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(54) Title of the Invention: **Electronic cigarette**  
Abstract Title: **Electronic cigarette**

(57) An electronic cigarette comprises a power cell (8, figs 2 & 3) and a vaporiser (10, figs 2 & 3), where the vaporiser comprises a heating element 16 and a heating element support 18. The gap 20 is provided between the heating element 16 and the heating element support 18. The gap may be provided in a number of different ways. As shown, the gap may be in the form of one or more channels 20 in the surface of the heating element support 18. Alternatively, the surface of the heating element support 18 may be pitted, with the gaps being provided by the heating element being coiled over the pitted areas (fig 6). The gap or gaps may be provided by coiling the heating element 16 over heating elements having various cross-sections (figs 11-22). In a further alternative embodiment, the heating element support 18 may be a planar member with openings (22, figs 23 & 24) over or through which the heating element 16 passes. The heating element support 18 may be porous, e.g. a porous ceramic.

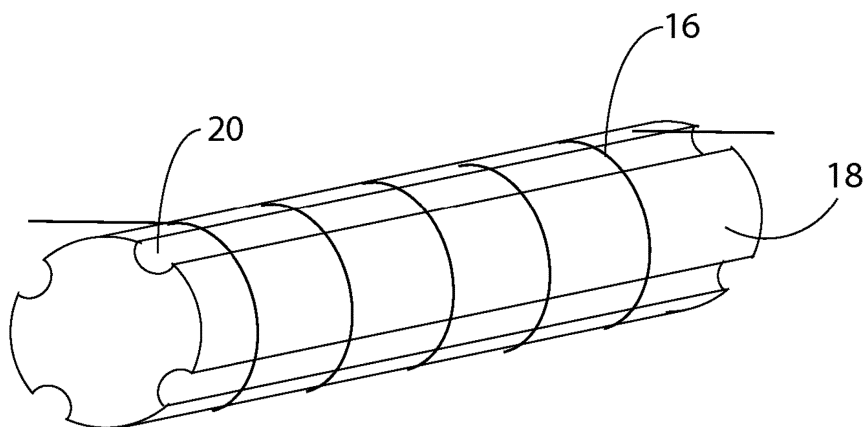


Figure 8

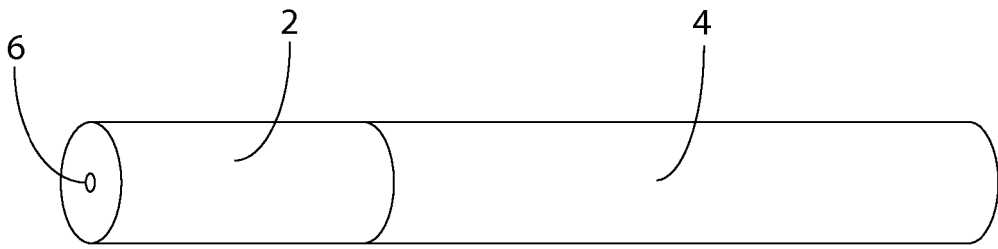


Figure 1

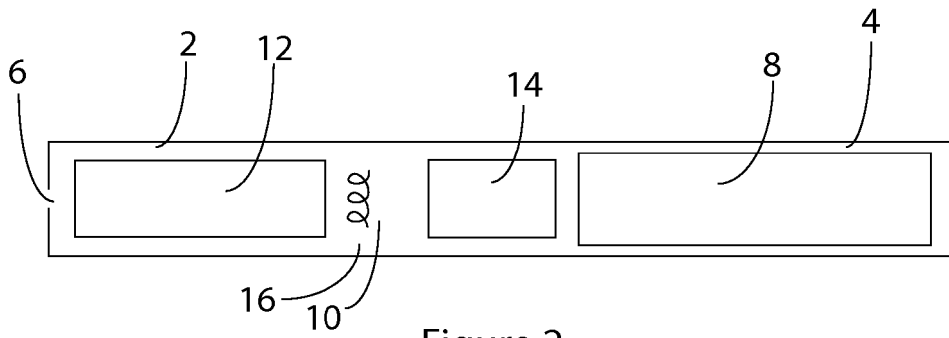


Figure 2

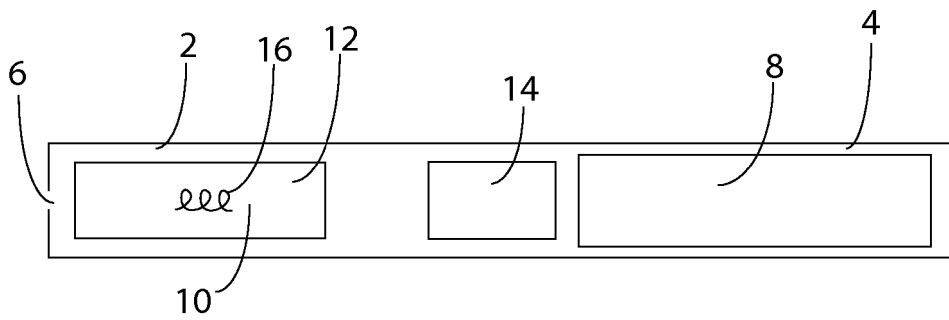


Figure 3

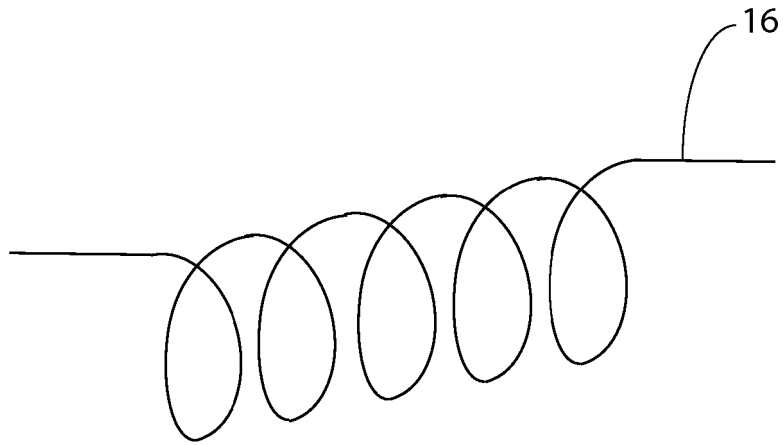


Figure 4

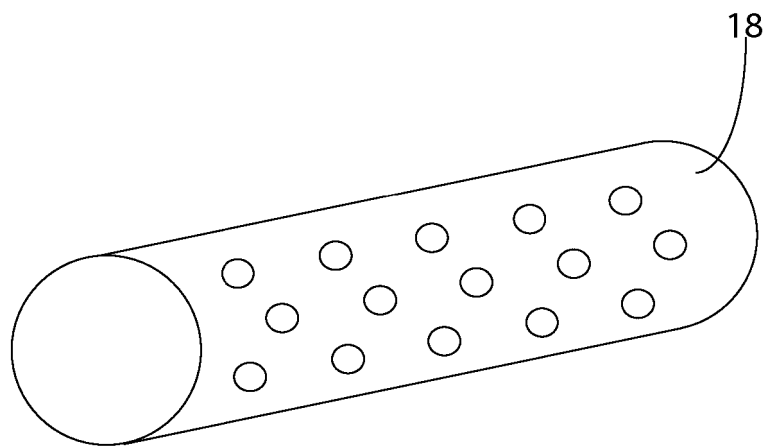


Figure 5

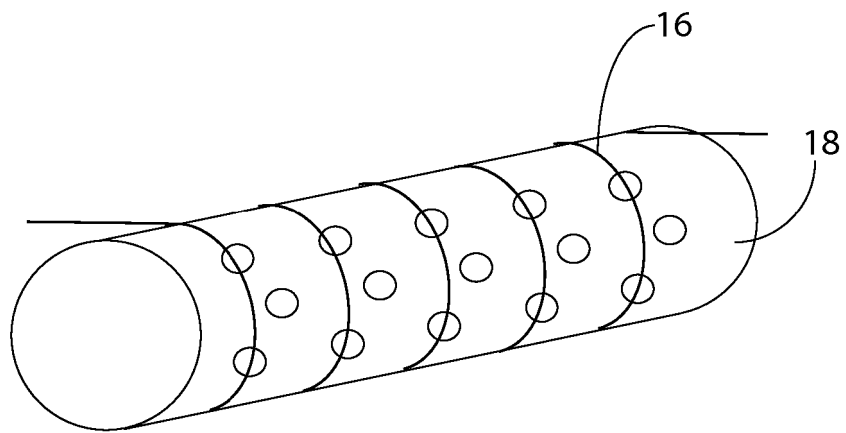


Figure 6

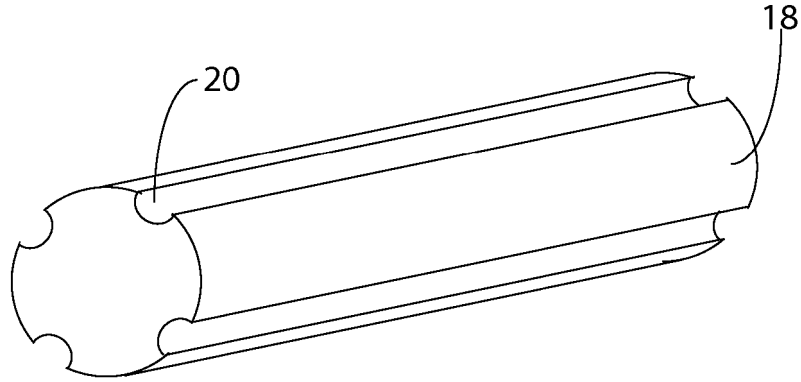


Figure 7

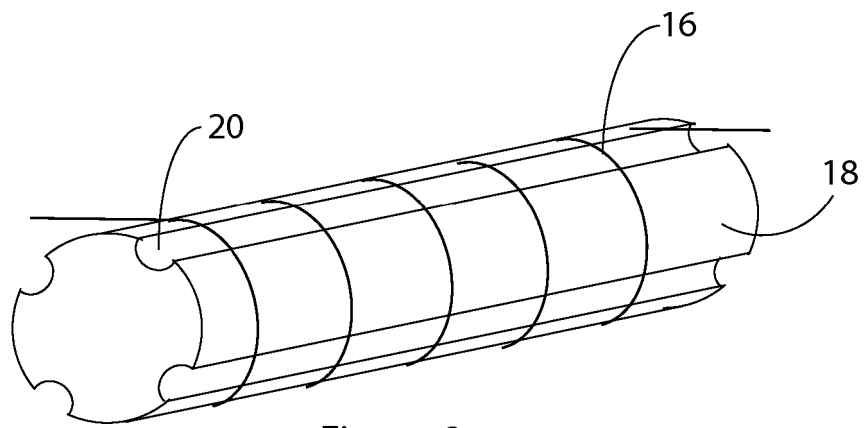


Figure 8

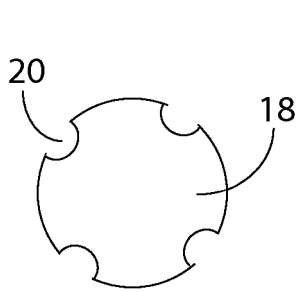


Figure 9

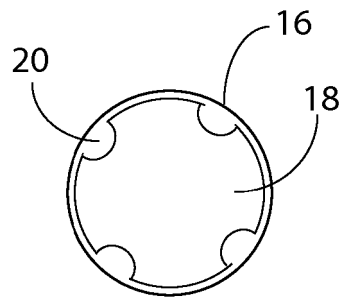


Figure 10

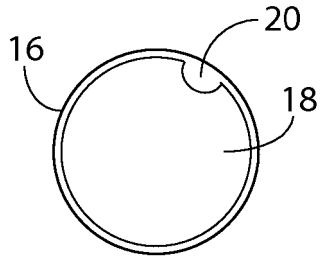


Figure 11

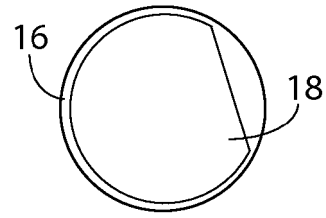


Figure 12

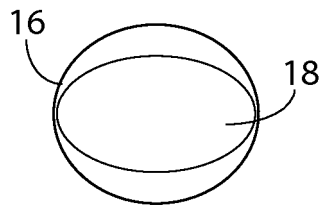


Figure 13

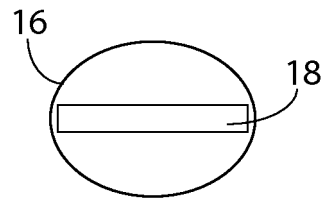


Figure 14

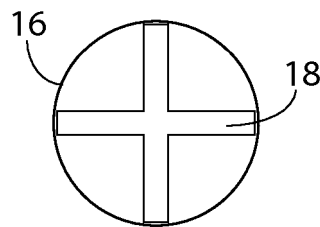


Figure 15

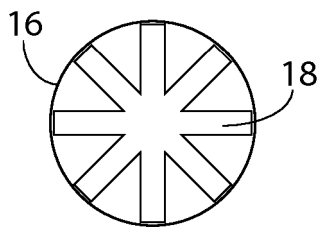


Figure 16

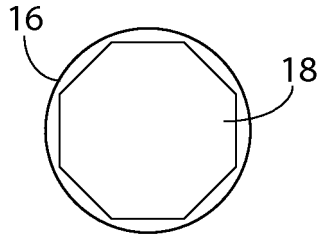


Figure 17

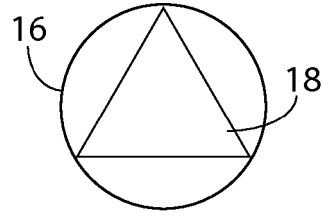


Figure 18

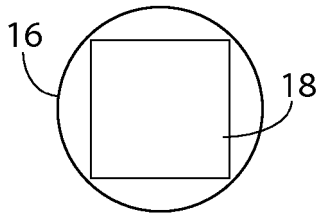


Figure 19

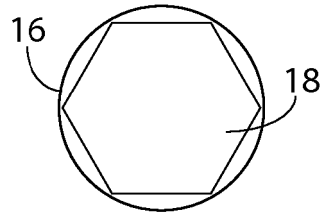


Figure 20

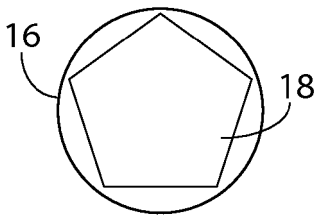


Figure 21

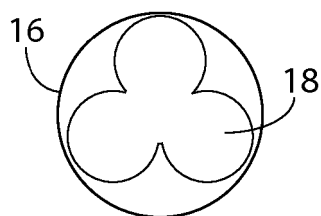


Figure 22

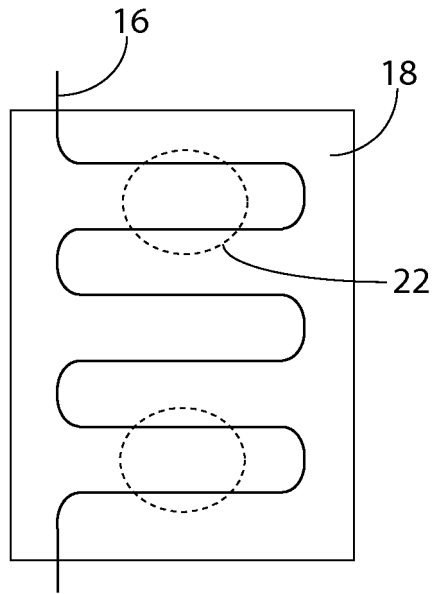


Figure 23

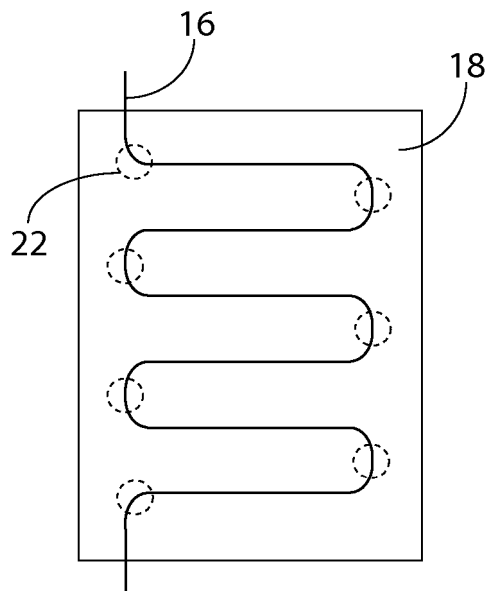


Figure 24

## **Electronic Cigarette**

### Field of the Invention

5 The present invention relates to electronic cigarettes. More particularly, but not exclusively, the present invention concerns electronic cigarettes comprising a vaporiser.

### Background of the Invention

10

It is well known that smoking tobacco is bad for your health and reduces your life expectancy. Smokers have an increased chance of developing lung cancer, suffering from chronic obstructive pulmonary disease and having heart attacks.

15

However, smokers can find it difficult to quit smoking because they are addicted to the nicotine found in tobacco. A number of smoking cessation techniques have been developed to help people quit, including the use of Nicotine Replacement Therapy (NRT) to introduce nicotine into the body in a form other than tobacco. NRT products include nicotine gums, nicotine patches and electronic cigarettes.

20

Electronic cigarettes are popular because they replicate the smoking habit. These devices are typically cigarette-sized and function by allowing a user to inhale a nicotine vapour from a liquid store by applying a suction force to a mouthpiece. Some electronic smoking devices have an airflow sensor that activates when a user applies the suction force and causes a heater coil to heat up and vaporise the liquid.

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### Summary of the Invention

In a first aspect of the present invention there is provided an electronic cigarette comprising a power cell and a vaporiser, where the vaporiser comprises a heating element and a heating

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element support, wherein a gap is provided between the heating element and the heating element support.

Having a separate heating element and support allows a finer heating element to be constructed. This is advantageous because a finer heating element can be more efficiently heated. Providing a gap between the heating element and the heating element support allows liquid to be gathered and stored in the gap region for vaporisation. The gap can also act to wick liquid onto the heating element. Also, providing a gap between the heating element and support means that a greater surface area of the heating element is exposed thereby giving a greater surface area for heating and vaporisation.

Suitably, the heating element is on the outside of the heating element support.

Suitably, the heating element support comprises a support outer surface and the gap is provided between the heating element and the support outer surface.

Suitably, the heating element and heating element support form a heating rod. Suitably, the heating element support is a rigid support. Suitably, the heating element support is solid.

This has the advantage that a rigid or solid support enables a more fragile, more efficient heating element to be used. The combination of the support and the heating element provides a more robust heating rod.

Suitably, the heating element support is porous. Suitably, the heating element support comprises a porous ceramic material.

Having a porous support enables liquid to be stored in the porous support. Thus the liquid can be easily transferred to the heating element in contact with the support for

vaporisation by the heating element. Also, the gap between the heating element and the support allows for wicking of liquid both from the porous support onto the heating element and into the porous support for storage.

5

Suitably, the heating element is formed around the heating element support. Suitably, the heating element is a heating coil. Suitably, the heating coil is coiled around the heating element support. Suitably, the heating coil is a wire coil.  
10 Suitably, the gap is between a coil turn and the heating element support. Suitably, gaps are between coil turns and the heating element support.

Having a heating element that wraps around the support provides  
15 a more sturdy construction. The support also facilitates the creation of a coil by enabling wire to be wrapped around the support. By providing a gap between a coil turn and the support, liquid can be wicked into the gap and held in the gap for vaporisation. In particular, liquid can be wicked by the  
20 spaces between coil turns and into the gap between a coil turn and the support.

Suitably, the vaporiser further comprises a vaporisation cavity configured such that in use the vaporisation cavity is a  
25 negative pressure cavity. Suitably, at least part of the heating element is inside the vaporisation cavity. Suitably, the electronic cigarette comprises a mouthpiece section and the vaporiser is part of the mouthpiece section.

30 By having the heating element in the vaporisation cavity, which in turn is a negative pressure cavity when a user inhales through the electronic cigarette, the liquid is directly vaporised and inhaled by the user.

35 Suitably, the heating element support is elongated in a lengthwise direction. Suitably, the heating element support has

a side channel running lengthwise along the support. Suitably, the heating element support comprises two or more side channels running lengthwise along the support. Suitably, the side channels are distributed substantially evenly around the heating element support.

A channel in the support provides a natural gap between the support and the heating element. This is particularly the case when the heating element is a coil wound around the support. The channel therefore provides the necessary gap to wick and store liquid. The area of the heating element exposed is also increased along the channel leading to increased vaporisation in this region.

Suitably, the heating element support is non-cylindrical. Suitably, the heating element support is cylinder-like but non-cylindrical. Suitably, the heating element support has a non-circular cross-section. Suitably, the heating element support has a pitted surface.

Since a coil is naturally cylindrical when formed due to the rigidity of the wire, a non-cylindrical support has the advantage that there will naturally be gaps between the coil and the support. These gaps lead to increased wicking, liquid storage and vaporisation. A cylinder-like support with a pitted surface provides gaps between the support and the coil in the pit regions. Cross-sections are sections perpendicular to the elongated lengthwise direction.

Alternatively, the cross-sectional shape of the heating element support is a polygon. Suitably, the cross-sectional shape of the heating element support has 3 sides. Suitably, the cross-sectional shape of the heating element support has 4 sides. Suitably, the cross-sectional shape of the heating element support has 5 sides. Suitably, the cross-sectional shape of the

heating element support has 6 sides. Suitably, the cross-sectional shape of the heating element support has 8 sides.

Alternatively, the cross-sectional shape of the heating element support is a flat rectangle. Alternatively, the cross-sectional shape of the heating element support is an ellipse. Alternatively, the cross-sectional shape of the heating element support is equivalent to three overlapping circles joined together.

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Alternatively, the cross-sectional shape of the heating element support is a cross. Suitably, the cross-sectional shape of the heating element support is a cross having 4 arms. Suitably, the cross-sectional shape of the heating element support is a cross having 8 arms.

Again, these various shapes of support provide natural gaps between the support and a heating element coil that is wound around the support. These gaps lead to increased wicking, liquid storage and vaporisation.

Alternatively, the heating element support is a flat planar substrate. Suitably, the heating element is on one surface of the heating element support. Alternatively, the heating element is threaded in and out of the heating element support. Alternatively, the heating element is wrapped around the heating element support. Suitably, the heating element support comprises a substrate having holes.

### 30 Brief Description of the Drawings

For a better understanding of the invention, and to show how example embodiments may be carried into effect, reference will now be made to the accompanying drawings in which:

35

Figure 1 is a side perspective view of an electronic cigarette;

- Figure 2 is a cross-sectional view of an electronic cigarette having a perpendicular coil;
- Figure 3 is a cross-sectional view of an electronic cigarette having a parallel coil;
- 5 Figure 4 is a side perspective view of a heating element coil;
- Figure 5 is a side perspective view of a cylindrical heating element support having a pitted surface;
- Figure 6 is a side perspective view of a heating element coil and heating element support having a pitted surface;
- 10 Figure 7 is a side perspective view of a heating element support having channels;
- Figure 8 is a side perspective view of a heating element coil and heating element support having channels;
- Figure 9 is an end view of the heating element support of
- 15 Figure 7;
- Figure 10 is an end view of the heating element coil and support of Figure 8;
- Figure 11 is an end view of a coil and a heating element support having a channel;
- 20 Figure 12 is an end view of a coil and a heating element support having a circular segment cross-section;
- Figure 13 is an end view of a coil and a heating element support having an oval cross-section;
- Figure 14 is an end view of a coil and a heating element
- 25 support having a flat rectangular cross-section;
- Figure 15 is an end view of a coil and a heating element support having a 4 arm cross, cross-section;
- Figure 16 is an end view of a coil and a heating element support having an 8 arm cross, cross-section;
- 30 Figure 17 is an end view of a coil and a heating element support having an octagonal cross-section;
- Figure 18 is an end view of a coil and a heating element support having a triangular cross-section;
- Figure 19 is an end view of a coil and a heating element
- 35 support having a square cross-section;

Figure 20 is an end view of a coil and a heating element support having a hexagonal cross-section;

Figure 21 is an end view of a coil and a heating element support having a pentagonal cross-section;

5 Figure 22 is an end view of a coil and a heating element support having cross-sectional shape of three circles joined together;

Figure 23 is a front view of a heating element support substrate and heating element; and

10 Figure 24 is a front view of a heating element support substrate and with a threaded heating element.

#### Description of the Preferred Embodiments

15 Referring to Figures 1 to 3 there is shown an electronic cigarette comprising a mouthpiece 2 section and a cigarette body 4 section. The electronic cigarette is shaped like a conventional cigarette having a cylindrical shape. The mouthpiece 2 has an air outlet 6 and the electronic cigarette  
20 is operated when a user places the electronic cigarette in their mouth and inhales, drawing air through the air outlet 6.

Figures 2 and 3 show an internal arrangement, the electronic cigarette having a power cell 8, a vaporiser 10, a liquid store  
25 12 and a control circuit 14. The liquid store is situated within the mouthpiece 2 section. The control circuit 14 has an airflow sensor and is connected to the power cell 8 and the vaporiser 10. In use, when air is drawn through the air outlet  
30 6 the airflow sensor on the control circuit 14 is activated causing power to be delivered to the vaporiser 10 which in turn vaporises liquid from the liquid store 12.

The vaporiser 10 has a heating element 16, in this example a wire coil, which is the part that heats up to vaporise liquid  
35 in contact with it. Liquid is vaporised in a vapourisation

cavity and the coil 16 is situated within this vaporisation cavity.

In the example shown in Figure 2, the coil 16 lies outside of the liquid store 12 where the coil 16 is mounted perpendicular to the longitudinal axis of the cigarette. A wicking element is used to wick liquid from the liquid store 12 to the heating element in order to vaporise the liquid. In use, the vaporised liquid travels down the side of the liquid store 12 and out of the air outlet 6 to be inhaled by the user.

In the example shown in Figure 3, the coil 16 lies within the liquid store 12 area and the coil 16 is mounted parallel to the longitudinal axis of the cigarette. Liquid is wicked directly onto the coil 16 for vaporisation, and vaporised liquid travels down an airway channel within the liquid store 12 and out of the air outlet 6 to be inhaled by the user.

Figures 4 to 6 show an example arrangement with a coil 16 supported by a heating element support 18. Figure 4 shows the coil 16, Figure 5 shows the heating element support 18 and the Figure 6 shows the coil 16 wound around the heating element support 18.

The heating element support 18 is substantially cylindrical in shape and the coil 16 is wound around the cylinder such that the coil 16 is in contact with the cylinder. The heating element support 18 has a pitted surface, such that depressions are formed on the surface. A gap is formed between the heating element support 18 and the coil 16 in a location where the coil 16 overlaps a depression in the surface.

In use, the heating element support 18 provides support to the coil 16. The gaps between the coil 16 and the heating element support 18 provide a means for wicking liquid by capillary action, provide an area for liquid to be stored prior to

vaporisation, and expose the coil 16 in the pitted areas for increased vaporisation in these areas.

Other examples will be described below where a gap or gaps are provided between the coil 16 and heating element support 18. These gaps provide the advantages already described.

Figures 7 to 10 show a different example of a heating element support 18. Here, the heating element support 18 is substantially cylindrical in shape and has channels 20 running along its length. Each channel 20 is a depression in the surface of the heating element support 18 running along the length. Four channels 20 are spaced evenly around the heating element support 18.

15

As shown in Figure 8 and Figure 10, when the coil 16 is wound around the heating element support 18, gaps are provided between the channels 20 and the coil sections overlapping the channels 20.

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Figures 11 to 22 each show an example of an elongated heating element support 18 with a coil 16 wound around and a gap or gaps provided between the coil 16 and the heating element support 18. Each example has a different cross-sectional shape as will be described.

25

In the example shown in Figure 11, the heating element support 18 is substantially cylindrical with a single channel 20 running along its length. Thus the cross-sectional shape of the heating element support 18 is a circle with a small indent for the channel 20. Gaps are provided between the overlap of the coil 16 and the channel 20 areas.

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In the example shown in Figure 12, the heating element support 18 has a cross-sectional shape being a major segment of a circle. This corresponds to an almost cylindrical shape with

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flat face running along the length of the heating element support 18. The coil 16 is wound around the heating element support 18 but the coil wire rigidity prevents the coil from following the shape of the heating element support 18 in the flat region. Thus a gap is provided between the heating element support 18 and the coil 16 in the area of the flat region.

In the example shown in Figure 13, the heating element support 18 has a cross-sectional shape being an ellipse. The coil 16 is wound around the heating element support 18 but the coil wire rigidity causes the coil 16 to form a more rounded shape than the ellipse, thereby providing gaps between the heating element support 18 and the coil 16.

In the example shown in Figure 14, the heating element support 18 is a flat bar having a cross-sectional shape being a flat rectangle. The coil 16 is wound around the heating element support 18 but the coil wire rigidity causes the coil 16 to form a more rounded shape than the rectangle, thereby providing gaps between the heating element support 18 and the coil 16.

In the example shown in Figure 15, the heating element support 18 has a cross-sectional shape being a 4-arm cross, where the arms are spaced evenly apart. The coil 16 is wound around the heating element support 18 and gaps are provided between adjacent arm sections and the coil 16.

In the example shown in Figure 16, the heating element support 18 has a cross-sectional shape being an 8-arm cross, where the arms are spaced evenly apart. The coil 16 is wound around the heating element support 18 and gaps are provided between adjacent arm sections and the coil 16.

Figures 17 to 21 show examples where the heating element support 18 has a cross-sectional shape being a regular polygon. Each of these has a different number of sides, Figure 17 is an

octagon, Figure 18 is a triangle, Figure 19 is a square, Figure 20 is a hexagon and Figure 21 is a pentagon. The coil 16 is wound around the heating element support 18 and is in contact with the heating element support 18 at the edges of the support corresponding to the corners of the cross-sectional shapes. In this way, polygons with more sides have more contact with the coil 16 and provide a greater number of smaller gaps between the coil 16 and the heating element support 18. This enables a cross-sectional shape to be selected that gives an optimum amount of contact between the heating element support 18 and the coil 16, and optimum gap formation.

In the example shown in Figure 22, the heating element support 18 has a cross-sectional shape corresponding to three overlapping circles joined together. The coil 16 is wound around the heating element support 18 and gaps are provided between adjacent circle sections and the coil 16.

In Figure 23, a different type of heating element support 18 and heating element 16 is shown. The heating element support 18 is a substantially flat substrate and the heating element 16 is arranged on the surface of the substrate in a zig-zag configuration to maximize the length of the heating element 16 for a given surface area of substrate. The heating element support 18 has substrate apertures 22 and gaps are formed between the heating element support 18 and the heating element 16 when the heating element 16 overlaps these substrate apertures 22.

Figure 24 shows an example similar to that shown in Figure 23. A heating element support 18 is a flat substrate comprising substrate apertures 22 and a zig-zag heating element 16. In this example, the substrate apertures 22 are located at the turning points of the zig-zag heating element 16 and the heating element 16 wire is threaded in and out of the substrate apertures 22 on respective turns such that the heating element

lies of both surfaces of the flat substrate. Gaps are provided between the heating element 16 and the substrate at the substrate aperture 22 locations.

5 Although examples have been shown and described it will be appreciated by those skilled in the art that various changes and modifications might be made without departing from the scope of the invention. The heating element is not restricted to being a coil and could be another wire form such as a zig-  
10 zag shape. Where channels are provided in the heating element support, a number other than one or four could be used. The heating element support could be made from a porous material such as porous ceramic to allow liquid storage within the support. The electronic cigarette is not restricted to the  
15 sequence of components described and other sequences could be used such as the control circuit being in the tip of the device or the liquid store being in the cigarette body rather than the mouthpiece. The vaporiser could form part of the mouthpiece or alternatively part of the cigarette body. Where the heating  
20 element support is a substrate, the heating element could be wrapped around the substrate.

Claims

1. An electronic cigarette comprising a power cell and a vaporiser, where the vaporiser comprises a heating element and a heating element support, wherein a gap is provided between the heating element and the heating element support.
2. The electronic cigarette of claim 1, wherein the heating element is on the outside of the heating element support.
3. The electronic cigarette of claim 1 or claim 2, wherein the heating element support comprises a support outer surface and the gap is provided between the heating element and the support outer surface.
4. The electronic cigarette of any preceding claim, wherein the heating element and heating element support form a heating rod.
5. The electronic cigarette of any preceding claim, wherein the heating element support is a rigid support.
6. The electronic cigarette of any preceding claim, wherein the heating element support is solid.
7. The electronic cigarette of any preceding claim, wherein the heating element support is porous.
8. The electronic cigarette of any preceding claim, wherein the heating element support comprises a porous ceramic material.
9. The electronic cigarette of any preceding claim, wherein the heating element is formed around the heating element support.

10. The electronic cigarette of any preceding claim, wherein the heating element is a heating coil.
11. The electronic cigarette of claim 10, wherein the heating  
5 coil is coiled around the heating element support.
12. The electronic cigarette of claim 10 or claim 11, wherein the heating coil is a wire coil.
- 10 13. The electronic cigarette of any one of claims 10 to 12, wherein the gap is between a coil turn and the heating element support.
14. The electronic cigarette of any one of claims 10 to 13,  
15 wherein gaps are between coil turns and the heating element support.
15. The electronic cigarette of any preceding claim, wherein the vaporiser further comprises a vaporisation cavity  
20 configured such that in use the vaporisation cavity is a negative pressure cavity.
16. The electronic cigarette of claim 15, wherein at least part  
25 of the heating element is inside the vaporisation cavity.
17. The electronic cigarette of any preceding claim, wherein the electronic cigarette comprises a mouthpiece section and the vaporiser is part of the mouthpiece section.
- 30 18. The electronic cigarette of any preceding claim, wherein the heating element support is elongated in a lengthwise direction.
19. The electronic cigarette of any preceding claim, wherein  
35 the heating element support has a side channel running lengthwise along the support.

20. The electronic cigarette of any preceding claim, wherein the heating element support comprises two or more side channels running lengthwise along the support.

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21. The electronic cigarette of claim 20, wherein the side channels are distributed substantially evenly around heating element.

10 22. The electronic cigarette of any preceding claim, wherein the heating element support is non-cylindrical.

23. The electronic cigarette of any preceding claim, wherein the heating element support is cylinder-like but non-  
15 cylindrical.

24. The electronic cigarette of any preceding claim, wherein the heating element support has a non-circular cross-section.

20 25. The electronic cigarette of any preceding claim, wherein the heating element support has a pitted surface.

26. The electronic cigarette of any preceding claim, wherein the cross-sectional shape of the heating element support is a  
25 polygon.

27. The electronic cigarette of any preceding claim, wherein the cross-sectional shape of the heating element support has 3 sides.

30

28. The electronic cigarette of any preceding claim, wherein the cross-sectional shape of the heating element support has 4 sides.

29. The electronic cigarette of any preceding claim, wherein the cross-sectional shape of the heating element support has 5 sides.

5 30. The electronic cigarette of any preceding claim, wherein the cross-sectional shape of the heating element support has 6 sides.

31. The electronic cigarette of any preceding claim, wherein  
10 the cross-sectional shape of the heating element support has 8 sides.

32. The electronic cigarette of any one of claims 1 to 25,  
wherein the cross-sectional shape of the heating element  
15 support is flat rectangle.

33. The electronic cigarette of any one of claims 1 to 25,  
wherein the cross-sectional shape of the heating element  
support is an ellipse.  
20

34. The electronic cigarette of any one of claims 1 to 25,  
wherein the cross-sectional shape of the heating element  
support is equivalent to three overlapping circles joined  
together.

25 35. The electronic cigarette of any one of claims 1 to 25,  
wherein the cross-sectional shape of the heating element  
support is a cross.

30 36. The electronic cigarette of any one of claims 1 to 25,  
wherein the cross-sectional shape of the heating element  
support is a cross having 4 arms.

37. The electronic cigarette of any one of claims 1 to 25,  
35 wherein the cross-sectional shape of the heating element  
support is a cross having 8 arms.

38. The electronic cigarette of any one or claims 1 to 25,  
wherein the heating element support is a flat planar substrate.

5 39. The electronic cigarette of claim 38, wherein the heating  
element is on one surface of the heating element support.

40. The electronic cigarette of claim 38, wherein the heating  
element is threaded in and out of the heating element support.

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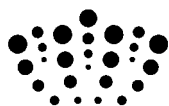
41. The electronic cigarette of claim 38, wherein the heating  
element is wrapped around the heating element support

42. The electronic cigarette of any one of claims 38 to 41,  
15 wherein the heating element support comprises a substrate  
having holes.

43. An electronic cigarette, substantially as described herein  
with reference to the accompanying drawings.

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**Application No:** GB1212599.3

**Examiner:** Dr Steven Chadwell

**Claims searched:** 1-43

**Date of search:** 13 November 2012

**Patents Act 1977: Search Report under Section 17**

**Documents considered to be relevant:**

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-19, 22-24, 38, 39, 41	EP 2340729 A1 (PHILIP MORRIS) see whole document
X	1, 5, 6, 10, 12-18	US 2010/006113 A1 (URTSEV et al) see whole document, especially figures 3-6

**Categories:**

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

**Field of Search:**

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC<sup>X</sup> :

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Worldwide search of patent documents classified in the following areas of the IPC

A24F; A61M
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The following online and other databases have been used in the preparation of this search report

EPODOC, WPI
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**International Classification:**

Subclass	Subgroup	Valid From
A24F	0047/00	01/01/2006