to any preceding claims 1 to 9, wherein the electrically conductive material of the first component is the same as the electrically conductive material of the second component.

12. The heating element according to any of the preceding claims, wherein the first and/or second electrically conductive component is porous.

13. The heating element according to any of the preceding claims wherein the contact points are positioned at a same side of the heating element and the second component is arranged to form a preferential current path which travels out from one contact point over a heating area of the heating element before returning to the other contact point.

14. The heating element according to any of the preceding claims wherein the first component is arranged at an edge region of the heating element and the second component is arranged at a central region, such that the preferential current path provides increased heating at a central region relative to an edge region during use.

15. An aerosol generation device, comprising:
    the heating element according to any of the preceding claims; and
    a liquid supply configured to supply a liquid to the heating element to form an aerosol during use.

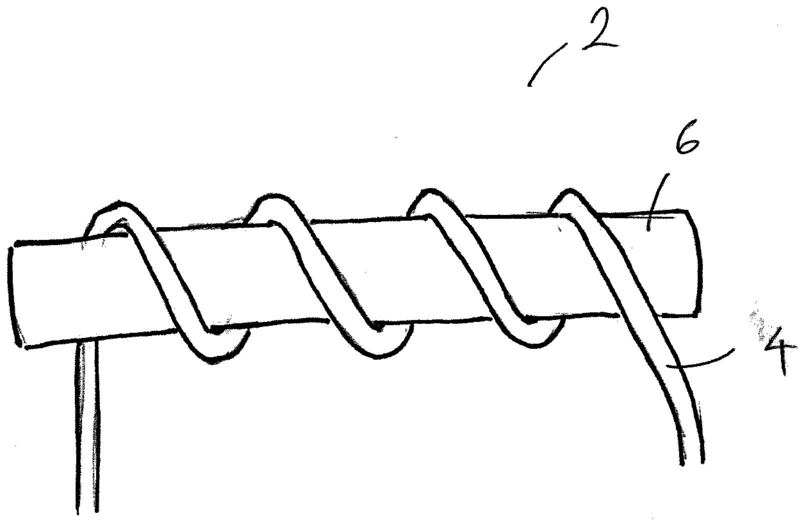

FIG. 1A

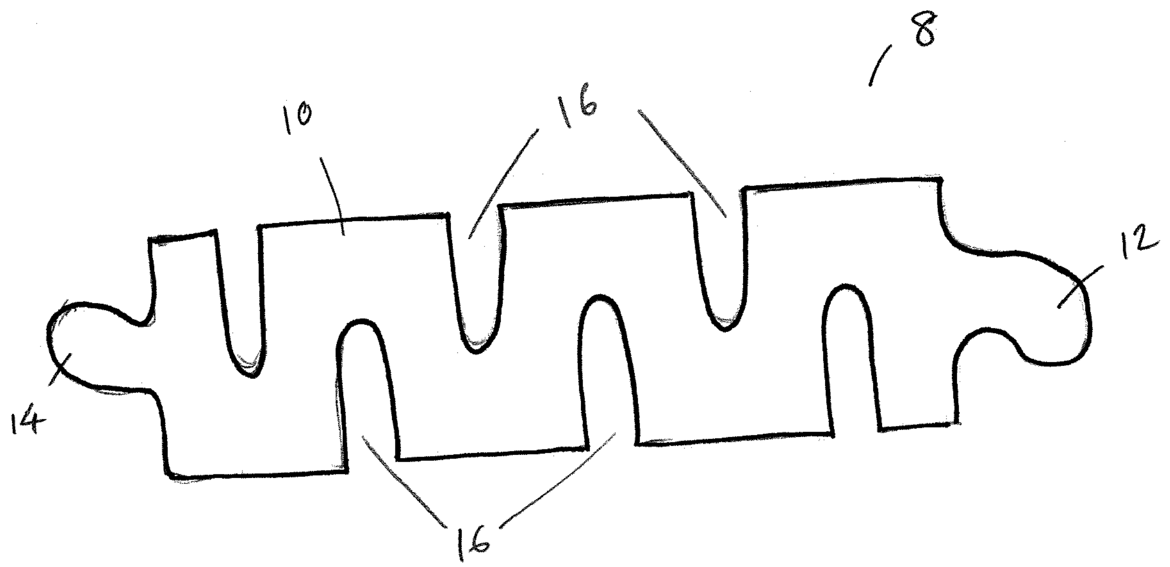

FIG. 1B

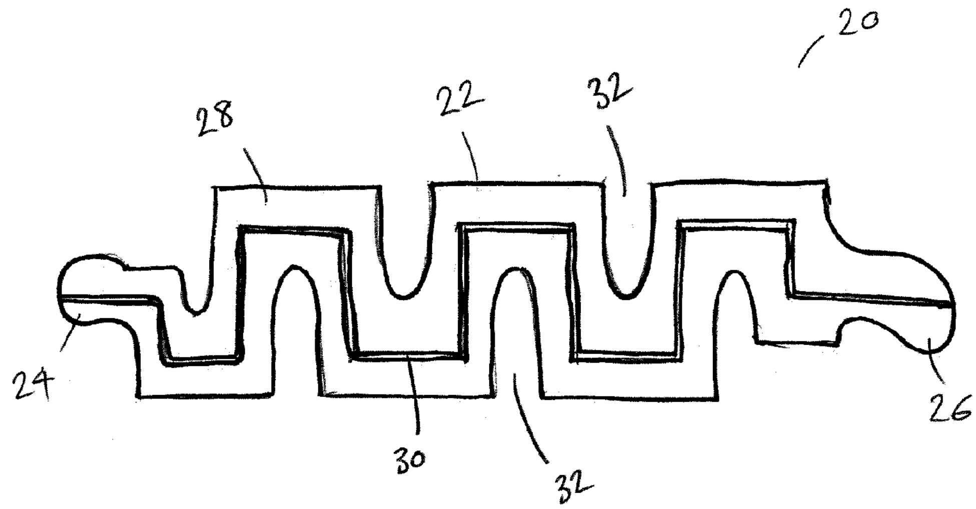

FIG. 2

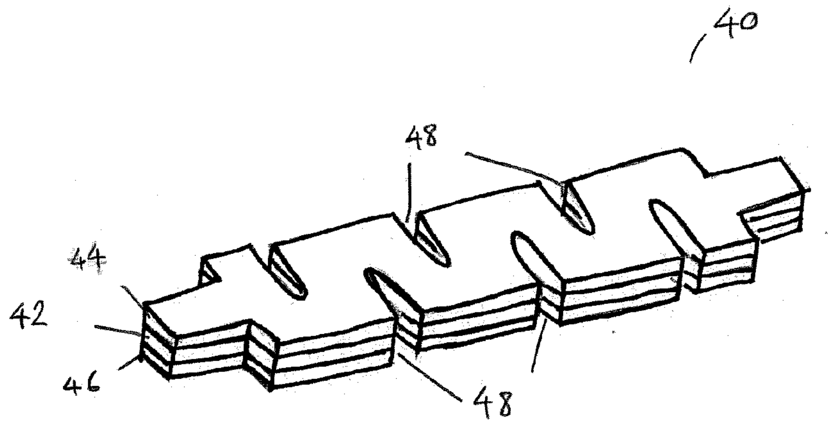

FIG. 3A.

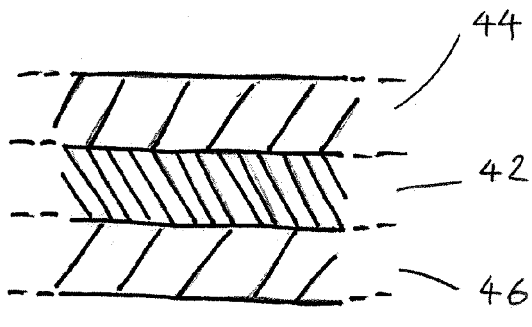

FIG. 3B

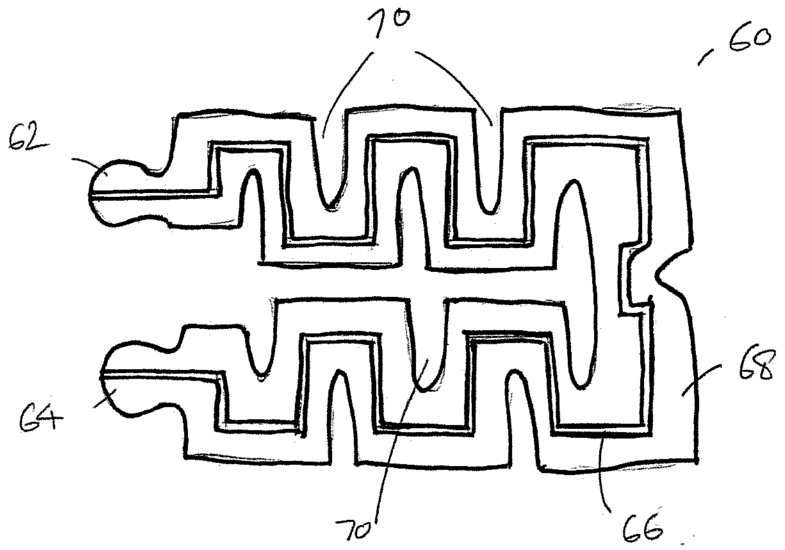

FIG. 4A

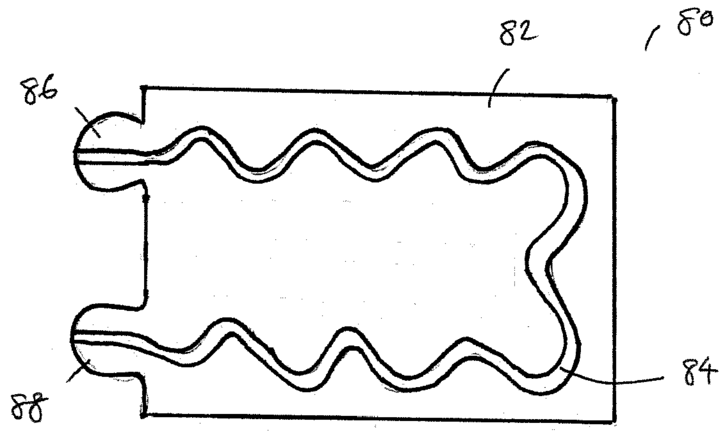

FIG 4B

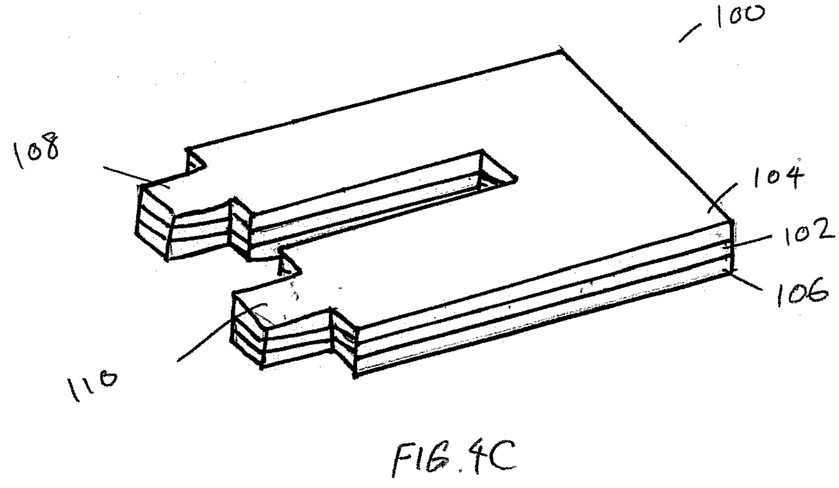

FIG.4C

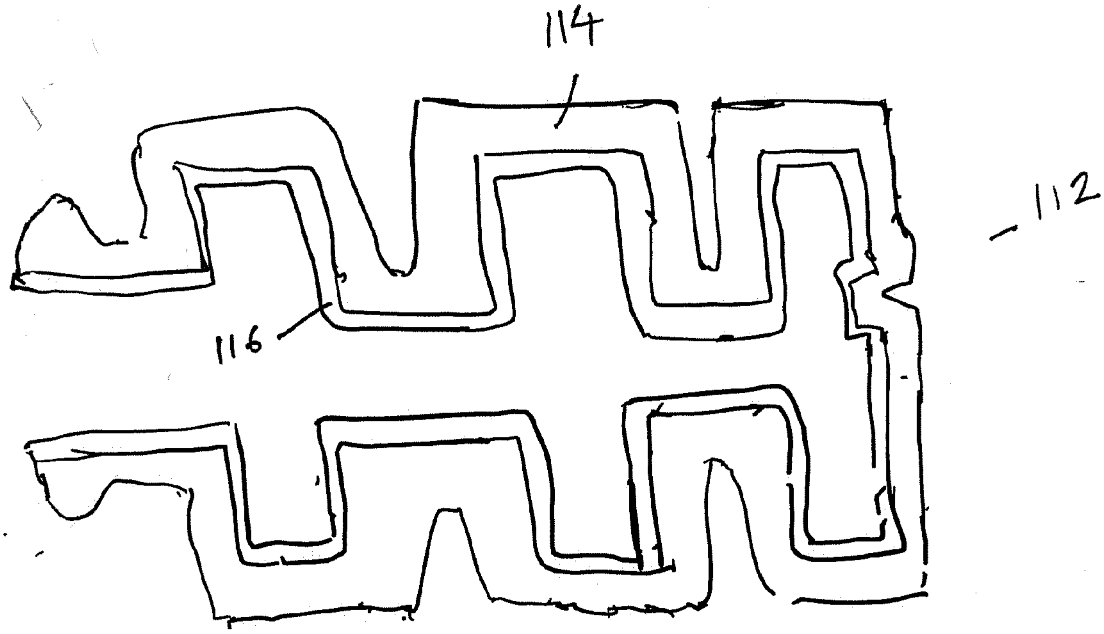

FIG. 4D

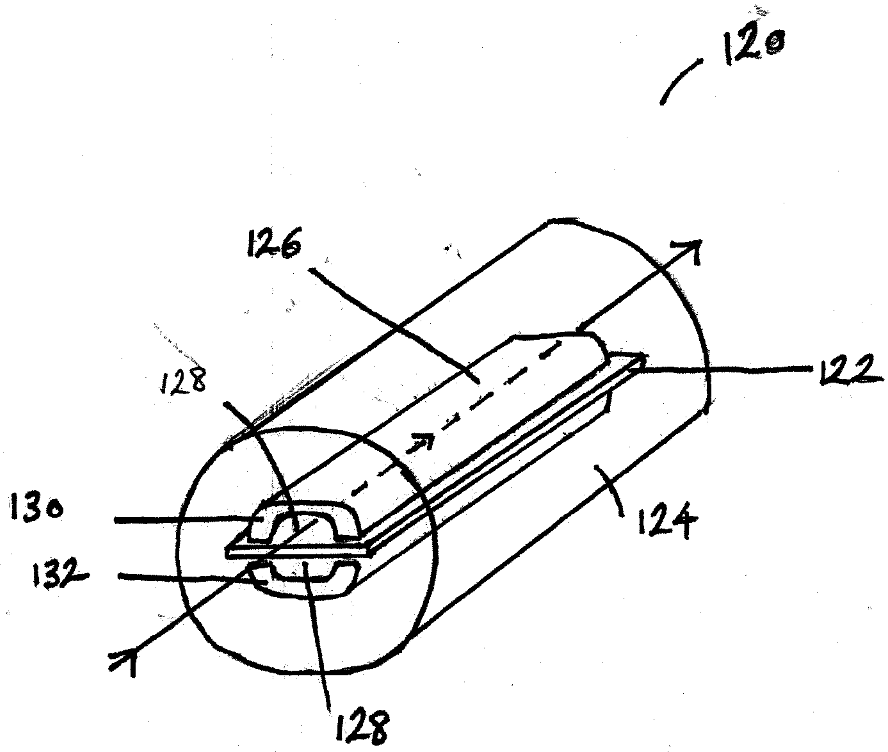

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 19 21 8310

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	GB 2 529 201 A (BATMARK LTD [GB]) 17 February 2016 (2016-02-17) * paragraph [0034] - paragraph [0053]; figures 1-10 * -----	1-15	INV. A24F40/44 A24F40/46 ADD. A24F40/10
A	WO 2018/211252 A1 (NICOVENTURES HOLDINGS LTD [GB]) 22 November 2018 (2018-11-22) * page 7, line 13 - page 9, line 34; figures 1-27 * -----	1-15	
A	US 2018/140014 A1 (YU FUCHENG [CN] ET AL) 24 May 2018 (2018-05-24) * paragraphs [0052], [0053], [0066], [0067]; figures 1-9 * -----	11	
A	EP 3 146 857 A2 (SHENZHEN FIRST UNION TECH CO [CN]) 29 March 2017 (2017-03-29) * paragraph [0011] - paragraph [0019]; figures 1-5 * -----	13	

TECHNICAL FIELDS SEARCHED (IPC)

A24F
A61M

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	18 June 2020	Espla, Alexandre

CATEGORY OF CITED DOCUMENTS

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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18-06-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2529201 A	17-02-2016	AU 2015303019 A1	02-03-2017
		AU 2019201795 A1	04-04-2019
		BR 112017002893 A2	12-12-2017
		CA 2957478 A1	18-02-2016
		CN 106659250 A	10-05-2017
		CN 110507008 A	29-11-2019
		CN 110507009 A	29-11-2019
		EP 3180060 A1	21-06-2017
		EP 3545998 A1	02-10-2019
		ES 2717759 T3	25-06-2019
		GB 2529201 A	17-02-2016
		HU E043106 T2	29-07-2019
		JP 6698143 B2	27-05-2020
		JP 2017529896 A	12-10-2017
		JP 2019071886 A	16-05-2019
		KR 20170032387 A	22-03-2017
		KR 20190089087 A	29-07-2019
		PH 12017500262 A1	10-07-2017
		PL 3180060 T3	30-08-2019
		RU 2018141222 A	26-12-2018
		TR 201903842 T4	22-04-2019
		US 2017238611 A1	24-08-2017
		US 2019230993 A1	01-08-2019
		WO 2016024083 A1	18-02-2016
		ZA 201700973 B	30-10-2019
WO 2018211252 A1	22-11-2018	BR 112019024161 A2	02-06-2020
		CA 3063305 A1	22-11-2018
		CN 110602957 A	20-12-2019
		EP 3624617 A1	25-03-2020
		KR 20190134793 A	04-12-2019
		WO 2018211252 A1	22-11-2018
US 2018140014 A1	24-05-2018	CN 107846974 A	27-03-2018
		EP 3291695 A1	14-03-2018
		US 2018140014 A1	24-05-2018
		WO 2016176800 A1	10-11-2016
EP 3146857 A2	29-03-2017	CN 205358219 U	06-07-2016
		EP 3146857 A2	29-03-2017
		US 2017105454 A1	20-04-2017

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82