produce and is robust. It would be further desirable to provide a heater assembly that is as efficient or more efficient than prior heater assemblies in aerosol-generating systems.

In one aspect there is provided a cartridge for use in an ~~electrically operated~~ aerosol-generating system, comprising: a liquid storage portion comprising a housing for holding a liquid aerosol-forming substrate, the housing having an opening; and a heater assembly comprising at least one heater element fixed to the housing and extending across the opening of the housing, wherein the at least one heater element of the heater assembly has a width that is smaller than a width of the opening of the housing, and wherein the heater element is fluid permeable and comprises a plurality of electrically conductive filaments.

The opening of the cartridge has a width and a length dimension. The at least one heater element extends across the full length dimension of the opening of the housing. The width dimension is the dimension perpendicular to the length dimension in the plane of the opening. Preferably the at least one heater element of the heater assembly has a width that is smaller than the width of the opening of the housing.

Preferably a part of the heater element is spaced apart from the perimeter of the opening. Where the heater element comprises a strip attached to the housing at each end, preferably the sides of the strip do not contact the housing. Preferably there is a space between the sides of the strip and the perimeter of the opening.

The width of the heater element may be less than the width of the opening in at least a region of the opening. The width of the heater element may be less than the width of the opening in all of the opening.

The width of the at least one heater element of the heater assembly may be less than 90%, for example less than 50%, for example less than 30 %, for example less than 25% of the width of the opening of the housing.

The area of the heater element may be less than 90%, for example less than 50%, for example less than 30 %, for example less than 25% of the area of the opening of the housing. The area of the heater elements of the heater assembly may be for example between 10% and 50% of the area of the opening, preferably between 15 and 25% of the area of the opening.

The heater element preferably is supported on an electrically insulating substrate. The insulating substrate preferably has an aperture defining the opening of the housing. The opening may be of any appropriate shape. For example the opening may have a circular, square or rectangular shape. The area of the opening may be small, preferably less than or equal to about 25 $mm^2$.

The at least one heater element is preferably arranged in such a way that the physical contact area with the substrate is reduced compared with a case in which the heater elements of

heating across the area of the opening may be obtained compared with for example where a single heating element having the same area is used.

In a particular preferred embodiment, the heater assembly comprises an odd number of heater elements, preferably three or five heater elements, and the first and second contact portions are located on opposite sides of the aperture of the substrate. This arrangement has the advantage that the first and second contact portions are arranged on opposite sides of the aperture.

The heater assembly may alternatively comprise an even number of heater elements, preferably two or four heater elements. In this embodiment the contact portions are preferably located on the same side of the cartridge. With this arrangement a rather compact design of the electric connection of the heater assembly to the power source may be achieved.

~~The at least one heater element may each be formed from a~~ The plurality of electrically conductive filaments, ~~which~~ may form a mesh or array of filaments or may comprise a woven or non-woven fabric. ~~The heater element may be fluid permeable.~~

In some examples, the at least one heater element has a first face that is fixed to the electrically insulating substrate and the first and second electrically conductive contact portions are configured to allow contact with an external power supply on a second face of the heater element opposite to the first face.

The system may further comprise a liquid storage portion comprising a housing containing a liquid aerosol-forming substrate, wherein the heater assembly is fixed to the housing of the liquid storage portion. The housing may be a rigid housing and impermeable to fluid. As used herein "rigid housing" means a housing that is self-supporting. The rigid housing of the liquid storage portion preferably provides mechanical support to the heater assembly.

The liquid storage portion may comprise a capillary material configured to convey liquid aerosol-forming substrate to the heater assembly.

The provision of a heater assembly of this type in an aerosol-generating system has several advantages over a conventional wick and coil arrangement. A heater element comprising a mesh or array of filaments allows for a greater area of the heater to be in contact with a liquid being vaporized. The heater assembly can be inexpensively produced, using readily available materials and using mass production techniques. The heater assembly is robust allowing it to be handled and fixed to other parts of the aerosol-generating system during manufacture, and in particular to form part of a removable cartridge. The provision of electrically conductive contact portions forming part of the heater element allows for reliable and simple connection of the heater assembly to a power supply.

The system may comprise a main unit and a cartridge that is removably coupled to the main unit, wherein the liquid storage portion and heater assembly are provided in the cartridge and the main unit comprises a power supply. As used herein, the cartridge being "removably coupled" to the device means that the cartridge and device can be coupled and uncoupled from one another without significantly damaging either the device or the cartridge.

The system may be an electrically operated smoking system. The system may be a handheld aerosol-generating system. The aerosol-generating 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 electrically insulating substrate may be a flexible sheet material. The electrically conductive contact portions and electrically conductive filaments may be integrally formed with one another.

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.

The present invention is also directed to an aerosol-generating system, preferably an electrically operated smoking system, comprising a cartridge according to the present invention.

The aerosol-generating system further comprises a main unit, to which the cartridge is removably coupled. The liquid storage portion and the heater assembly are provided in the cartridge and the main unit comprises a power supply. Different arrangements are possible.

The cartridge can be exchanged after consumption. As the cartridge holds the liquid and the heater assembly, the heater assembly is also exchanged regularly such that the optimal vaporization conditions are maintained even after longer use of the main unit.

The aerosol-generating system preferably further comprises electric circuitry connected to the heater assembly and to an electrical power source. The electric circuitry is configured to monitor the electrical resistance of the heater assembly or of one or more filaments of a heater element 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. By monitoring the temperature of the heater element, the system can prevent over- or underheating of the heater assembly and ensure that optimal vaporization conditions are provided.

~~The~~In another aspect, the present invention is also directed to a method of manufacture of a cartridge for use in an aerosol-generating system, ~~for example an electrically operated aerosol-generating~~

~~system,~~ comprising the steps of providing a liquid storage portion with a housing having an opening, filling the liquid storage portion with liquid aerosol-forming substrate and providing a heater assembly comprising at least one heater element extending across the opening of the housing wherein the heater element is smaller than the opening of the housing. The width of the at least one heater element of the heater assembly may be less than 90%, preferably less than 50, further preferably less than 30 %, most preferably less than 25% of the width of the opening of the housing.

The heater assembly and the heater element or elements are preferably fluid permeable. 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 or heater element.

The term "substantially flat" filament arrangement is used to refer to a filament arrangement that is preferably in the form of a substantially two dimensional topological manifold. Thus, the substantially flat filament arrangement extends in two dimensions along a surface substantially more than in a third dimension. In particular, the dimensions of the substantially flat filament arrangement in the two dimensions within the surface are at least 5 times larger than in the third dimension, normal to the surface. An example of a substantially flat filament arrangement is a structure between two substantially parallel surfaces, wherein the distance between these two surfaces is substantially smaller than the extension within the surfaces. In some embodiments, the substantially flat filament arrangement is planar. In other embodiments, the substantially flat filament arrangement is curved along one or more dimensions, for example forming a dome shape or bridge shape.

The term "filament" is used preferably to refer to an electrical path arranged between two electrical contacts. A filament may arbitrarily branch off and diverge into several paths or filaments, respectively, or may converge from several electrical paths into one path. A filament may have a round, square, flat or any other form of cross-section. A filament may be arranged in a straight or curved manner.

The term "filament arrangement" is used preferably to refer to an arrangement of one or preferably a plurality of filaments. The filament arrangement may be an array of filaments, for example arranged parallel to each other. Preferably, the filaments may form a mesh. The mesh may be woven or non-woven.

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

## CLAIMS

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

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

a heater assembly comprising at least one heater element fixed to the housing and extending across the opening of the housing,

wherein the at least one heater element of the heater assembly has a width that is smaller than a width of the opening of the housing, and

wherein the heater element is fluid permeable and comprises a plurality of electrically conductive filaments.

2. The cartridge according to claim 1, wherein the width of the at least one heater element is less than 90%, preferably less than 50%, preferably less than 30 %, preferably less than 25% of the width of the opening of the housing.

3. The cartridge according to claim 1 or claim 2, wherein the area of the heater elements of the heater assembly is less than 90% of the area of the opening of the housing, preferably between 10% and 50% of the area of the opening, preferably between 15 and 25% of the area of the opening.

4. The cartridge according to any one of the preceding claims, wherein the heater assembly has a total resistance of over 1 Ohm, preferably of between 1 and 4 Ohm and most preferably of about 1.5 Ohm.

5. A cartridge according to one of the preceding claims, wherein the heater assembly comprises a plurality of heater elements connected in series.

6. A cartridge according to claim 5, wherein the heater elements of the heater assembly are arranged substantially in parallel to each other.

7. A cartridge according to one of the preceding claims, wherein the heater assembly is substantially flat.

~~8. A cartridge according to any one of the preceding claims, wherein the heater element is fluid permeable and comprises a plurality of electrically conductive filaments.~~

~~9~~8. A cartridge according to one of the preceding claims~~claim 8~~, wherein the at least one heater element comprises a mesh having interstices between the electrically conductive filaments.

~~10~~9. A cartridge according to claim ~~9~~8, wherein at least a portion of the heater element is spaced apart from the periphery of the opening by a distance which is greater than a dimension of the interstices of that portion of the heater element.

~~11~~10. A cartridge according to claim ~~9~~8 or claim ~~10~~9, wherein the housing of the liquid storage portion contains a capillary material and wherein the capillary material extends into the interstices between the filaments.

~~12~~11. A method of manufacture of a cartridge for use in an 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

providing a heater assembly comprising at least one heater element extending across the opening of the housing,

wherein the at least one heater element of the heater assembly is smaller than the opening of the housing.

~~13~~12. An aerosol-generating system comprising

a main unit, and

a cartridge according to any one of claims 1 to ~~11~~10 that is removably coupled to the main unit,

wherein the liquid storage portion and heater assembly are provided in the cartridge and the main unit comprises a power supply.

~~14~~13. An aerosol-generating system according to claim ~~13~~12, 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.

~~15~~14. An aerosol-generating system comprising a cartridge according to any of claims 1 to ~~11~~10, wherein the system is an electrically operated smoking system.