AN AEROSOL-GENERATING SYSTEM HAVING A HEATER ASSEMBLY AND A CARTRIDGE FOR AN AEROSOL-GENERATING SYSTEM HAVING A FLUID PERMEABLE HEATER ASSEMBLY

The present invention relates to aerosol-generating systems that comprise a heater assembly that is suitable for vapourising a liquid. In particular, the invention relates to handheld aerosol-generating systems, such as electrically operated smoking systems.

One type of aerosol-generating system is an electrically operated smoking system. Handheld electrically operated smoking systems consisting of a device portion comprising a battery and control electronics, and a cartridge portion comprising a supply of aerosol-forming substrate, and an electrically operated vapouriser, are known. A cartridge comprising both a supply of aerosol-forming substrate and a vapouriser is sometimes referred to as a "cartomiser". The vapouriser typically comprises a coil of heater wire wound around an elongate wick soaked in liquid aerosol-forming substrate. The cartridge portion typically comprises not only the supply of aerosol-forming substrate and an electrically operated vapouriser, but also a mouthpiece, which the user sucks on in use to draw aerosol into their mouth.

However, this arrangement has the drawback that the cartridges are relatively expensive to produce. This is because manufacturing the wick and coil assembly is difficult. Also, the electrical contacts between the coil of heater wire and the electrical contacts through which electrical current is delivered from the device portion must be delicately handled during manufacture. Furthermore, these cartridges include a mouthpiece portion in order to protect the delicate wick and coil assembly during transport. But the inclusion of a complete and robust mouthpiece in each cartridge means that each cartridge has a high material cost.

It would be desirable to provide a heater assembly suitable for an aerosol-generating system, such as a handheld electrically operated smoking system, that is inexpensive to produce and is robust. It would be further desirable to provide a heater assembly that is more efficient than prior heater assemblies in aerosol-generating systems.

There is provided an aerosol-generating system comprising:

a liquid storage portion comprising a housing holding a liquid aerosol-forming substrate, the housing having an opening; and

a fluid permeable heater assembly comprising a substantially flat electrically conductive filament arrangement, wherein the fluid permeable heater assembly is fixed to the housing and extends across the opening of the housing;

wherein the area of the electrically conductive filament arrangement is less than or equal to 25mm^2.

Herein disclosed is an aerosol-generating system comprising:

a liquid storage portion comprising a housing holding a liquid aerosol-forming substrate, the housing having an opening; and

a fluid permeable heater assembly comprising a plurality of electrically conductive filaments, wherein the fluid permeable heater assembly is fixed to the housing and extends across the opening of the housing.

The provision of a heater assembly that extends across an opening of a liquid storage portion allows for a robust construction that is relatively simple to manufacture.

In a first aspect, there is provided A cartridge for use in an electrically operated aerosol-generating system, comprising:

a liquid storage portion comprising a rigid housing holding a liquid aerosol-forming substrate, the housing having an opening; and

a fluid permeable heater assembly comprising a plurality of electrically conductive filaments, wherein the filaments have a diameter between 8 μm and 100 μm, and wherein the fluid permeable heater assembly is fixed to the housing and extends across the opening of the housing.

system may have a size comparable to a conventional cigar or cigarette. The smoking system may have a total length between approximately 30 mm and approximately 150 mm. The smoking system may have an external diameter between approximately 5 mm and approximately 30mm.

The aerosol-forming substrate is a substrate capable of releasing volatile compounds that can form an aerosol. The volatile compounds may be released by heating the aerosol-forming substrate.

The aerosol-forming substrate may comprise plant-based material. The aerosol-forming substrate may comprise tobacco. The aerosol-forming substrate may comprise a tobacco-containing material containing volatile tobacco flavour compounds, which are released from the aerosol-forming substrate upon heating. The aerosol-forming substrate may alternatively comprise a non-tobacco-containing material. The aerosol-forming substrate may comprise homogenised plant-based material. The aerosol-forming substrate may comprise homogenised tobacco material. The aerosol-forming substrate may comprise at least one aerosol-former. The aerosol-forming substrate may comprise other additives and ingredients, such as flavourants.

There is provided a cartridge for use in an electrically operated aerosol-generating system, comprising:

a liquid storage portion comprising a rigid housing holding a liquid aerosol-forming substrate, the housing having an opening; and

a fluid permeable heater assembly comprising a plurality of electrically conductive filaments, wherein the fluid permeable heater assembly is fixed to the housing and extends across the opening of the housing.

Herein disclosed is a cartridge for use in an electrically operated aerosol-generating system, comprising:

a liquid storage portion comprising a housing holding a liquid aerosol-forming substrate, the housing having an opening; and

a fluid permeable heater assembly comprising a plurality of electrically conductive filaments, wherein the fluid permeable heater assembly extends across the opening of the housing of the liquid storage portion.

A cartridge with this construction may be made robust, reliable and at low cost. The heater assembly may be substantially flat, without the need for any winding of a heater wire around a capillary wick.

The electrically conductive filaments may lie in a single plane. A planar heater assembly can be easily handled during manufacture and provides for a robust construction.

The electrically conductive filaments may define interstices between the filaments and the interstices may have a width of between 10 μm and 100 μm. Preferably the

filaments give rise to capillary action in the interstices, so that in use, liquid to be vapourised is drawn into the interstices, increasing the contact area between the heater assembly and the liquid.

The electrically conductive filaments may form a mesh of size between 160 and 600 Mesh US (+/- 10%) (i.e. between 160 and 600 filaments per inch (+/- 10%)). The width of the interstices is preferably between 75 µm and 25 µm. The percentage of open area of the mesh, which is the ration of the area of the interstices to the total area of the mesh is

heater assembly from the second capillary material by a distance of at least 1.5 mm, and preferably between 1.5 and 2 mm in order to provide a sufficient temperature drop across the first capillary material.

As described in relation to the first aspect, the heater assembly may comprise at least one filament made from a first material and at least one filament made from a second material different from the first material.

The heater assembly may comprise an electrically insulating substrate on which the filaments are supported, the filaments extending across an aperture formed in the substrate. The electrically insulating substrate may comprise any suitable material, and is preferably a material that is able to tolerate high temperatures (in excess of 300°C) and rapid temperature changes. An example of a suitable material is a polyimide film, such as Kapton®.

The heater assembly may comprise an electrically conductive contact in contact with a plurality of the filaments. The electrically conductive contact may be provided between the housing of the liquid storage portion and the electrically insulating substrate. The electrically conductive contact may be provided between the filaments and the electrically insulating substrate. An aperture may be formed in the electrically insulating layer, and the cartridge may comprise two electrically conductive contacts positioned on opposite sides on the aperture to one another.

Advantageously, the electrically conductive contact is accessible from an exterior of the cartridge. The heater assembly may extend in a lateral plane and the electrically conductive contact may extend laterally beyond the housing of the liquid storage portion. The cartridge may then be configured to be inserted into an aerosol-generating device in a direction orthogonal to the lateral plane, bringing the electrically conductive contact into contact with an electrical contact on the device.

The housing of the liquid storage portion may be substantially cylindrical, wherein the opening is at one end of the cylinder. The housing of the liquid storage portion may have a substantially circular cross section.

The heater assembly is advantageously covered by a removable cover or seal prior to use. The cover or seal may protect the substrate from degradation during storage and transport.

In a preferred embodiment the cartridge does not comprise an electrical power source.

In a third aspect, there is provided a method of manufacture of a cartridge for use in an electrically operated aerosol-generating system, comprising:

providing a liquid storage portion comprising a housing having an opening;

filling the liquid storage portion with liquid aerosol-forming substrate; and

fixing a fluid permeable heater assembly comprising a plurality of electrically conductive filaments to the liquid storage portion, wherein the filaments have a diameter between 8 μm and 100 μm, and wherein the fluid permeable heater assembly extends across the opening of the housing of the liquid storage portion.

There is provided a method of manufacture of a cartridge for use in an electrically operated aerosol-generating system, comprising:

providing a liquid storage portion comprising a housing having an opening;

filling the liquid storage portion with liquid aerosol-forming substrate; and

fixing a fluid permeable heater assembly comprising a plurality of electrically conductive filaments to the liquid storage portion, wherein the fluid permeable heater assembly extends across the opening of the housing of the liquid storage portion.

The step of filling the liquid storage portion may be performed before or after the step of fixing the heater assembly to the liquid storage portion.

The step of fixing may, for example, comprise heat sealing, gluing or welding the heater assembly to the liquid storage portion. The liquid storage portion may contain a capillary material.

Features described in relation to one aspect may equally be applied to other aspects of the invention. In particular features described in relation to the first aspect may equally be applied to the second aspect and the third aspect.

As used herein, "electrically conductive" means formed from a material having a resistivity of $1x10^{-4}\Omega m$, or less. As used herein, "electrically insulating" means formed from a material having a resistivity of $1x10^{4}\ \Omega m$ or more. As used herein "fluid permeable" in relation to a heater assembly means that the aerosol-forming substrate, in a gaseous phase and possibly in a liquid phase, can readily pass through the heater assembly.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figures 1a to 1d are schematic illustrations of a system, incorporating a cartridge, in accordance with an embodiment of the invention;

Figure 2 is a schematic illustration of a clasp mechanism for the mouthpiece portion of the system of Figure 1;

Figure 3 is an exploded view of the cartridge of Figures 1a to 1d;

Figure 4 is an exploded view of an alternative cartridge for use in a system as shown in Figures 1a to 1d;

Figure 5a is a perspective underside view of the cartridge of Figure 2;

Figure 5b is a perspective topside view of the cartridge of Figure 2, with the cover removed;

Figure 6 is a detail view of a heater assembly used in the cartridge shown in Figure 2;

Figure 7 is a detail view of an alternative heater assembly that can be used in the cartridge shown in Figure 2;

Figure 8 is a detail view of a further alternative heater assembly that can be used in the cartridge shown in Figure 2;

Figure 9 is a detail view of a still further alternative heater assembly that can be used in the cartridge shown in Figure 2;

Claims

1. A cartridge for use in an electrically operated aerosol-generating system, comprising:

a liquid storage portion comprising a rigid housing holding a liquid aerosol-forming substrate, the housing having an opening; and

a fluid permeable heater assembly comprising a plurality of electrically conductive filaments, wherein the filaments have a diameter between 8 μm and 100 μm, and wherein the fluid permeable heater assembly is fixed to the housing and extends across the opening of the housing.

2. A cartridge according to claim 1, wherein the heater assembly is substantially flat.

3. A cartridge according to claim 1 or 2, wherein the plurality of filaments form a mesh.

4. A cartridge according to any one of claims 1 to 3, wherein the plurality of filaments consists of a plurality of filaments arranged parallel to one another.

5. A cartridge according to claim 1 or 2 wherein the housing of the liquid storage portion contains a capillary material.

6. A cartridge according to claim 5, wherein the capillary medium is substantially the same size and shape as the heater assembly and the capillary material is provided in contact with the heater assembly, and wherein the liquid aerosol-forming substrate is drawn via the capillary medium to the electrically conductive filament.

7. A cartridge according to claim 5 or 6, wherein the capillary material extends into interstices between the filaments.

8. A cartridge according to claim 5, 6 or 7, wherein the capillary material includes a first capillary material and a second capillary material, the first capillary material in contact with the heater assembly, and the second capillary material in contact with the first capillary material and spaced apart from the heater assembly by the first capillary material, wherein the first capillary material has a higher thermal decomposition temperature than the second capillary material.

9. A cartridge according to claim 8, wherein the second capillary material retains between 20-160 mg of the liquid.

10. A cartridge according to claim 9, wherein the thermal decomposition temperature of the first capillary material is at least 160°C, and preferably at least 250°C.

11. A cartridge according to any preceding claim, wherein the heater assembly comprises at least one filament made from a first material and at least one filament made from a second material different from the first material.

12. A cartridge according to any preceding claim wherein the heater assembly comprises an electrically insulating substrate on which the filaments are supported.

13. A cartridge according to any preceding claim wherein the heater assembly comprises an electrically conductive contact in contact with a plurality of the filaments.

14. A cartridge according to claim 13, wherein the heater assembly extends in a lateral plane and wherein the electrically conductive contact extends laterally beyond the housing of the liquid storage portion.

15. An aerosol-generating system comprising a main unit and a cartridge according to any preceding claim, the cartridge being removably coupled to the main unit, wherein the main unit comprises a power supply.

16. An aerosol-generating system according to claim 15, further comprising electric circuitry connected to the heater assembly and to an electrical power source, the electric circuitry configured to monitor the electrical resistance of the heater assembly or of one or more filaments of the heater assembly, and to control a supply of power from the electrical power source to the heater assembly dependent on the electrical resistance of the heater assembly or the one or more filaments.

17. A method of manufacture of a cartridge for use in an electrically operated aerosol-generating system, comprising:

providing a liquid storage portion comprising a housing having an opening;

filling the liquid storage portion with liquid aerosol-forming substrate; and

fixing a fluid permeable heater assembly comprising a plurality of electrically conductive filaments to the liquid storage portion, wherein the filaments have a diameter between 8 μm and 100 μm, and wherein the fluid permeable heater assembly extends across the opening of the housing of the liquid storage portion.