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(54) Title of the Invention: **Aerosol provision systems**  
 Abstract Title: **Aerosol provision system with heating element support**

(57) An apparatus for an electronic aerosol provision system comprising a reservoir 210 for a source liquid; a carrier module 160 that defines an airflow path 120 within the reservoir and comprises a heating element 103 supported in the airflow path within the reservoir for generating an aerosol from the source liquid, wherein the carrier module comprises a first and second part which cooperatively engage to support the heating element and engage at an interface that extends in a direction substantially parallel to the direction of airflow in the airflow path. The apparatus may comprise a gap between the first and second parts of the carrier module providing a capillary channel 200 to draw liquid to the heating element from the reservoir. The heating element is preferably a sheet material extending in a plane which is substantially parallel to the interface between the first and second parts of the carrier module. The apparatus preferably comprises an outer housing 180 in which the carrier module is received, the reservoir around the airflow path being defined at least in part by a space between the carrier module and the outer housing.

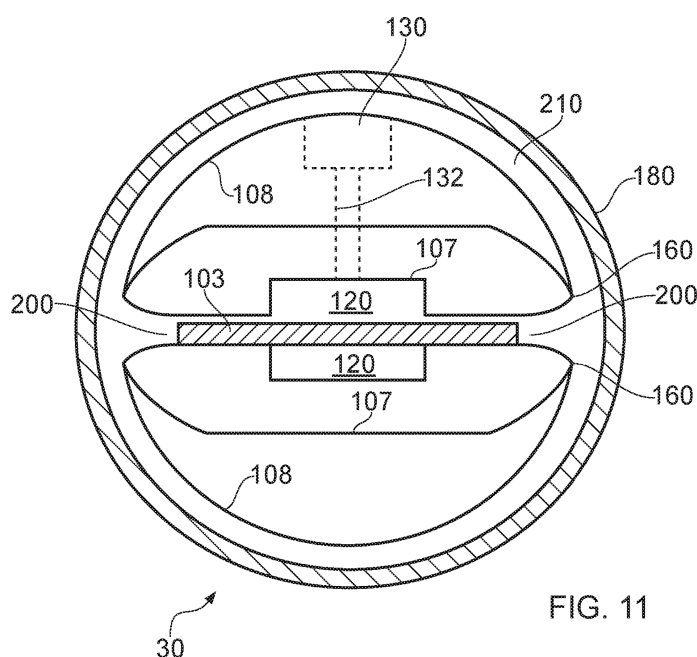


FIG. 11

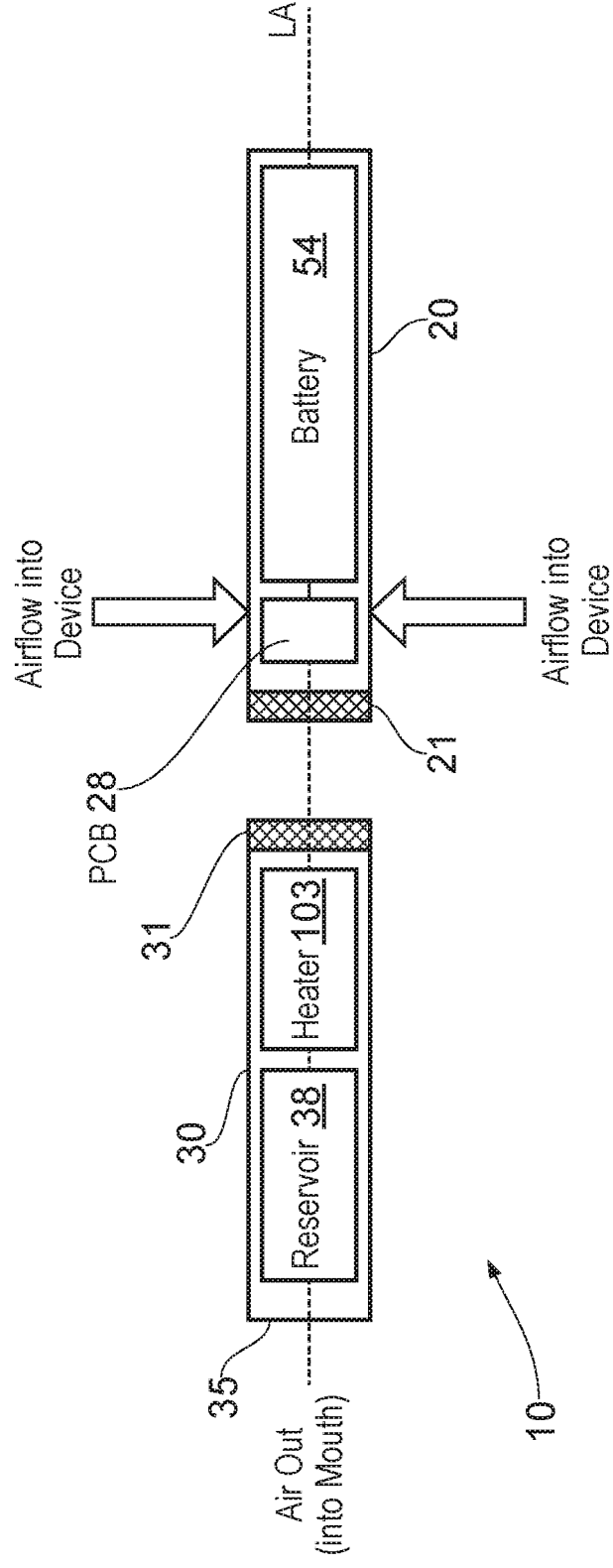


FIG. 1

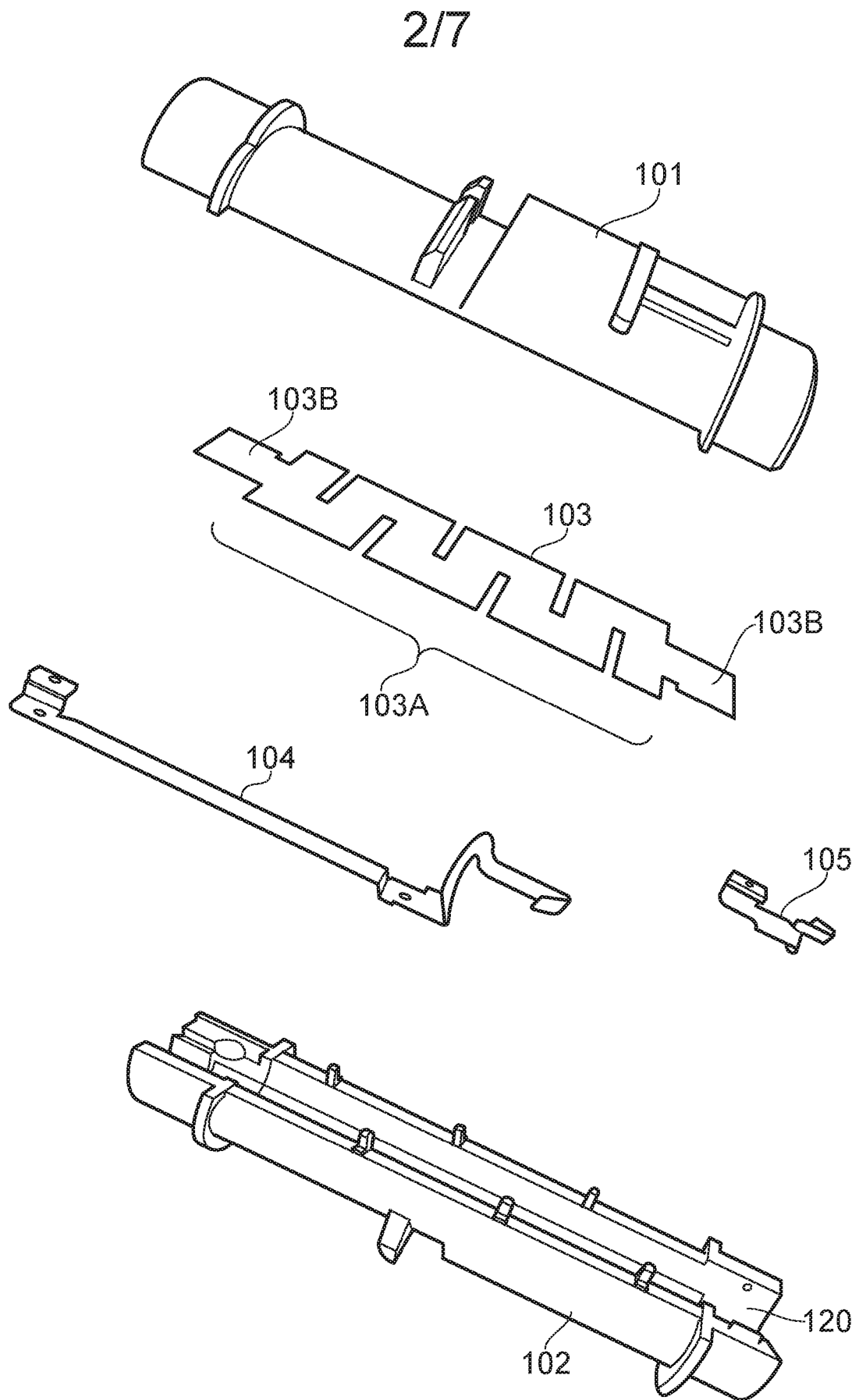


FIG. 2

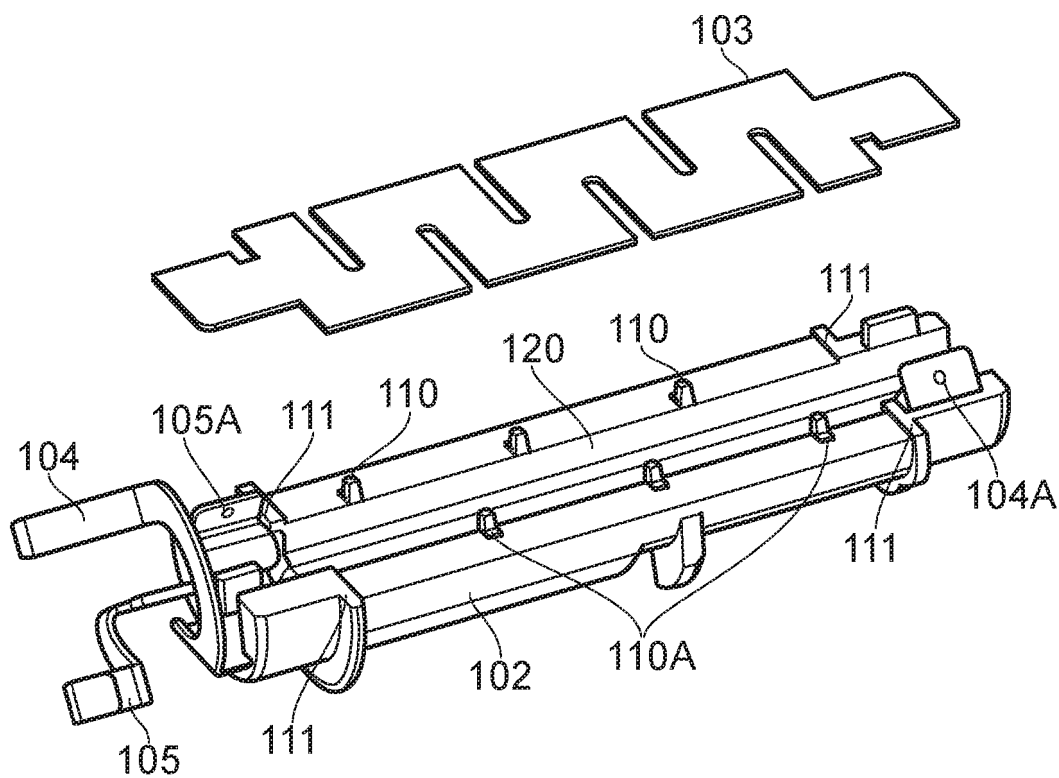


FIG. 3

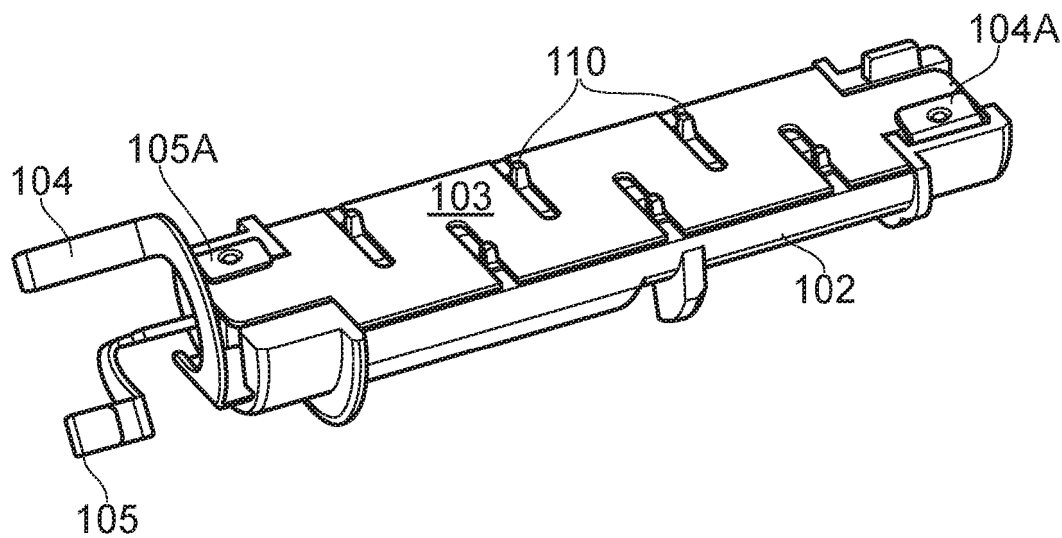


FIG. 4

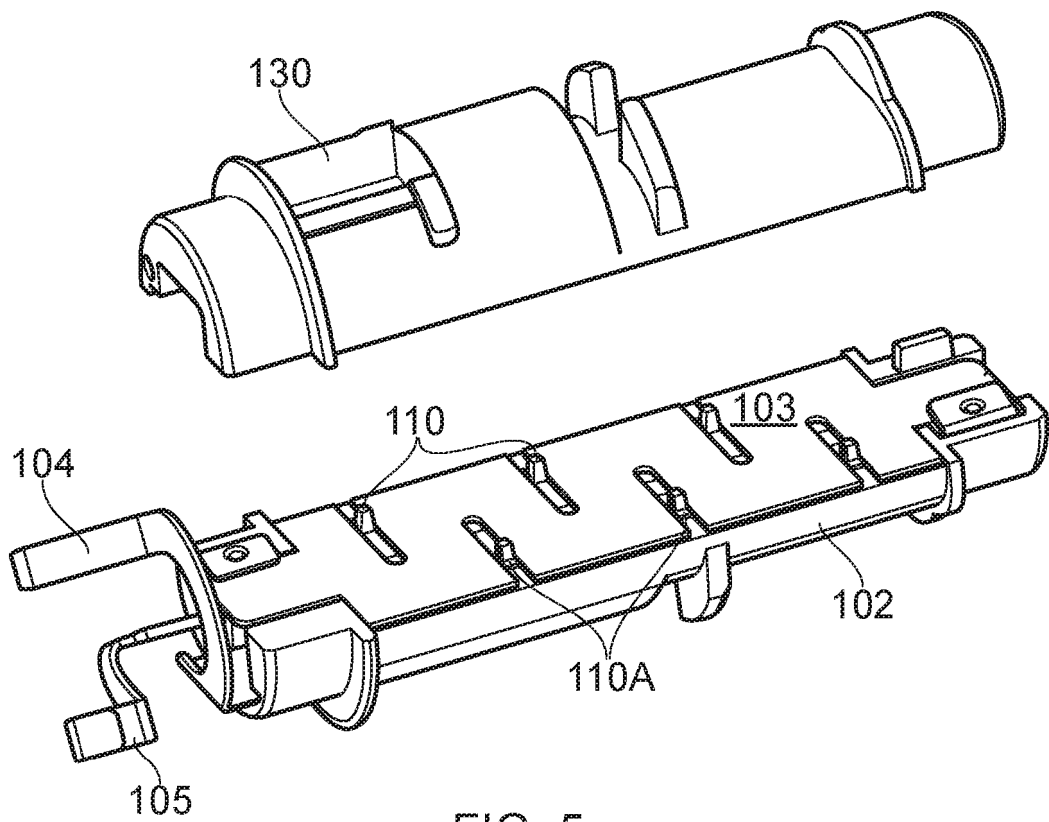


FIG. 5

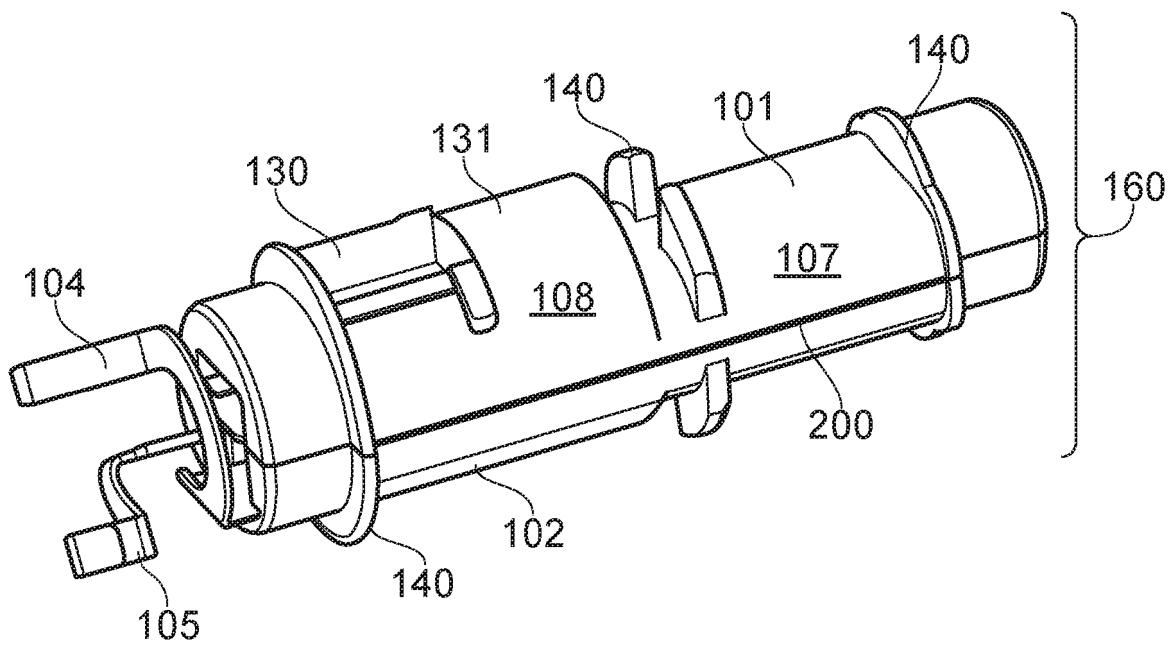


FIG. 6

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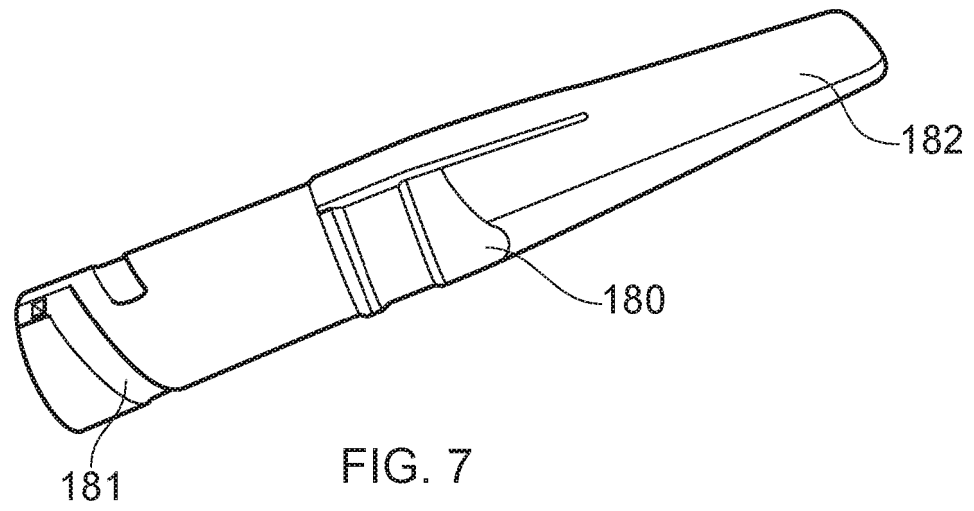
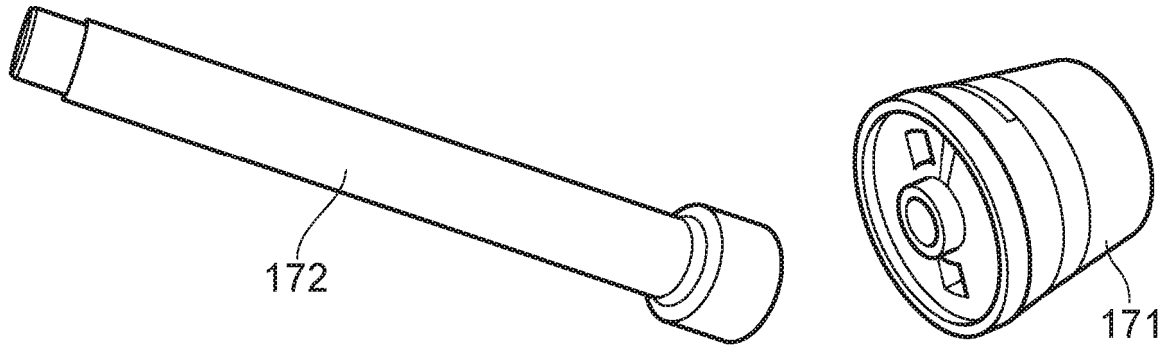


FIG. 7

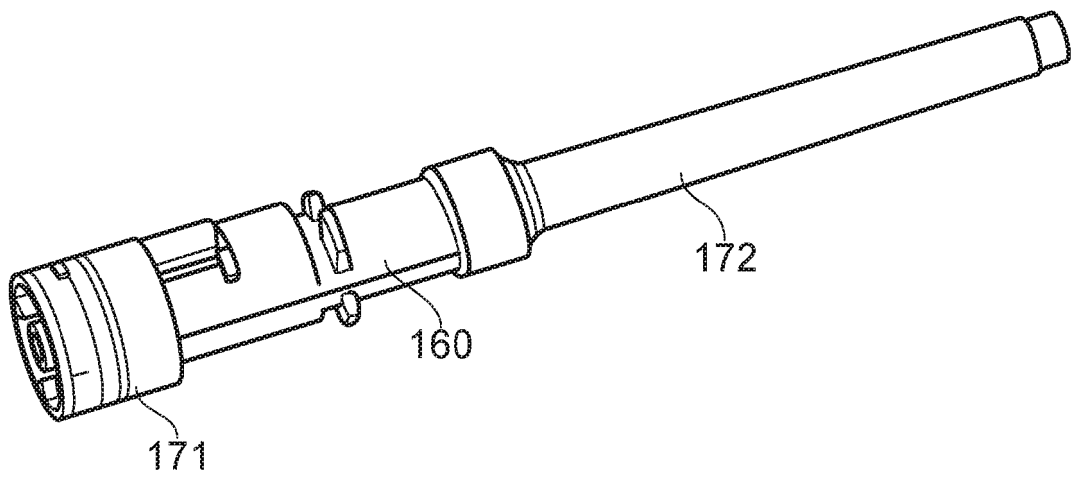


FIG. 8

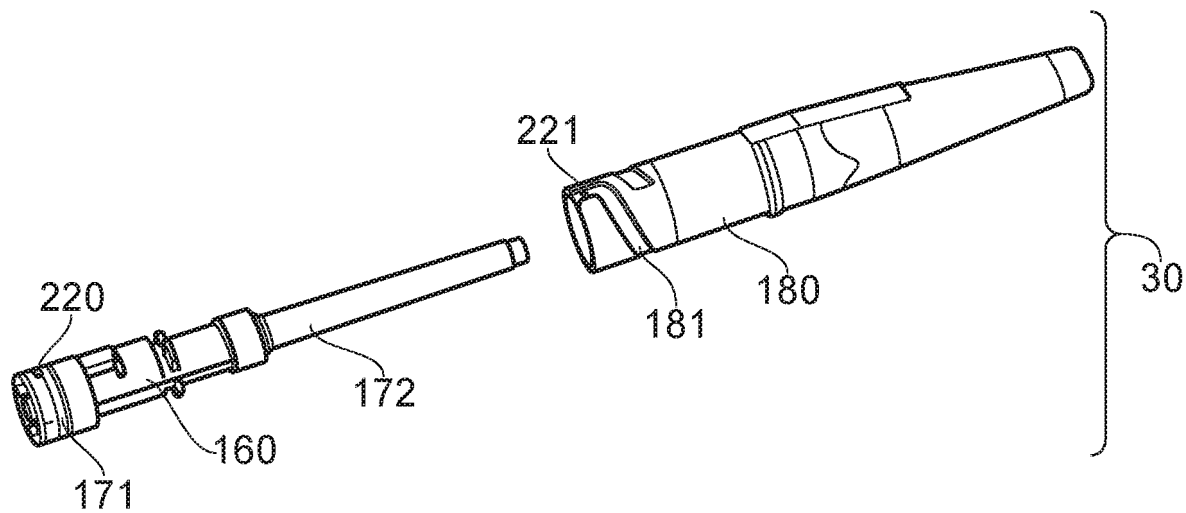


FIG. 9

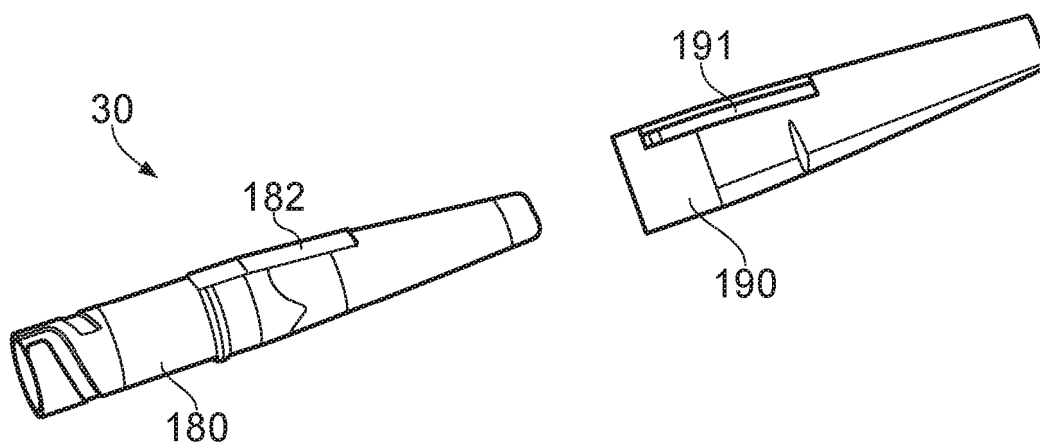


FIG. 10

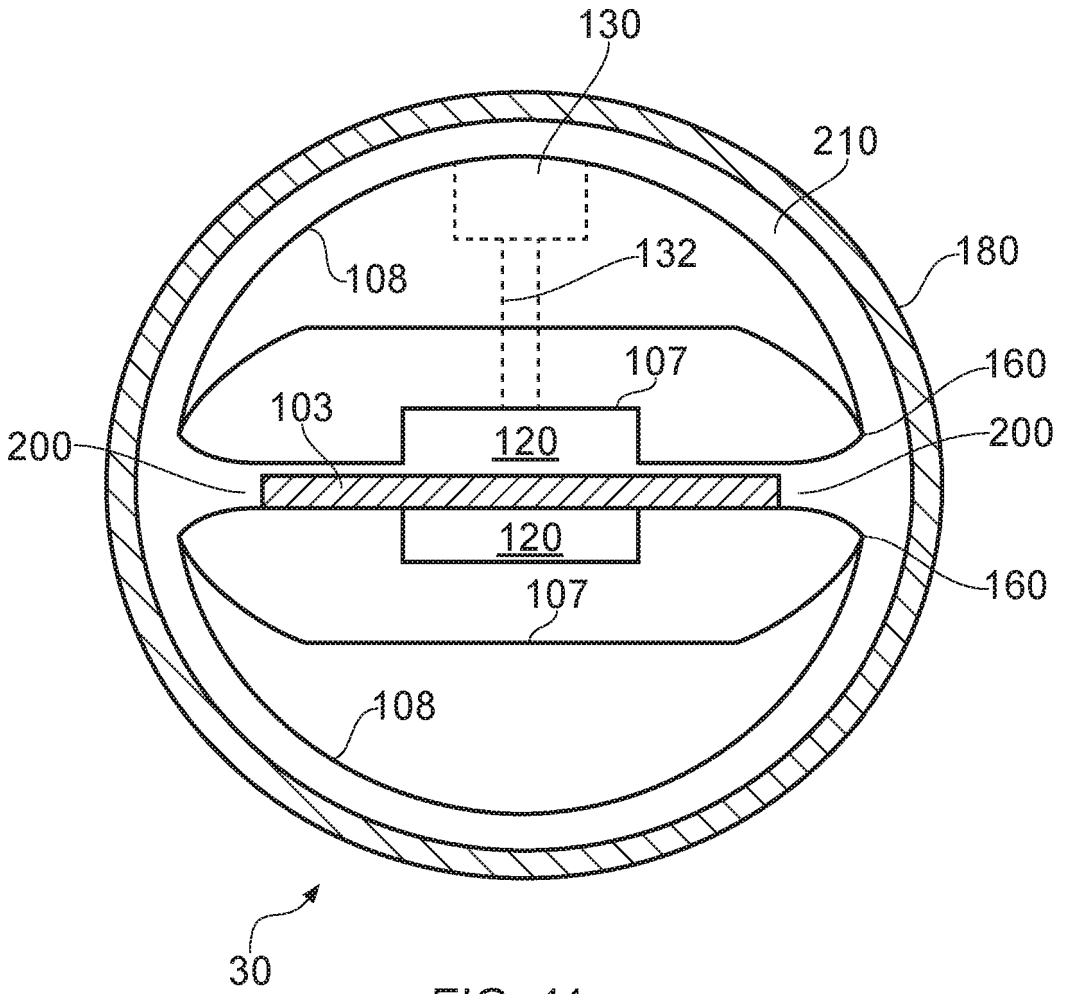


FIG. 11



## AEROSOL PROVISION SYSTEMS

### Field

The present disclosure relates to aerosol provision systems such as, but not exclusively, nicotine delivery systems (e.g. e-cigarettes).

### 5 Background

Aerosol provision systems such as e-cigarettes generally contain a reservoir of a source liquid containing a formulation, typically including nicotine, from which an aerosol is generated, e.g. through vaporisation or other means. Thus an aerosol source for an aerosol provision system may comprise a heating element coupled to a portion of the source liquid  
10 from the reservoir. When a user inhales on the device, the heating element is activated to vaporise a small amount of the source liquid, which is thus converted to an aerosol for inhalation by the user. More particularly, such devices are usually provided with one or more air inlet holes located away from a mouthpiece of the system. When a user sucks on the mouthpiece, air is drawn in through the inlet holes and past the aerosol source. There is a  
15 flow path connecting between the aerosol source and an opening in the mouthpiece so that air drawn past the aerosol source continues along the flow path to the mouthpiece opening, carrying some of the aerosol from the aerosol source with it. The aerosol-carrying air exits the aerosol provision system through the mouthpiece opening for inhalation by the user.

One important consideration for aerosol provision systems is the manner in which  
20 liquid is supplied to the heating element. On the one hand there is a need to supply source liquid to replace that vaporised during use to provide continued aerosol generation and to help avoid overheating caused by the heating element becoming dry. However, on the other hand, there is a need to restrict the supply source liquid to the heating element to avoid leakage from the aerosol provision system, for example due to excess liquid from the  
25 heating element running through the airflow channel to an aerosol outlet (mouthpiece) for the aerosol provision system. It can also be important to provide for an appropriate supply of liquid to the heating element for a range of different orientations in which a device might be held. Another important consideration for aerosol provision systems is the need to support what can be relatively fragile heating elements in an appropriate manner.

30 In this regard, various approaches for mounting heating elements in relation to a supply of source liquid in aerosol provision systems have been previously proposed. For example, US 2013 / 333700 [1] and WO 2013 / 057185 [2] describe approaches in which a composite wick is fed by a remotely mounted reservoir, KR 20130004985 [3] discloses a wick and heating element arranged in a conduit which is mounted transversely in an air  
35 channel with the wick extending into a surrounding reservoir and WO 2013 / 083631 [4] describes a device in which a heating element is mounted adjacent a porous reservoir wall. However, the Inventors have recognised the previously-proposed approaches do not always

provide for an appropriate supply of source liquid and can be relatively complicated to manufacture.

Accordingly there remains a need for approaches which seek to ameliorate some of the drawbacks associated with existing schemes for mounting and supplying source liquid to heating elements in aerosol provision systems.

### **Summary**

According to a first aspect of certain embodiments, there is provided an apparatus for an electronic aerosol provision system comprising: a reservoir for a source liquid; and a carrier module that defines an airflow path within the reservoir and comprises a heating element supported in the airflow path within the reservoir for generating an aerosol from the source liquid, wherein the carrier module comprises a first part and a second part which cooperatively engage to support the heating element, wherein the first part and the second part of the carrier module cooperatively engage at an interface which extends in a direction that is substantially parallel to a direction along which air flows in the airflow path when the apparatus is in normal use.

According to a second aspect of certain embodiments there is provided an electronic aerosol provision system comprising an apparatus according to the above-mentioned first aspect and a power source configured to supply electrical power to the heating element to generate an aerosol from the source liquid.

These and further aspects of certain embodiments are set out in the appended independent and dependent claims. It will be appreciated that features of the dependent claims may be combined with each other and features of the independent claims in combinations other than those explicitly set out in the claims. Furthermore, the approach described herein is not restricted to specific embodiments such as set out below, but includes and contemplates any appropriate combinations of features presented herein. For example, an electronic aerosol provision system may be provided in accordance with the approach described herein which includes any one or more of the various features described below as appropriate.

### **Brief Description of the Drawings**

Various embodiments will now be described in detail by way of example only with reference to the following drawings:

Figure 1 is a schematic diagram of an aerosol provision system such as an e-cigarette in accordance with some embodiments;

Figure 2 schematically represents components of a heating element carrier module for use in a cartridge assembly of the aerosol provision system of Figure 1 in accordance with some embodiments;

Figures 3 to 6 schematically represent the components represented in Figure 2 at different stages of assembly of a heating element carrier module for use in a cartridge assembly in accordance with some embodiments;

5 Figure 7 schematically represents some further components of a cartridge assembly in accordance with some embodiments;

Figures 8 to 10 schematically represents a cartridge assembly comprising the heating element carrier module of Figure 6 and the further components of Figure 7 at different stages of assembly in accordance with some embodiments; and

10 Figure 11 schematically represent a cross-section through a cartridge assembly in accordance with an embodiment.

### **Detailed Description**

Aspects and features of certain examples and embodiments are discussed / described herein. Some aspects and features of certain examples and embodiments may be implemented conventionally and these are not discussed / described in detail in the interests  
15 of brevity. It will thus be appreciated that aspects and features of apparatus and methods discussed herein which are not described in detail may be implemented in accordance with any conventional techniques for implementing such aspects and features.

As described above, the present disclosure relates to an aerosol provision system, such as an e-cigarette. Throughout the following description the term "e-cigarette" may  
20 sometimes be used; however, it will be appreciated this term may be used interchangeably with aerosol (vapour) provision system.

Figure 1 is a highly schematic diagram of an aerosol / vapour provision system such as an e-cigarette 10 in accordance with some embodiments (not to scale). The e-cigarette has a generally cylindrical shape, extending along a longitudinal axis indicated by dashed  
25 line LA, and comprises two main components, namely a body 20 and a cartridge assembly (cartomiser) 30.

The cartridge assembly 30 includes a reservoir (chamber) 38 containing a source liquid comprising a liquid formulation from which an aerosol is to be generated, for example containing nicotine, and a heating element (distiller) 103 for heating source liquid to generate  
30 the aerosol. The source liquid and the heating element may be collectively referred to as an aerosol source. The cartridge assembly 30 further includes a mouthpiece 35 having an opening through which a user may inhale the aerosol generated by the heating element 103. The source liquid may be of a conventional kind used in e-cigarettes, for example comprising around 1 to 3% nicotine and 50% glycerol, with the remainder comprising roughly equal  
35 measures of water and propylene glycol, and possibly also comprising other components, such as flavourings. The body 20 includes a re-chargeable cell or battery to provide power for the e-cigarette 10 and a circuit board for generally controlling the e-cigarette. In use,

when the heating element receives power from the battery, as controlled by the circuit board, the heating element vaporises source liquid at the heating location to generate the aerosol, and this is then inhaled by a user through the opening in the mouthpiece. The aerosol is carried from the aerosol source to the mouthpiece along an air channel that connects the aerosol source to the mouthpiece opening as a user inhales on the mouthpiece.

The main body 20 of the e-cigarette includes a re-chargeable cell or battery 54 to provide power for the e-cigarette 10 (referred to hereinafter as a battery) and a printed circuit board (PCB) 28 and / or other electronics for generally controlling the e-cigarette.

In this particular example, the body 20 and cartridge assembly 30 are detachable from one another by separating in a direction parallel to the longitudinal axis LA, as shown in Figure 1, but are joined together when the device 10 is in use by cooperating engagement elements 21, 31 (e.g. forming a screw or bayonet fitting) to provide mechanical and electrical connectivity between the body 20 and the cartridge assembly 30. An electrical connector interface on the body 20 used to connect to the cartridge assembly 30 may also serve as an interface for connecting the body 20 to a charging device (not shown) when the body 20 is detached from the cartridge assembly 30. The other end of the charging device can be plugged into an external power supply, for example a USB socket, to charge or to re-charge the cell / battery in the body of the e-cigarette. In other implementations, a separate charging interface may be provided, for example so the battery can be readily charged when still connected to the cartridge assembly 30.

The e-cigarette 10 is provided with one or more holes (not shown in Figure 1) for air inlet. These holes connect to an airflow path through the e-cigarette 10 to the mouthpiece 35. The air flow path includes a region around the heating element 103 so that when a user inhales through the mouthpiece 35, air is drawn into the airflow path through the one or more air inlet holes, which are suitably located on the outside of the e-cigarette. This airflow (or the resulting change in pressure) is detected by a pressure sensor that in turn activates the heating element to vaporise a portion of the source liquid to generate the aerosol. The airflow passes through the airflow path, and combines with the vapour in the region around the heating element 103 and the resulting aerosol (combination of airflow and condensed vapour) travels along the airflow path connecting from the region of the heating element 103 to the mouthpiece 35 to be inhaled by a user. The cartridge assembly 30 may be detached from the body 20 and disposed of when the supply of source liquid is exhausted (and replaced with another cartridge assembly if so desired). Alternatively, the cartridge 30 may be refillable.

Some embodiments described herein focus primarily on aspects of supplying source liquid to a suitably mounted heating element in an aerosol provision system, for example in a replaceable cartridge assembly of an e-cigarette. In this regard a main body component of

aerosol provision systems in accordance with certain embodiments of the invention may be provided in accordance with generally conventional techniques.

Figure 2 schematically represents components of a heating element carrier module 160 for use in a cartridge assembly 30 of the aerosol provision system 10 of Figure 1 in accordance with some embodiments. Figures 3 to 6 schematically represent the components represented in Figure 2 at different stages of assembly of the heating element carrier module 160.

The carrier module 160 comprises a first carrier component (first part) 101 and a second carrier component (second part) 102. As described further below, these two components 101, 102 play a role in supporting the heating element 103, and in this regard may sometimes be referred to as providing a heating element cradle. Thus, the first and second components 101, 102 represented in Figure 2 may for convenience, and having regard to the orientation represented in the figures, also be referred to as an upper cradle 101 and a lower cradle 102. However, it will be appreciated the terms "upper" and "lower", and similar orientation-related terms, are used herein purely for convenience in referring to elements represented in the accompanying figures and are not intended to indicate any particular orientation for these components is required for implementing the various embodiments described herein. The carrier module 160 further comprises the heating element 103 and a first electrical contact element 104 for connecting to a first end of the heating element 103 and a second electrical contact element 105 for connecting to a second end of the heating element 103.

The upper and lower cradle components 101, 102 in this example are moulded from a plastics material having a high glass fibre content (e.g. 50%) to provide improved rigidity and resistance to high temperatures, for example temperatures around 230 degrees centigrade. The respective upper and lower cradle components are broadly speaking of a generally semi-circular cross-section (although with variations in size and shape along their lengths as discussed further below). Each cradle component is provided with a recess 120 (only visible for lower cradle component 102 in Figure 2) running along its length on what would otherwise be their flattest faces so that when the two cradle components are brought together to sandwich the heating element 103 as discussed further below they form a cradle having a generally tubular configuration with an airflow path (defined by the respective recesses 120) running down the interior of the tube and in which the heating element 103 is disposed.

The first and second electrical contact elements 104, 105 may be formed of a sheet metal material, for example comprising copper strips formed into an appropriate shape having regard to the shape and configuration of the other elements of the apparatus in accordance with conventional manufacturing techniques. In other cases the first and second

electrical contact elements 104, 105 may comprise conventional flexible wiring. In some examples the first and / or second electrical contact elements may be provided with plating, for example gold plating, to help lower contact resistance and / or reduce any risk of corrosion.

5           The heating element 103 is formed from a sintered metal fibre material and is generally in the form of a sheet. However, it will be appreciated that other porous conducting materials may equally be used. In this particular example the heating element 103 comprises a main portion 103A with electrical contact extensions 103B at each end for connecting to the respective electrical contact elements 104, 105. The overall resistance of the heating  
10 element between the electrical contact extensions 103B in this example is around 1 ohm. However, it will be appreciated that other resistances may be selected, for example having regard to the available battery voltage and the desired temperature / power dissipation characteristics of the heating element. In this regard the relevant characteristics may be selected in accordance with the desired aerosol generation properties for the apparatus in  
15 accordance with the established principles of aerosol generation for the source liquid of interest. The main portion 103A of the heating element is generally rectangular with a length (i.e. in a direction running between the electrical contact extensions 103B) of around 20 mm and a width of around 8 mm. The thickness of the sheet comprising the heating element 103 in this example is around 0.15 mm. As can be seen in Figure 2, the generally-rectangular  
20 main portion 103A of the heating element 103 has slots extending inwardly from each of the longer sides. The slots extend inwardly by around 4.8 mm and have a width of around 0.6 mm. The slots extending inwardly are separated from one another by around 5.4 mm on each side of the heating element with the slots extending inwardly from the opposing sides being offset from one another by around half this spacing. A consequence of this  
25 arrangement of slots in the heating element is that current flow along the heating element is in effect forced to follow a meandering path which results in a concentration of current, and hence electrical power, around the ends of the slots. The different current / power densities at different locations on the heating element mean there are areas of relatively high current density that become hotter than areas of relatively low current density. This in effect provides  
30 the heating element with a range of different temperatures and increases temperature gradients, which can be desirable in the context of aerosol provision systems. This is because different components of a source liquid may aerosolise / vaporise at different temperatures and so providing a heating element with a range of temperatures can help simultaneously aerosolise a range of different components in the source liquid.

35           A process of assembling the components represented in Figure 2 to provide a heating element carrier module 160 for use in a cartridge assembly 30 of an electronic

cigarette 10 in accordance with certain embodiments is now described with reference to Figures 3 to 6.

As can be seen in Figure 3, the first and second electrical contact elements 104, 105 have been mounted to the lower cradle component 102 and the heating element 103 is represented above the lower cradle component 102 ready to be put in place. The second electrical contact element 105 is mounted at a second end of the lower cradle component 102 (the leftmost end for the orientation in Figure 3). The lower cradle component 102 is profiled to receive and match the shape of a first portion of the second electrical contact element 105 in accordance with conventional manufacturing techniques for mounting electrical conductors to plastic body parts. One end of the second electrical contact element 105 provides a second electrical contact element clamp portion 105A for receiving one of the electrical contact extensions 103B of the heating element 103 while the other end of the second electrical contact element 105 extends away from the lower cradle component 102 as schematically represented in the figure. The first electrical contact element 104 is mounted so as to run along the length of the lower cradle component 102 adjacent a wall of the recess 120. As for the second electrical contact element 105, one end of the first electrical contact element 104 extends away from the second end of the lower cradle component 102 as schematically represented in the figure. The other end of the first electrical contact element 104 provides a first electrical contact element clamp portion 105A arranged at a first end of the lower cradle component 102 (rightmost end in Figure 3) for receiving the other of the electrical contact extensions 103B of the heating element 103.

As can be seen in Figure 3, an upper surface of the lower cradle component 102 comprises a plurality of locating pegs 110 which align with the slots in the heating element discussed above and corresponding locating holes in the upper cradle 101 (not shown in the figures). These locating pegs are for helping to align the upper cradle 101 with the lower cradle 102, and for helping to align the heating element 103 relative to the upper and lower cradles 102 when assembled.

Figure 4 schematically shows the heating element 103 mounted to the lower cradle 102 containing the first and second electrical contact elements 104, 105. The heating element 103 is mounted to the lower cradle simply by being placed on the upper surface of the lower cradle with the locating pegs 110 aligned with the slots of the heating element 103. Slightly raised portions of the upper surface of the lower cradle element 102 provide locating walls 111 in the vicinity of the electrical contact extensions 103B at each end of the heating element 103 to further help align the heating element. In this example, the locating walls are separated by slightly more than the size of the heating element and the locating pegs are slightly smaller than the size of the slots so the heating element is overall free to move slightly in the horizontal plane, for example by around 0.1 mm. This is to allow for thermal

expansion and contraction when the heating element is in use to help avoid buckling. The first and second electrical contact element clamping portions 104A, 105A are bent down so as to clamp around respective ones of the electrical contact extensions 103B at each end of the heating element 103, thus providing an electrical connection between the portions of the electrical contact elements 104, 105 extending away from the lower cradle component 102 and the ends of the heating element 103. In this example the electrical connections between the electrical contact elements 104, 105 and the heating element 103 rely solely on physical contact, but in other implementations other techniques may be used, for example welding or soldering.

Figure 5 schematically shows the combined lower cradle component 102, first and second electrical contact elements 104, 105 and the heating element 103 as represented in Figure 4, but with the other cradle component 101 shown ready to be mounted to the lower cradle component.

Figure 6 schematically shows the upper cradle component 101 mounted to the lower cradle component 102 (and other elements represented in Figure 4) to provide an assembled carrier module 160. The upper cradle component 101 is mounted to the lower cradle component 102 by simply placing them together with the locating pegs 110 of the lower cradle component aligned with corresponding locating holes (not shown) in the upper cradle component 101. As can be seen in Figures 4 and 5, the locating pegs 110 are each provided with a shoulder 110A. The shoulders 110A have a height above the upper surface of the lower cradle component 102 of around 0.18 mm (i.e. 0.03 millimetres larger than the thickness of the heating element), and this also matches the height of the locating walls 111. The shoulders 110A are sized and arranged so as to fall within the slots of the heating element. However, the corresponding locating holes in the upper cradle are sized only to receive the locating pegs, and not their shoulders. Thus, when the upper cradle component 101 is mounted to the lower cradle component 102 they are separated by a gap corresponding to the height of the shoulders 110A and the locating walls 111. Because this gap between the upper and lower cradle components is 0.18 mm, and the heating element has a thickness of 0.15 mm, the heating element is loosely sandwiched between the upper and lower cradle components, rather than being fixedly clamped in place. As noted above, this loose mounting of the heating element is to allow for thermal expansion and contraction of the heating element during use.

Thus the assembled carrier module 160 is generally tubular with a central passageway defined by the respective recesses 120 in the upper and lower carrier components providing an airflow path through the carrier module. In this example the airflow path defined by the upper and lower carrier components has a generally rectangular cross-section with a width of around 4 mm and a height of around 2.2 mm and with the heating



element 103 being disposed in a plane around the middle of the airflow path. The carrier module 160 has an overall length of around 2.5 cm and a diameter of around 1 cm at its widest. The outer surface of the carrier module (provided by the respective outer surfaces of the first and second cradle components) comprises various surface profile features. Most notably, the carrier module comprises a first portion 107 arranged towards one end of the carrier module 160 (rightmost in Figure 6) which has a cross-sectional area that is smaller than that of a second portion 108 arranged towards the other end of the carrier module 160 (leftmost in Figure 6). The first and second portions 107, 108 of the carrier module 160 have broadly the same width in the plane of the heating element 103 (i.e. at the interface between the upper and lower cradle components), but different thicknesses in a direction perpendicular to the plane of the heating element 103. Thus the larger second portion 108 has a generally circular cross-section whilst the smaller first portion 101 has a generally elongate cross-section (see Figure 11 discussed further below). Thus, there is a step change in the cross-sectional area of the carrier module around halfway along its length. The outer surface of the carrier module further comprises a number of protrusions 140, a chamber 130 defined by a recess in the larger second portion 108 of the carrier module, and flat region 131 on the outer surface of the larger second portion 108 of the carrier module extending from the chamber 130 to where the larger second portion 108 of the carrier module meets the smaller first portion 107 of the carrier module 160. Although not apparent in Figure 6, the upper cradle component also comprises a passageway connecting between the flow path 120 running through the interior of the carrier module and the chamber 130. These features may be moulded into the respective cradle components during their manufacture and the respective functions of these various elements are discussed further below.

Figure 7 schematically represents some further components of a cartridge assembly 30 comprising the carrier module 160 of Figure 6 in accordance with certain embodiments. More specifically, Figure 7 shows a first sealing element (sealing ring) 171, a second sealing element in the form of a support tube 172, and an outer housing 180 for the cartridge assembly. These components may be moulded from plastics material, for example polypropylene.

Figure 8 schematically represents how the first and second sealing elements 171, 172 are mounted to the carrier module 160.

The first sealing element 171 comprises a recess for receiving the second end (leftmost in Figure 8) of the carrier module. The recess in the first sealing element is sized to receive the portion of the carrier module 160 which is to the left of the leftmost protrusion 140 seen in Figure 6 and to abut against this protrusion. The first sealing element 171 may be fixed to the carrier module 160 by a friction and / or snap fitting. The first sealing ring 171 further comprises openings through which the respective parts of the first and second

electrical contact elements 104, 105 that extend away from the carrier module 160 pass, thereby allowing electrical contact with the heater to be established through the first sealing ring 171 via the respective electrical contact elements 104, 105. The first sealing element furthermore comprises a central opening in alignment with the airflow path through the carrier module. This central opening may be provided with an airflow deflector element arranged to help direct air being drawn into the carrier module to either side of the heating element 103.

The second sealing element (support tube) 172 comprises a recess for receiving the first end (rightmost in Figure 8) of the carrier module 160. The recess in the second sealing element is sized to receive the portion of the carrier module 160 which is to the right of the rightmost protrusion 140 seen in Figure 6 and to abut against this protrusion. The second sealing element 172 may also be fixed to the carrier module 160 by a friction and / or snap fitting. The second sealing element 172 is hollow with a central opening providing an extension to the airflow path through the carrier module 160.

Figure 9 schematically shows the combined sealing ring 171, carrier module 160 and support tube 172 ready for insertion into the outer housing 180. The combined carrier module and sealing elements may thus be simply inserted into the outer housing 180 to provide a cartridge assembly 30 as schematically represented in Figure 10. Also shown in Figure 10 is a mouthpiece cover 190 which may be placed over a portion of the outer housing 180. The outer housing has a raised portion 182 which matches a correspondingly sized opening 191 in the mouthpiece cover 190 to provide a snap fitting engagement for locating the mouthpiece cover on the outer housing to help locate the mouthpiece cover on the outer housing 180. The mouthpiece cover may be provided for aesthetic and / or hygiene reasons, and may further be provided with a surface texture, e.g. a rubberised texture, to provide what users may perceive to be a more pleasing feel than bare plastic. The raised portion 182 may be transparent to allow the interior of the outer housing to be viewed, for example to ascertain a fill level for the cartridge assembly 30.

The rightmost end of the support tube 172 is received in a correspondingly sized recess at the rightmost end of the outer housing 180. The sealing ring 171 is received in the leftmost end of the outer housing 180. A compliant seal around the sealing ring 171 forms a seal with the inner surface of the outer housing 180. The combined sealing elements and carrier module may be fitted into the outer housing 180 with a snap and / or friction fitting. For example, the sealing ring 171 in this example is provided with a protrusion 220 that is received in an opening in the inner wall of the outer housing 180 to provide a snap fitting. The protrusions 140 on the carrier module 160 mentioned above are sized so as to abut against the interior wall of the outer housing 180 when the carrier module is inserted into the outer housing 180 so as to hold the carrier module in place relative to the outer housing. The

outer housing 180 has a generally cylindrical portion surrounding the carrier module 160 and a generally tapering portion surrounding the support tube 172. The outer housing 180 has a generally uniform wall thickness such that there is a relatively small gap between the larger second portion 108 of the carrier module 160 and the inner wall of the outer housing 180, e.g. around 0.5 mm or less, and a relatively large gap between the smaller first portion 107 of the carrier module and the inner wall of the outer housing 180. There is a tapering gap provided between the support tube 172 and the inner wall of the tapering portion of the other housing 180 which reduces down towards where the end of the support tube 172 is received at the end of the outer housing 180.

The space between the outer wall of the carrier module 160 and the inner wall of the outer housing 180 defines at least a part of the source liquid reservoir 38 for the cartridge assembly 30. In this example the reservoir 38 for the source liquid further comprises the gap between the support tube 172 and the inner wall of the tapering portion of the outer housing 180. This reservoir may be filled with source liquid through an opening in the outer housing (not shown) which is sealed after filling, e.g. by plugging.

The leftmost end of the cartridge assembly 30 comprises an engagement mechanism for removeably engaging the cartridge to a body portion of an electronic aerosol provision system with which the cartridge assembly is connected in normal use. In this example the engagement mechanism comprises a partial (e.g. less than one turn) female screw thread for cooperating with a corresponding male screw thread on the body portion of the electronic aerosol provision system with which the cartridge assembly is intended to be used. Other engagement mechanisms, for example based around bayonet, friction or snap fitting could be used in other implementations. The body portion 20 of an electronic aerosol provision system with which the cartridge assembly 30 is intended to be used is provided with electrical connectors for cooperating with the portions of the first and second electrical contact elements 104, 105 extending through the sealing element 171 to establish an electrical connection between the heater 103 and the body portion 20. This may be achieved in accordance with conventional techniques for standard electrical connections between removable elements, for example using spring-loaded collector pins.

Figure 11 schematically represents some aspects of the cartridge assembly 30 represented in Figure 10 in schematic cross-section. The cross-section is taken through a section of the first portion 107 of the carrier module 160 (i.e. the smaller / thinner portion) in a plane perpendicular to the airflow path 120 (i.e. perpendicular to the direction along which airflows in the airflow path when the apparatus is in normal use). The cross-section represented in Figure 11 is not a strict cross-section in that the figure also schematically represents further aspects of the cartridge assembly which are not in the plane of the cross-section. In particular, the figure also represents the outer periphery of the second (larger /

fatter) portion of the carrier module 160 as well as the chamber 130 in this portion of the carrier module and passageway 132 connecting between this chamber and the airflow path 120 (the chamber 130 and passageway 132 are represented by dotted lines). As described above the upper and lower cradle component are configured to engage in such a way as to define a gap in which the heater 103 is arranged (the gap preferably being slightly larger than the thickness of the heater 103). This gap is in fluid communication with the space between the outer wall of the carrier module 160 and the inner wall of the outer housing 180 which together define (a part of) the reservoir for source liquid.

Thus, the gap between the upper and lower cradle components provides capillary channels 200 which extend along both sides of the heating element 103 and through which source liquid may be drawn from the reservoir to the heating element for vaporisation to generate an aerosol in the airflow path 120 during use. The aerosol generated at the heater may then be drawn along the airflow path 120 and through the support tube 172 to exit the cartridge assembly 30 through the mouthpiece end of the outer housing 180 (i.e. the part covered by the mouthpiece cover 190) as a user inhales on the electronic cigarette 10 comprising the cartridge assembly 30.

The passageway 132 providing fluid communication between the airflow path 120 and the reservoir defined by the space between the carrier module and the outer housing allows for air to enter the reservoir from the airflow path 120 to replace source liquid that has been drawn through the capillary gap 200 and vaporised (i.e. the passageway 132 allows for pressure balancing / air ventilation between the airflow path 120 and the reservoir of source liquid). The chamber 130 is provided to allow source liquid to temporarily accumulate in this region during a puff of the reservoir. The inventors have found this configuration reduces the chance of source liquid leaking into the airflow path 120 through the passageway 132. The flat region 131 connecting between the chamber 130 and the portion of the reservoir adjacent the thinner part 107 of the carrier module (see Figure 6) has been found to help ensure that air passes from the chamber 130 into the main body of the reservoir adjacent the first portion 107 of the carrier module 160 rather than becoming stuck in the thinner part of the reservoir between the larger portion 108 of the carrier module 160 and the outer housing 180.

Thus, certain embodiments provide an apparatus (e.g. a cartridge assembly) for an electronic aerosol provision system (e.g. electronic cigarette). The cartridge assembly comprises a reservoir for a source liquid and a carrier module that defines an airflow path 120 within the reservoir and comprises a heating element 103 supported in the airflow path. The carrier module comprises a first part (upper cradle component) and a second part (lower cradle component) which cooperatively engage to support the heating element with a gap

between the first part and second parts providing capillary channels 200 arranged to draw source liquid to the heating element from the reservoir.

The inventors have found this to be a configuration which provides an effective supply of source liquid to the heating element without giving rise to problems with leakage.

5 As described above, the upper and lower cradle components cooperatively engage at an interface which extends in a direction that is substantially parallel to a direction along which air flows in the airflow path when the apparatus is in normal use. By in effect splitting the holder (cradle) and arranging the heating element in the plane of the interface between the two parts of the holder, the heating element can be supported around a relatively large  
10 fraction of its periphery, and this can be helpful because of the relatively fragile nature of the heating elements. Furthermore, the two-part configuration has been found to aid manufacturing and assembly, whilst providing a ready mechanism for defining appropriately sized capillary gaps for drawing source liquid to the heating element from the surrounding reservoir.

15 As can be seen in Figure 11, the upper and lower cradle portions are provided with rounded corners such that the gap between them defining the capillary gap increases with increasing distance from the airflow path 120. The inventors have found this further helps maintain an appropriate supply of source liquid to the heater 103 during use. However, in other example embodiments the capillary gap might not increase in width and maintain the  
20 same width out to the edges of the upper and lower cradle parts.

As noted above, the space between the carrier module and the outer housing along a first (thinner) portion 107 of the carrier module is larger than the space between the carrier module and the outer housing along a second portion (fatter) portion of the carrier module. This approach has been found to help with maintaining an appropriate supply of source  
25 liquid to the heating element for different orientations of the cartridge assembly 30 while still allowing for a reasonable reservoir capacity. This is because the space between the carrier module and the outer housing along the first portion of the carrier module defines a main body of the reservoir for storing the majority of the source liquid that is around the airflow path to provide reasonable capacity. However, the space between the carrier module and  
30 the outer housing along the second (fatter) portion of the carrier module is sized so as to define an annular capillary space 210 extending around the carrier module along the second portion of the carrier module. This annular capillary space 210 can in effect store source liquid to be drawn to the heating element regardless of the orientation of the cartridge assembly 30.

35 It will be appreciated there are various modifications to the configurations described above which may be adopted in accordance with other embodiments.

For example, whereas in the above implementation a gap is provided on both sides of the heating element 103, in some configurations one side of the heating element may be blocked, such that only a single capillary channel is provided to supply source liquid to the heating element.

5 Furthermore, whereas in the example implementation represented in Figure 11 the heating element 103 is contained within the capillary gap 200, in some other example implementations, the heating element 103 may extend beyond the capillary gap 200 and into the reservoir.

10 Furthermore, whereas in the example implementations described above the carrier module 140 has been provided with protrusions 140 to help locate the carrier module within the outer housing 180, in other implementations the inner wall of the outer housing may instead, or in addition, be provided with protrusions for this purpose.

15 In some implementations the chamber 130 may not be provided so the air passage 132 seen in Figure 11 would in effect be extended out to the outer surface of the cradle component in which the passage way 132 is provided (i.e. the upper cradle component in the example represented Figure 11).

20 Furthermore, whereas in the above-described examples the flat region 131 extends directly in a straight line from the chamber 130 to the main body of the reservoir adjacent the first portion 107, in another implementation the flat region 131 may instead follow a non-straight path from the chamber 130 (or the end of the passageway 132 in the event there is no chamber) to the main body of the reservoir. This may be so as to increase the overall length of the flat region, thereby increasing its effective resistance to fluid flow. In yet other examples, the flat region 131 may be replaced by a groove formed in the outer surface of the cradle component, and this may be straight or follow a meandering path to increase its flow  
25 resistance.

30 In yet other example implementations, there may be no passage way 132 (and no chamber 130; and no groove or flat region 131). Instead, pressure balancing between the airflow path 120 and the reservoir 38 may be provided by air flowing in the parts of the very gaps which are not occupied by the heating element 103 (because the gap may be wider than the thickness of the heating element).

35 Thus there has been described an apparatus for an electronic aerosol provision system. The apparatus may comprise a replaceable cartridge for the electronic aerosol provision system or may comprise a fixed component of a re-fillable or disposable electronic aerosol provision system. The apparatus comprises a reservoir for a source liquid and a carrier module supported within the reservoir. The carrier module defines an airflow path within the reservoir and comprises a heating element supported in the airflow path for generating an aerosol from the source liquid and first and second mounting parts which

cooperatively engage to support the heating element. The first and second mounting parts of the carrier module cooperatively engage at an interface which extends in a direction that is substantially parallel to a direction along which air flows in the airflow path when the apparatus is in normal use. A gap between the first and second mounting parts may provide a capillary channel for drawing source liquid to the heating element from the reservoir heating during use.

In order to address various issues and advance the art, this disclosure shows by way of illustration various embodiments in which the claimed invention(s) may be practiced. The advantages and features of the disclosure are of a representative sample of embodiments only, and are not exhaustive and / or exclusive. They are presented only to assist in understanding and to teach the claimed invention(s). It is to be understood that advantages, embodiments, examples, functions, features, structures, and / or other aspects of the disclosure are not to be considered limitations on the disclosure as defined by the claims or limitations on equivalents to the claims, and that other embodiments may be utilised and modifications may be made without departing from the scope of the claims. Various embodiments may suitably comprise, consist of, or consist essentially of, various combinations of the disclosed elements, components, features, parts, steps, means, etc. other than those specifically described herein, and it will thus be appreciated that features of the dependent claims may be combined with features of the independent claims in combinations other than those explicitly set out in the claims. The disclosure may include other inventions not presently claimed, but which may be claimed in future.

#### REFERENCES

- [1] US 2013 / 333700
- [2] WO 2013 / 057185
- [3] KR 20130004985
- [4] WO 2013 / 083631

## CLAIMS

1. An apparatus for an electronic aerosol provision system comprising:  
a reservoir for a source liquid; and  
5 a carrier module that defines an airflow path within the reservoir and comprises a heating element supported in the airflow path within the reservoir for generating an aerosol from the source liquid, wherein the carrier module comprises a first part and a second part which cooperatively engage to support the heating element, wherein the first part and the second part of the carrier module cooperatively engage at an interface which extends in a  
10 direction that is substantially parallel to a direction along which air flows in the airflow path when the apparatus is in normal use.
2. The apparatus of claim 1, wherein a peripheral part of the heating element is received in a gap between the first part and second part to thereby support the heating  
15 element in the airflow path.
3. The apparatus of claim 2, wherein the gap between the first part and second part provides a capillary channel arranged to draw source liquid to the heating element from the reservoir.  
20
4. The apparatus of claim 2 or 3, wherein the width of the gap between the first part and second part of the carrier module increases with increasing distance from the airflow path.
5. The apparatus of any preceding claim, wherein at least one of the first part and the  
25 second part of the carrier module comprises one or more locating pegs received in corresponding locating holes of the other of the first part and the second part of the carrier module so as to help maintain their relative alignment.
6. The apparatus of claim 5, wherein the one or more locating pegs pass through  
30 corresponding opening in the heating element so as to help maintain the heating element in position relative to the first and second parts of the carrier module.
7. The apparatus of any preceding claim, wherein the heating element comprises a sheet material extending in a plane which is substantially parallel to the interface between  
35 the first part and the second part.



8. The apparatus of any preceding claim, wherein the heating element comprises a sintered metal fibre material.

9. The apparatus of any preceding claim, wherein the heating element is supported  
5 loosely with respect to the first and second parts of the carrier module.

10. The apparatus of any preceding claim, further comprising an outer housing in which the carrier module is received such that the reservoir around the airflow path is defined at least in part by a space between the carrier module and the outer housing.

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11. The apparatus of claim 10, further comprising one or more spacer elements arranged to support the carrier module at a defined position within the outer housing.

12. The apparatus of claim 11, wherein the one or more spacer elements comprise one  
15 or more protrusions formed on an outer surface of the first and / or second parts of the carrier module.

13. The apparatus of claim 11 or 12, wherein the one or more spacer elements comprise one or more protrusions formed on an inner surface of outer housing.

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14. The apparatus of any of claims 10 to 13, further comprising a first sealing element for providing a seal between the carrier module and the outer housing at one end of the carrier module and a second sealing element for providing a seal between the carrier module and the outer housing at another end of the carrier module.

25

15. The apparatus of claim 14, wherein the second sealing element comprises a support tube providing an extension to the air flow path and having a first end coupled to the carrier module and a second end coupled to an aerosol outlet end of the outer housing.

30 16. The apparatus of claim 14 or 15, wherein the first sealing element comprises a sealing ring arranged between the carrier module and the outer housing.

17. The apparatus of any of claims 10 to 16, wherein the space between the carrier module and the outer housing along a first portion of the carrier module is larger than the  
35 space between the carrier module and the outer housing along a second portion of the carrier module.

18. The apparatus of claim 17, wherein the space between the carrier module and the outer housing along the first portion of the carrier module defines a main body of the reservoir for storing the majority of the source liquid that is around the airflow path.
- 5 19. The apparatus of claim 17 or 18, wherein the space between the carrier module and the outer housing along the second portion of the carrier module defines a capillary space extending around the carrier module along the second portion of the carrier module.
20. The apparatus of any of claims 10 to 19, further comprising a mouthpiece mounted to  
10 the outer housing at an aerosol outlet end of the apparatus.
21. The apparatus of any preceding claim, wherein at least one of the first and second parts of the carrier module is provided with a passageway to allow air to pass between the flow path and the reservoir.
- 15 22. The apparatus of claim 21, wherein the passageway connects to a groove formed in an outer surface of the at least one of the first and second parts in which the passageway is provided.
- 20 23. The apparatus of claim 22, wherein the groove follows a non-linear path.
24. The apparatus of claim 21, wherein the passageway connects to a chamber of the reservoir which is separated from the rest of the reservoir by a further capillary gap.
- 25 25. The apparatus of any preceding claim, further comprising an engagement mechanism for removeably engaging the apparatus to a body portion of an electronic aerosol provision system with which apparatus is connected in normal use.
26. An electronic aerosol provision system comprising the apparatus of any preceding  
30 claim and a power source configured to supply electrical power to the heating element to generate an aerosol from the source liquid.
27. An apparatus substantially as described hereinbefore described with reference to the accompanying drawings.



**Application No:** GB1422018.0

**Examiner:** Dr Kerri Stenning

**Claims searched:** 1-27

**Date of search:** 28 May 2015

**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	1-3, 7, 8, 21, 25, 26	WO2012/106739 A1 (BUCHBERGER) see particularly Figures 3, 4 and 5; noting heating element 6, carrier plate 4 and upper section 9.
A	-	EP2801273 A2 (SHENZHEN FIRST UNION TECH CO) see whole document.
A	-	US2014/332019 A1 (LIU QIUMING) see whole document.
A	-	US2010/181387 A1 (ZAFFARONI) see whole document.

**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

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

EPODOC, WPI, TXTA

**International Classification:**

Subclass	Subgroup	Valid From
None		