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(54) A VAPOUR GENERATING DEVICE, A VAPORIZER UNIT THEREFOR AND A METHOD FOR CONTROLLING VAPOUR GENERATION

(57) A vaporizer unit (30, 130, 230, 330) for a vapour generating device (10) comprises: a liquid store (32) for containing a vapour generating liquid; a heating element (36) in fluid communication with a vapour outlet (24) of the vapour generating device (10) and configured to heat vapour generating liquid from the liquid store (32) to generate a vapour to be inhaled; and a liquid transfer unit (40) configured to transfer vapour generating liquid from the liquid store (32) to the heating element (36). The liquid transfer unit (40) comprises: a liquid regulating arrangement (42) for actively controlling the flow of vapour generating liquid from the liquid store (32); and a hollow liquid distribution element (46) in communication with the liquid regulating arrangement (42). The hollow liquid distribution element (46) comprises a liquid distribution surface (48) having a plurality of liquid outlets (50) arranged to transfer the vapour generating liquid to the heating element (36).

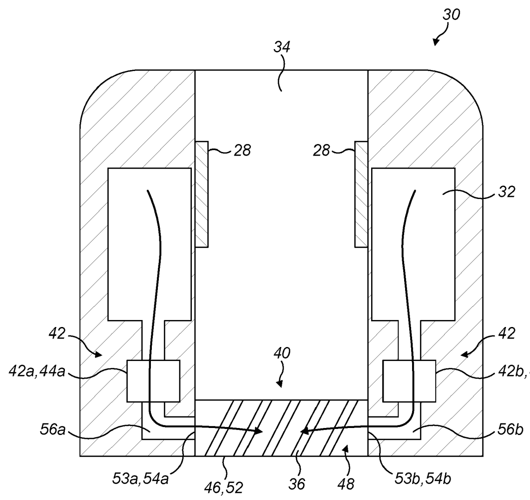

FIG. 2

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Description

Technical Field

[0001] The present disclosure relates generally to a vapour generating device, for example an electronic cigarette or a personal vaporizer, for heating a vapour generating liquid to generate a vapour which may cool and condense to form an aerosol for inhalation by a user of the device. Embodiments of the present disclosure relate in particular to a vaporizer unit for a vapour generating device and/or to a method for controlling vapour generation in the vapour generating device.

Technical Background

[0002] Vapour generating devices, such as electronic cigarettes or "e-cigarettes" as they are commonly known, have gained in popularity over recent years as an alternative to traditional smoking articles, like cigarettes, cigars, and cigarillos. Developments in the design and configuration of vapour generating devices are ongoing to improve their performance and their reliability, as well as their ease of production and production costs.

[0003] Conventional vapour generating devices usually include a vaporizer unit (commonly known as a cartomizer) to generate a vapour which may cool and condense to form an aerosol for inhalation by the user. The vaporizer unit includes a heating element powered by an electrical power source (typically a battery) and a liquid store containing a vapour generating liquid (or so called "e-liquid") that can be volatized by the heating element to form a vapour. The vapour generating liquid usually contains one or more of nicotine, propylene glycol, glycerine and flavourings.

[0004] Conventional vaporizer units typically employ a wicking element, e.g., a cotton wick, to transfer vapour generating liquid by capillary action from the liquid store to the heating element which is often in the form of a heating coil wrapped around the wicking element. When a user operates the vapour generating device, vapour generating liquid that has soaked into the wicking element is heated by the heating element and volatized to form a vapour which may then be entrained in an airflow through the device and which may cool and condense to form an aerosol that is inhaled by a user.

[0005] Conventional wicking elements do not allow the amount of vapour generating liquid transferred from the liquid store to the heating element to be controlled with a sufficient degree of precision because they rely on passive capillary action. In some circumstances, the wicking element can draw too much vapour generating liquid from the liquid store and become over saturated whereas in other circumstances the wicking element can draw insufficient vapour generating liquid from the liquid store. In either case, too much or too little vapour may be generated and/or the temperature of the generated vapour may be too high or too low. In addition, the vapour generating liquid is usually absorbed by the wicking element at one or both ends and may not, therefore, be distributed uniformly throughout the wicking element. As a consequence, the vapour generating liquid may not be transferred uniformly to the heating element. The non-uniform distribution of vapour generating liquid in the wicking element may cause depletion or drying out of the liquid in some parts of the wicking element, resulting in overheating of the heating element. This may not only deteriorate the sensory experience but also damage or shorten the life of components in the vaporizer unit, for example the heating element and/or the wicking element. There can also be some variability in the characteristics of the wicking material used to form the wicking element in different vaporizer units. In view of these constraints, the quality and/or consistency of the vapour (and resulting aerosol) that is generated by the vaporizer unit, when a user inhales or puffs on the vapour generating device, may be unsatisfactory and the present disclosure seeks to address this problem.

Summary of the Disclosure

[0006] According to a first aspect of the present disclosure, there is provided a vaporizer unit for a vapour generating device, the vaporizer unit comprising:

- a liquid store for containing a vapour generating liquid;
- a heating element in fluid communication with a vapour outlet of the vapour generating device and configured to heat vapour generating liquid from the liquid store to generate a vapour to be inhaled;
- a liquid transfer unit configured to transfer vapour generating liquid from the liquid store to the heating element, the liquid transfer unit comprising:
  - a liquid regulating arrangement for actively controlling the flow of vapour generating liquid from the liquid store; and
  - a hollow liquid distribution element in communication with the liquid regulating arrangement, the hollow liquid distribution element comprising a liquid distribution surface having a plurality of liquid outlets arranged to transfer the vapour generating liquid to the heating element.

[0007] The vaporizer unit, and in particular the heating element, is configured to heat the vapour generating liquid to volatise at least one component of the vapour generating liquid and thereby generate a vapour which may cool and condense to form an aerosol for inhalation by a user of the vapour generating device. The present disclosure is particularly applicable to a portable (hand-held) vapour generating device. The vaporizer unit may be a cartomizer.

[0008] In general terms, a vapour is a substance in the gas phase at a temperature lower than its critical temperature, which means that the vapour can be condensed to a liquid by increasing its pressure without reducing the temperature, whereas an aerosol is a suspension of fine solid particles or liquid droplets, in air or another gas. It should, however, be noted that the terms 'aerosol' and 'vapour' may be used interchangeably in this specification, particularly with regard to the form of the inhalable medium that is generated for inhalation by a user.

[0009] The liquid transfer unit provides for controlled and precise delivery of vapour generating liquid from the liquid store to the heating element by virtue of the active control of liquid flow provided by the liquid regulating arrangement. In addition, the plurality of liquid outlets formed in the liquid distribution surface of the hollow liquid distribution element allow the vapour generating liquid to permeate across the liquid distribution surface, thereby assuring a controlled and uniform transfer of vapour generating liquid to the heating element so that the vapour generating liquid can be volatised (i.e., evaporated) upon being heated by the heating element. This allows the vaporizer unit to generate a vapour with satisfactory characteristics at all times during use of the vapour generating device, thereby providing an improved user experience. The energy consumption, and hence energy efficiency, of the vapour generating device may also be improved.

[0010] The liquid regulating arrangement may comprise a pump, for example a piezoelectric pump. The pump may be a micropump, in the sense that it may be configured to deliver small quantities of vapour generating liquid that are required by the heating element.

[0011] The hollow liquid distribution element may include at least two liquid inlets which may be in communication with the liquid regulating arrangement. By providing the hollow liquid distribution element with at least two liquid inlets, the transfer of vapour generating liquid from the liquid store to the heating element may be improved. In particular, the provision of two liquid inlets allows a pressurised delivery of vapour generating liquid through the hollow liquid distribution element, and in particular through the liquid outlets in the liquid distribution surface. This in turn ensures a uniform transfer of the vapour generating liquid through the liquid outlets formed in the liquid distribution surface and provides substantial benefits over known wick arrangements.

[0012] In particular, if pressure is applied (e.g., by a liquid regulating arrangement such as a pump) to a flow of vapour generating liquid supplied to both ends of a conventional bulky capillary wicking material (without a hollow structure), the applied pressure is concentrated only in the vicinity of the ends of the wicking element due to a relatively high flow resistance of the wicking material. Non-uniform pressure across the length of the wicking element (in the longitudinal direction of the wicking element) causes variations in the delivery rate of vapour generating liquid in different regions of the wicking element. This leads to a non-uniform generation of vapour at different parts of the heating element and, consequently, the overall delivery rate of vapour generating liquid to the heating element may be difficult to control precisely. In addition, there may be a significant delay in controlling the delivery rate of vapour generating liquid to the heating element in response to a change in the applied pressure by the liquid regulating arrangement.

[0013] By using a hollow liquid distribution element in accordance with the present disclosure, the pressure drop in the longitudinal direction of the liquid distribution element is significantly reduced. In the hollow liquid distribution element, the pressure drop takes place substantially only at a side wall of the liquid distribution element, where vapour generating liquid is delivered from the inner surface of the side wall through the interior volume of the sidewall to the outer surface (i.e. the liquid distribution surface). Thus, when the thickness of the side wall of the liquid distribution element is uniform, the liquid flow across the length of the liquid distribution element is substantially uniform. Moreover, because the liquid flow path within the liquid distribution element is limited to the thickness of the side wall, the delivery rate of vapour generating liquid to the outer surface of the liquid distribution element (i.e., to the liquid distribution surface and to the heating element) can be altered more quickly by a change in the pressure applied by the liquid regulating arrangement, which may allow for more spontaneous control of the amount of vapour generated by the heating element.

[0014] Because the liquid distribution element comprises a hollow core, the liquid delivery within the hollow liquid distribution element is more susceptible to the effects of gravity than a liquid distribution element comprising a conventional bulky wicking material without any hollow core wherein the liquid delivery is almost fully based on the capillary effect. The combination of the liquid regulating arrangement and the hollow liquid distribution element overcomes the effects of the gravity, i.e., the orientation of the device does not have any effect on the flow of vapour generating liquid within the hollow core of the liquid distribution element. A controlled and precise delivery of vapour generating liquid is thereby assured at all times during use of the vapour generating device.

[0015] The liquid distribution surface may comprise a porous surface. Pores in the liquid distribution surface may constitute the liquid outlets. The liquid distribution element may, for example, comprise a porous material which defines the porous liquid distribution surface. The liquid distribution surface may comprise a perforated surface. Perforations or openings in the liquid distribution surface may constitute the liquid outlets. The liquid distribution element may, for example, comprise a non-porous material and may comprise a continuous liquid distribution surface including a plurality of perforations or openings. With these arrangements, a unform transfer of vapour generating liquid from the interior of the hollow liquid distribution element to the liquid distribution surface is assured.

[0016] The hollow liquid distribution element may comprise a hollow tube which may be in communication with the liquid regulating arrangement. The plurality of liquid outlets may be formed as openings in a side wall of the hollow tube. The heating element may comprise a heating coil disposed around the hollow tube. With this arrangement, vapour generating liquid may be delivered by the liquid regulating arrangement to the hollow tube, and in particular to opposite ends of the hollow tube, allowing pressurised delivery of vapour generating liquid through the openings in the side wall of the hollow tube. This in turn ensures a uniform delivery of vapour generating liquid across the liquid distribution surface (i.e., an outer surface of the side wall of the hollow tube), so that the vapour generating liquid can be heated uniformly and efficiently by the heating coil.

[0017] The heating element may be positioned externally of the hollow liquid distribution element, and may be positioned adjacent to the plurality of liquid outlets. An efficient and uniform heating of the vapour generating liquid is thereby achieved as the vapour generating liquid is transferred by the liquid outlets from a hollow interior of the hollow liquid distribution element to the externally located liquid distribution surface.

[0018] In an embodiment, the hollow liquid distribution element may comprise a wicking material, for example a porous material. In some examples, the hollow liquid distribution element may consist exclusively of a wicking material and may comprise a porous tubular element, e.g., a hollow tube with a side wall formed of porous material. The wicking material may be sufficiently strong and have sufficient rigidity to be self-supporting and to maintain its shape so that the hollow interior does not become obstructed or occluded. In this embodiment, the hollow liquid distribution element has a simple structure which may facilitate manufacture and assembly of the vaporizer unit.

[0019] In an embodiment, the vaporizer unit may further comprise a wicking element positioned between the hollow liquid distribution element and the heating element. For example, and as noted above, the hollow liquid distribution element may comprise a hollow tube, e.g., comprising a plastics material. In this case, the wicking element may surround the hollow tube, and may for example comprise a sleeve formed of a wicking material. In this embodiment, the structural integrity of the hollow liquid distribution element is assured because the hollow liquid distribution element can easily maintain its shape so that the hollow interior does not become obstructed or occluded.

[0020] The vaporizer unit may comprise a first liquid store for containing a first vapour generating liquid and may comprise a second liquid store for containing a second vapour generating liquid. The liquid transfer unit may comprise a first liquid regulating arrangement for actively controlling the flow of the first vapour generating liquid from the first liquid store and may comprise a second liquid regulating arrangement for actively controlling the flow of the second vapour generating liquid from the second liquid store. The hollow liquid distribution element may have a first end which may be in communication with the first liquid regulating arrangement and may have a second end which may be in communication with the second liquid regulating arrangement. By providing first and second liquid regulating arrangements for actively controlling the flow of first and second vapour generating liquids respectively, and by arranging the first and second ends of the hollow liquid distribution element in communication with the first and second liquid regulating arrangements, it is possible to adjust the composition of the vapour generating liquid delivered by the hollow liquid distribution element to the heating element and to thereby adjust the composition of the generated vapour.

[0021] For example, the first vapour generating liquid could comprise a nicotine liquid formulation and the second vapour generating liquid could comprise a liquid flavourant. By appropriately controlling the first and second liquid regulating arrangements, the first and second vapour generating liquids may be supplied to the hollow liquid distribution element from the first and second liquid stores in a controlled, and variable, ratio to provide a vapour generating liquid, and hence a vapour, with desired characteristics. The first and second liquid regulating arrangements could, for example, be configured to provide a variable ratio of the first and second vapour generating liquids based on user preference. For example, a user may be able to change or alter the major constituents of the generated vapour, like for example the ratio between propylene glycol and vegetable glycerine, the strength of nicotine or the strength of a certain flavour like menthol or cherry flavour, to provide an enhanced user experience.

[0022] The vapour generating liquid, for example the first vapour generating liquid or the second vapour generating liquid, may comprise polyhydric alcohols and mixtures thereof such as glycerine or propylene glycol. The vapour generating liquid may contain one or more additives, such as a flavouring. The flavouring may include Ethylvanillin (vanilla), menthol, cherry, Isoamyl acetate (banana oil) or similar, for instance.

[0023] The vapour generating liquid may be vaporised by heating the vapour generating liquid up to its boiling point by the heating element, such as a temperature up to 400°C, preferably up to 350°C.

[0024] In an example, one or both of the first liquid regulating arrangement and the second liquid regulating arrangement may comprise a ring element which may be configured to change between a first cross-section which may at least partially close a flow path from the first or second liquid store to the hollow liquid distribution element and a second cross-section which may at least partially open the flow path from the first or second liquid store to the hollow liquid distribution element, wherein the second cross-section may be larger than the first cross-section. The ring element acts as a flow control element and enables the flow of the first and/or second vapour generating liquid along the flow path, from the first or second liquid store to the hollow liquid distribution element, to be adjusted. The flow of the first vapour generating liquid and/or the second vapour generating liquid along the flow path is more restricted when the ring element has the smaller, first cross-section, and this may be helpful in controlling the flow of the first vapour generating liquid and/or the second vapour generating liquid from the corresponding first liquid store and/or second liquid store along the flow path to the hollow liquid distribution element. This may help to facilitate the adjustment of the composition and characteristics of the generated vapour and/or may help to minimise the risk of leakage of the first and/or second vapour generating liquids when the aerosol generating device is not in use, e.g., by arranging the ring element so that it has the first cross-section when the vapour generating device is not in use.

[0025] The ring element may be configured to change between the first cross-section and the second cross-section based on the temperature of the ring element. In some embodiments, the ring element may include a heat-sensitive material. For example, the ring element may include a shape memory alloy. As the ring element is heated, it changes from the first cross-section to the second cross-section. As the ring element cools, it changes from the second cross-section to the first cross-section.

[0026] The ring element may comprise at least partially a shape memory alloy. The ring element may comprise, for example, Nitinol (a nickel titanium alloy) or any other shape memory alloy. The shape memory alloy may have a transformation temperature of approximately 100°C. Because the ring element may contact the vapour generating liquid, the ring element may ideally be made of a sufficiently corrosion resistant material (like Nitinol) or at least the surface of the ring element may be corrosion resistant (e.g., coated with a corrosion resistant coating if the base material of the ring element is not sufficiently corrosion resistant).

[0027] The ring element may adopt the first cross-section when the ring element is at a first temperature. The first temperature can be considered to be a temperature at which heat is not actively applied to the ring element by the heating element, for example room temperature. The ring element may adopt the second cross-section when the ring element is at a second temperature. The second temperature can be considered to be a temperature at which heat is actively applied to the ring element by the heating element. As the temperature of the ring element varies between the first temperature and the second temperature, the cross-section of the ring element varies correspondingly between the first cross-section and the second cross-section. Thus, the cross-section of the ring element may increase gradually as its temperature increases. In particular, as heat is applied to the ring element, for example directly or indirectly via the heating element, the diameter of the ring element may increase (to give a larger cross-section), thereby opening the flow path and allowing an increased flow of the first vapour generating liquid and/or the second vapour generating liquid from the corresponding first liquid store or second liquid store to the hollow liquid distribution element. This makes it possible to control a flow or flow rate from the first liquid store and/or the second liquid store towards the heating element.

[0028] The ring element may be positioned around the liquid distribution element to increase or decrease the constriction force applied to the liquid distribution element. The ring element may be positioned between an end of the liquid distribution element and the heating element. The ring element may be positioned between the heating element and the liquid distribution surface and may be surrounded by the heating element. The constriction force applied to the liquid distribution element may decrease as the ring element changes from the first cross-section to the second cross-section. Thus, as heat is applied to the ring element by the heating element during use of the vapour generating device and the cross-section changes from the first (smaller) cross-section to the second (larger) cross-section, the constriction force applied to the liquid distribution element is correspondingly reduced allowing an increased flow of the first vapour generating liquid and/or the second vapour generating liquid from the corresponding first liquid store or second liquid store. The resistance to flow of vapour generating liquid at the ring element decreases as the diameter of the ring element increases (i.e., as the ring element changes from the first (smaller) cross-section to the second (larger) cross-section), resulting in a reduction of the overall resistance to flow of vapour generating liquid of the assembly of the ring element and the liquid distribution element.

[0029] The vaporizer unit may further comprise a controller.

[0030] The controller may be configured to activate the liquid regulating arrangement in response to an activation of the vapour generating device. Thus, vapour generating liquid is only transferred by the liquid regulating arrangement from the liquid store to the hollow liquid distribution element when the vapour generating device is in use, and not when the vapour generating device is not in use. The vapour generating liquid is thereby retained in the liquid store when the vapour generating device is not in use, minimising or eliminating the escape or leakage of vapour generating liquid from the liquid store.

[0031] The vaporizer unit may further comprise a motion sensor, for example an accelerometer, for providing a motion signal to the controller. The controller may be configured to activate the liquid regulating arrangement in response to a motion signal provided by the motion sensor. With this arrangement, activation of the liquid regulating arrangement takes place automatically, without user intervention, thereby facilitating use of the vapour generating device and providing an improved user experience.

[0032] According to a second aspect of the present disclosure, there is provided a vapour generating device comprising:

a vaporizer unit according to the first aspect;

a vapour outlet;

a sensor in fluid communication with the vapour outlet for generating a signal indicative of the amount of vapour generated by the vaporizer unit during a predetermined time period; and

a controller configured to control the operation of at least one of the heating element and the liquid regulating arrangement in response to the signal to thereby control the amount of vapour generated by the vaporizer unit.

[0033] By arranging the sensor in fluid communication with the vapour outlet, the amount of vapour generated by the vaporizer unit can be determined and appropriately adjusted by actively controlling the operation of the heating element and/or the liquid regulating arrangement. The amount of vapour delivered to a user during use of the vapour generating device can, therefore, be readily increased or decreased, for example in real-time, to provide consistent vapour delivery and an improved user experience. The energy efficiency of the vapour generating device may also be improved.

[0034] The controller may be configured to control the operation of the heating element by varying the electrical power supplied to the heating element. The controller may be configured to control the operation of the liquid regulating arrangement, for example by varying the electrical power supplied to the liquid regulating arrangement, to actively control the flow rate of vapour generating liquid from the liquid store to the heating element. A precise control of the amount of vapour generated by the vaporizer unit and delivered to the user can be achieved with this arrangement.

[0035] The sensor may comprise one or more selected from the group consisting of a humidity sensor, a temperature sensor, and a vapour concentration sensor. The amount of vapour generated by the vaporizer unit can be readily detected. The use of a combination of sensors of different types may enable the amount of vapour generated by the vaporizer unit to be more accurately determined, although in practice a single sensor type may be sufficient to provide the required degree of control of the heating element and/or the liquid regulating arrangement.

[0036] The controller may be configured to activate the liquid regulating arrangement in response to an activation of the vapour generating device. As explained above, vapour generating liquid is only transferred by the liquid regulating arrangement from the liquid store to the hollow liquid distribution element when the vapour generating device is in use, and not when the vapour generating device is not in use. The vapour generating liquid is thereby retained in the liquid store when the vapour generating device is not in use, minimising or eliminating the escape or leakage of vapour generating liquid from the liquid store.

[0037] The vapour generating device may further comprise a motion sensor, for example an accelerometer, for providing a motion signal to the controller. The controller may be configured to activate the liquid regulating arrangement in response to a motion signal provided by the motion sensor. As explained above, activation of the liquid regulating arrangement takes place automatically, without user intervention, thereby facilitating use of the vapour generating device and providing an improved user experience.

[0038] According to a third aspect of the present disclosure, there is provided a method for controlling vapour generation in the vapour generating device according to the second aspect, the method comprising controlling, by the controller, the operation of the at least one heating element by varying the electrical power supplied to the heating element and/or controlling, by the controller, the liquid regulating arrangement to actively control the flow rate of vapour generating liquid from the liquid store to the heating element.

[0039] The method allows the amount of vapour generated by the vaporizer unit to be determined and appropriately adjusted, for example in real-time, by actively controlling the operation of the heating element and/or the liquid regulating arrangement. The amount of vapour delivered to a user during use of the vapour generating device can, therefore, be readily increased or decreased to provide consistent vapour delivery and an improved user experience.

[0040] The method may comprise:

in response to an activation of the vapour generating device, supplying electrical power to the heating element and the liquid regulating arrangement to generate a vapour;

determining, by the controller, the amount of vapour generated during a predetermined time period based on the signal from the sensor;

evaluating, by the controller, whether an increased or decreased quantity of vapour is needed; and

increasing or decreasing the electrical power supplied to one or both of the heating element and the liquid regulating arrangement to thereby control the amount of vapour generated by the vaporizer unit.

[0041] The method allows the amount of vapour generated by the vaporizer unit to be determined and controlled without user intervention, following activation of the vapour generating device.

Brief Description of the Drawings

[0042]

Figures 1a and 1b are schematic side and cross-sectional views respectively of an example of a vapour generating device;

Figure 2 is a schematic cross-sectional view of a first example of a vaporizer unit;

Figure 3 is a schematic perspective view of a first embodiment of a hollow liquid distribution element;

Figure 4 is a schematic cross-sectional view of a second embodiment of a hollow liquid distribution element in combination with a wicking element and a heating coil;

Figure 5 is a schematic cross-sectional view of a second example of a vaporizer unit;

Figure 6 is a schematic cross-sectional view of a third example of a vaporizer unit;

Figures 7a and 7b are schematic views of a ring element changeable between a first (smaller) cross-section and a second (larger) cross-section; and

Figure 8 is a schematic cross-sectional view of a fourth example of a vaporizer unit.

Detailed Description of Embodiments

[0043] Embodiments of the present disclosure will now be described by way of example only and with reference to the accompanying drawings.

[0044] As described hereinafter, example implementations of the present disclosure relate to a vaporizer unit for a vapour generating device, in particular a portable hand-held smoking device such as an electronic cigarette. Vapour generating devices according to the present disclosure use electrical energy to heat and volatise a vapour generating liquid, without combusting the vapour generating liquid and/or without significant chemical alteration of the vapour generating liquid, to form an inhalable aerosol or vapour; and components of such device have the form of articles that most preferably are sufficiently compact to be considered hand-held devices. The use of the vapour generating device does not result in the production of smoke in the sense that the vapour does not result from by-products of combustion or pyrolysis of tobacco, but rather, the use of the vapour generating device results in the production of a vapour due to volatilization or vaporization of certain components incorporated in the vapour generating liquid.

[0045] In some example implementations, the vapour generating device may be characterized as an electronic cigarette in which the vapour generating liquid may comprise propylene glycol or glycerine. Vapour generating devices within the meaning of the present disclosure may transport the volatilized components of the vapour generating liquid in an airflow through the vapour generating device to a user of the device, the user of the device being able to activate or deactivate the generation of vapour and to control the duration, velocity and volume of the airflow by means of a puffing or inhaling action.

[0046] Referring to Figures 1a and 1b, there is shown an example of a vapour generating device 10 according to an embodiment of the present disclosure. The vapour generating device 10 comprises a mouthpiece portion 12 and a power supply portion 14. The power supply portion 14 can also be referred to as a main body 14 of the vapour generating device 10, and is advantageously configured as a re-usable unit. The power supply portion 14 comprises a power source 18 (e.g., a battery) and a controller 20 (e.g., a printed circuit board (PCB), an integrated circuit, a memory component, a microprocessor, individually or as part of a micro-controller, and the like) to control the operation of the vapour generating device 10.

[0047] The mouthpiece portion 12 comprises a mouthpiece 22 having a vapour outlet 24 for delivering vapour or aerosol to the user. The mouthpiece portion 12 has an exterior housing 16a (or shell) which is configured to connect to a separable exterior housing 16b (or shell) of the power supply portion 14. In an embodiment, the mouthpiece portion 12 and the power supply portion 14 are connectable to each other by a releasable connection 26. The releasable connection 26 can be, for example, a threaded connection, a bayonet connection or a magnetic connection.

[0048] The vapour generating device 10 illustrated in Figures 1a and 1b has an elongate and substantially cylindrical shape which resembles a cigarette or cigar. Other shapes are, however, entirely within the scope of the present disclosure. It should also be noted that in some examples, all of the components of the vapour generating device 10 can be contained within single housing, rather than two separable exterior housings 16a, 16b as described with reference to Figures 1a and 1b.

[0049] The vapour generating device 10 comprises a vaporizer unit 30, 130, 230, 330 configured to heat and vaporize a vapour generating liquid. The vaporizer unit 30, 130, 230, 330 can be a consumable component (e.g., a cartomizer) positioned in the mouthpiece portion 12 and various examples of the vaporizer unit 30, 130, 230, 330 will now be described in further detail with reference to Figures 2 to 8.

[0050] Figure 2 is a schematic sectional view of a first example of a vaporizer unit 30. The vaporizer unit 30 includes a liquid store 32 for containing a vapour generating liquid. The liquid store 32 is substantially annular and surrounds a vaporization chamber 34 which is in fluid communication with the vapour outlet 24 of the vapour generating device 10. The vaporizer unit 30 further comprises a heating element 36 positioned in the vaporization chamber 34 and in fluid communication with the vapour outlet 24. The heating element 36 is configured to heat vapour generating liquid supplied from the liquid store 32 to volatise at least one component of the vapour generating liquid and thereby generate a vapour which may cool and condense to form an aerosol for inhalation by a user through the mouthpiece 22.

[0051] The vaporizer unit 30 comprises a liquid transfer unit 40 which is configured to transfer vapour generating liquid from the liquid store 32 to the heating element 36 so that the transferred vapour generating liquid can be heated and vaporized.

[0052] The liquid transfer unit 40 comprises a liquid regulating arrangement 42, for example a first liquid regulating arrangement 42a such as a first pump 44a and a second liquid regulating arrangement 42b such as a second pump 44b. The first and second pumps 44a, 44b may be micropumps, for example piezoelectric pumps. The liquid regulating arrangement 42 is controlled by the controller 20 of the vapour generating device 10 to actively control the flow of vapour generating liquid from the liquid store 32 to the heating element 36.

[0053] The liquid transfer unit 40 further comprises a hollow liquid distribution element 46 which is fluidly connected to, and therefore in fluid communication with, the liquid regulating arrangement 42. The hollow liquid distribution element 46 comprises a liquid distribution surface 48 having a plurality of liquid outlets 50 (see Figures 3 and 4) which are arranged to transfer the vapour generating liquid to the heating element 36 so that it can be heated and vaporized.

[0054] In the illustrated example, the hollow liquid distribution element 46 comprises a hollow tube 52 having open ends which form first and second liquid inlets 54a, 54b. The liquid outlets 50 are formed as openings 51 in a side wall 52a of the hollow tube 52 and the heating element 36 comprises a heating coil that is wound around the outside of the hollow tube 52, adjacent to the openings 51.

[0055] The first pump 44a is positioned in a first flow path 56a that connects the liquid store 32 to the first liquid inlet 54a and the second pump 44b is positioned in a second flow path 56b that connects the liquid store 32 to the second liquid inlet 54b. When the first and second pumps 44a, 44b are operated simultaneously to supply vapour generating liquid from the liquid store 32 to the hollow tube 52, the liquid inside the hollow tube 52 is pressurised and forced out of the openings 51 formed in the side wall 52a. A uniform distribution of the vapour generating liquid across the liquid distribution surface 48 is thereby achieved.

[0056] Referring to Figure 3, in a first embodiment the hollow liquid distribution element 46, i.e. hollow tube 52, comprises a porous tubular element 58 that consists exclusively of a wicking material. The porous tubular element 58 comprises a hollow tube 52 in which the side wall 52a is formed of the wicking material to provide a porous liquid distribution surface 48. The wicking material is sufficiently strong and has sufficient inherent rigidity that it is self-supporting and maintains its shape so that obstruction or occlusion of the hollow interior of the porous tubular element 58 is avoided.

[0057] Referring to Figure 4, in a second embodiment a wicking element 60 is positioned between the hollow liquid distribution element 46, i.e. hollow tube 52, and the heating element 36. In this second embodiment, the wicking element 60 is formed as a sleeve comprising a wicking material, and the hollow tube 52 comprises a plastics material which is sufficiently rigid to maintain its shape and support the wicking element 60 that is sleeved onto it.

[0058] Referring now to Figure 5, there is shown a schematic sectional view of a second example of a vaporizer unit 130. The vaporizer unit 130 is similar to the vaporizer unit 30 descried above with reference to Figures 1 to 4 and corresponding features are identified using the same reference numerals.

[0059] The vaporizer unit 130 includes a first liquid store 132a containing a first vapour generating liquid and a second liquid store 132b containing a second vapour generating liquid. The first and second vapour generating liquids may differ from each other. For example, the first vapour generating liquid may comprise a nicotine formulation and the second vapour generating liquid may comprise a liquid flavourant, such as menthol or cherry flavour. The first and second liquid stores 132a, 132b could be arranged to be semi-annular, in the sense that each liquid store 132a, 132b circumscribes an angle of less than 360° and resembles part of a ring. In an example embodiment, the first liquid store 132a may circumscribe an angle of approximately 180° and the second liquid store 132b may also circumscribe an angle of approximately 180°, so that together the first and second liquid stores 132a, 132b form a ring shape which encircles the vaporization chamber 34. In other examples, the first liquid store 132a, for example containing the nicotine formulation, may be larger than the second liquid store 132b, for example containing liquid flavourant.

[0060] In this example, first and second liquid pumps 44a, 44b (e.g., micropumps) are again used to deliver the first and second vapour generating liquids from the first and second liquid stores 132a, 132b to the hollow tube 52 that acts as the hollow liquid distribution element 46. More specially, the first pump 44a is fluidly connected to a first end 53a of the hollow tube 52 and actively controls the flow of the first vapour generating liquid along the first flow path 56a from the first liquid store 132a to the first liquid inlet 54a of the hollow tube 52. The second pump 44b is fluidly connected to a second end 53b of the hollow tube 52 and actively controls the flow of the second vapour generating liquid along the second flow path 56b from the second liquid store 132b to the second liquid inlet 54b of the hollow tube 52. The first and second pumps 44a, 44b are configured to increase or decrease the flow rate of the respective first or second vapour generating liquid supplied to the hollow tube 52 during use of the vapour generating device 10, thereby enabling the constituents and composition of the generated vapour to be altered. For example, a user of the vapour generating device 10 may be able to control the flow rate of one or both of the first and second pumps 44a, 44b, e.g., via a user interface of the device 10 or via a remote application, thereby enabling the user to alter the strength of nicotine and/or the strength of the flavour of the generated vapour. This is advantageous as some users may prefer a higher nicotine content and/or stronger flavour whereas other users may prefer a lower nicotine content and/or weaker flavour. A personalised user experience can, therefore, be achieved.

[0061] Referring now to Figure 6, there is shown a schematic sectional view of a third example of a vaporizer unit 230. The vaporizer unit 230 is similar to the vaporizer units 30, 130 descried above with reference to Figures 1 to 5 and corresponding features are identified using the same reference numerals.

[0062] Like the second example of the vaporizer unit 130, the third example of the vaporizer unit 230 includes first and second liquid stores 132a, 132b and a heating element 36, e.g., a heating coil, wrapped around the outside of the hollow tube 52 (i.e., hollow liquid distribution element 46). In this example, the first and second liquid regulating arrangements 42a, 42b comprise first and second ring elements 62a, 62b which are configured to control the flow of first and second vapour generating liquids respectively from the first and second liquid stores 132a, 132b to the hollow tube 52. The first and second ring elements 62a, 62b thus act as flow control elements to control the flow of the first and second vapour generating liquids.

[0063] The first and second ring elements 62a, 62b are positioned around the hollow tube 52, at a position between the heating element 36, e.g., an end of the heating coil, and one end 53a, 53b of the hollow tube 52. The first and second ring elements 62a, 62b are configured to change between a first cross-section which at least partially closes the corresponding first or second flow path 56a, 56b, and a second cross-section which is larger than the first cross-section and at least partially opens the corresponding first or second flow path 56a, 56b. The first (smaller) cross-section may, for example, provide sufficient compression of the hollow tube 52 at the first end 53a or second end 53b to reduce the cross-sectional area of the hollow interior and thereby prevent, or at least reduce, the flow of the first or second vapour generating liquid from the corresponding first or second liquid store 132a, 132b to the liquid distribution surface 48. It should be understood that the cross-section of the first and second ring elements 62a, 62b may vary continuously between the first (smaller) cross-section and the second (larger) cross-section.

[0064] The first and second ring elements 62a, 62b can include a heat-sensitive material, such as a shape memory alloy (e.g., Nitinol), so that their cross-section varies depending on their temperature. More specifically, the first and second ring elements 62a, 62b may adopt the first (smaller) cross-section when they are at a first temperature, and may adopt the second (larger) cross-section when they are at a second temperature which is higher than the first temperature and higher than a transformation temperature of the heat-sensitive material. With this arrangement, as the temperature of the first and second ring elements 62a, 62b increases, for example from the first temperature to the second temperature, the first and second ring elements 62a, 62b expand to change from the first (smaller) cross-section to the second (larger) cross-section. Conversely, as the temperature of the first and second ring elements 62a, 62b decreases, for example from the second temperature to the first temperature, the first and second ring elements 62a, 62b shrink or contract to change from the second (larger) cross-section to the first (smaller) cross-section.

[0065] Typically, when the vapour generating device 10 is not in use, heat is not applied to the first and second ring elements 62a, 62b by the heating element 36 and the first and second ring elements 62a, 62b may, therefore, be at or close to the first temperature, typically ambient or room temperature. Thus, the first and second ring elements 62a, 62b adopt the first (smaller) cross-section and compress the hollow tube 52 at the first and second ends 53a, 53b. The first and second flow paths 56a, 56b are thus at least partially closed, preventing or at least restricting the flow of the first and second vapour generating liquids from the first and second liquid stores 132a, 132b to the liquid distribution surface 48. On the other hand, during use of the vapour generating device 10, heat is applied to the first and second ring elements 62a, 62b by the heating element 36. As the temperature of the first and second ring elements 62a, 62b increases from the first temperature (e.g., room temperature) towards the second temperature, the first and second ring elements 62a, 62b change their shape into a lager diameter (larger cross-section), thereby at least partially opening the first and second flow paths 56a, 56b and allowing an increased flow of the first and second vapour generating liquids from the first and second liquid stores 132a, 132b to the liquid distribution surface 48. When the heating element 36 is switched off, the temperature of the first and second ring elements 62a, 62b decreases, causing the first and second ring elements 62a, 62b to change their shape into a smaller diameter (smaller cross-section), thereby at least partially closing the first and second flow paths 56a, 56b and decreasing the flow of the first and second vapour generating liquids from the first and second liquid stores 132a, 132b to the liquid distribution surface 48. Thus, the flow or flow rate of the first and second vapour generating liquids from the corresponding first and second liquid stores 132a, 132b towards the heating element 36 is controlled based on the operational state of the vapour generating device 10.

[0066] Referring to Figures 7a and 7b, the first and second ring elements 62a, 62b can comprise a loop-shaped element 64 including a narrow cut 66 between adjacent ends, to form an open jump ring. The action of the heat-sensitive material (e.g., shape memory alloy) at or above its transformation temperature (i.e., as it changes from the first temperature to the second temperature) causes the loop-shaped element 64 to deform to increase the size of the narrow cut 66 (i.e., to increase the distance between the adjacent ends), such that the diameter of the ring element 62a, 62b increases as best seen by comparing Figures 7a and 7b. The inner diameter of the first and second ring elements 62a, 62b may be 2 to 3 mm when the first and second ring elements 62a, 62b are at the first temperature. The inner diameter may increase by 0.5 to 2.0 mm, or more, when the first and second ring elements 62a, 62b are at the second temperature.

[0067] Referring now to Figure 8, there is shown a schematic sectional view of a fourth example of a vaporizer unit 330. The vaporizer unit 330 is similar to the vaporizer unit 230 descried above with reference to Figure

6 and corresponding features are identified using the same reference numerals.

[0068] In the vaporizer unit 330, the heating element 36, e.g., heating coil, extends fully between the first and second ends 53a, 53b of the hollow tube 52. The first and second ring elements 62a, 62b are positioned between the heating element 36 and an outer surface of the hollow tube 52, so that the heating element 36 surrounds at least part of each ring element 62a, 62b. In this fourth example of the vaporizer unit 330, the inner diameter of the heating element 36 is larger than the outer diameter of the first and second ring elements 62a, 62b when they are in the expanded state (i.e., when they have the second (larger) cross-section), thus ensuring that the first and second ring elements 62a, 62b can freely expand upon being heated by the heating element 36 to a temperature above their transformation temperature.

[0069] In order to avoid direct contact between the first and second ring elements 62a, 62b and the heating element 36 as the first and second ring elements 62a, 62b expand to adopt the second (larger) cross-section during operation of the heating element 36, the first and second ring elements 62a, 62b and the heating element 36 may be arranged such that a small air gap is maintained between the first and second ring elements 62a, 62b and the heating element 36. Alternatively or in addition, an electrical insulation layer may be provided between the first and second ring elements 62a, 62b and the heating element 36. The electrical insulation layer may, for example, be a thin coating on the first and second ring elements 62a, 62b.

[0070] In each of the examples described above, the vaporizer unit 30, 130, 230, 330 can include a sensor 28 for generating a signal that is indicative of the amount of vapour generated by the vaporizer unit 30, 130, 230, 330 during a predetermined time period. The sensor 28 is in fluid communication with the vapour outlet 24 of the vapour generating device 10 and may, for example, be positioned in the vaporization chamber 34 as shown in Figures 2, 5 and 6. The sensor 28 can be any type of sensor that is capable of determining (directly or indirectly, via the controller 20) the amount or quantity of vapour generated by the vaporizer unit 30, 130, 230, 330 during a predetermined time period, and may be a humidity sensor, a temperature sensor or a vapour concentration sensor. In some embodiments, a combination of different sensor types could be employed.

[0071] Based on the signal generated by the sensor 28, the controller 20 is configured to control the operation of the heating element 36 and/or the liquid regulating arrangement 42 (e.g., first pump 44a and/or second pump 44b) to control the amount of vapour that is generated by the vaporizer unit 30, 130, 230, 330 and delivered to the user. For example, if the controller 20 determines based on the signal from the sensor 28 that an inadequate amount of vapour is being generated, the controller 20 may increase the power supplied by the power source 18 to the heating element 36 to increase its temperature and/or may control one or both of the first and second pumps 44a, 44b to increase the flow rate of the vapour generating liquid supplied from the liquid store 32, 132a, 132b to the liquid distribution surface 48 for evaporation by the heating element 36. Conversely, if the controller 20 determines based on the signal from the sensor 28 that too much vapour is being generated, the controller 20 may decrease the power supplied by the power source 18 to the heating element 36 to reduce its temperature and/or may control one or both of the first and second pumps 44a, 44b to decrease the flow rate of the vapour generating liquid supplied from the liquid store 32, 132a, 132b to the liquid distribution surface 48 for evaporation by the heating element 36.

[0072] In some embodiments, the controller 20 is configured to activate the first and second pumps 44a, 44b in response to an activation of the vapour generating device 10, thus ensuring that vapour generating liquid is transferred from the liquid store 32, 132a, 132b to the hollow tube 52 only when the device 10 is in use. In order to automate the activation of the first and second pumps 44a, 44b, the vapour generating device 10 (or possibly the vaporizer unit 30, 130, 230, 330) can include a motion sensor 38 (Figure 1a), such as an accelerometer, for generating a motion signal. The controller 20 is configured to activate the first and second pumps 44a, 44b upon receipt of the motion signal from the motion sensor 38, thereby ensuring that the vapour generating liquid is retained in the liquid store 32, 132a, 132b when the vapour generating device 10 is not in use.

[0073] Upon activation of the vapour generating device 10, for example upon receiving the motion signal from the motion sensor 38, the controller 20 can be configured to supply electrical power from the power source 18 to the heating element 36 and to the first and second pumps 44a, 44b so that the vapour generating liquid is transferred to the liquid distribution surface 48 and heated to generate a vapour. The controller 20 can then determine, based on the signal from the sensor 28, the amount of vapour generated during a predetermined time period and can evaluate whether an increased or decreased quantity of vapour is needed for a satisfactory user experience. If the controller 20 determines that an inadequate amount of vapour is being generated, the controller 20 can increase the electrical power supplied from the power source 18 to the heating element 36 (to increase its temperature) and/or to the first and second pumps 44a, 44b (to increase the flow of vapour generating liquid) to thereby increase the amount of vapour that is generated. Conversely, if the controller 20 determines that too much vapour is being generated, the controller 20 can decrease the electrical power supplied from the power source 18 to the heating element 36 (to reduce its temperature) and/or to the first and second pumps 44a, 44b (to decrease the flow of vapour generating liquid) to thereby decrease the amount of vapour that is generated. Of course, if (or when) the controller 20 determines that an acceptable amount of vapour is being generated for a satisfactory user experience, the controller 20 may not perform any adjustment of the electrical power supplied from the power source 18 to the heating element 36 and/or to the first and second pumps 44a, 44b.

[0074] Although exemplary embodiments have been described in the preceding paragraphs, it should be understood that various modifications may be made to those embodiments without departing from the scope of the appended claims. Thus, the breadth and scope of the claims should not be limited to the above-described exemplary embodiments.

[0075] Any combination of the above-described features in all possible variations thereof is encompassed by the present disclosure unless otherwise indicated herein or otherwise clearly contradicted by context.

[0076] Unless the context clearly requires otherwise, throughout the description and the claims, the words "comprise", "comprising", and the like, are to be construed in an inclusive as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to".

Claims

1. A vaporizer unit (30, 130, 230, 330) for a vapour generating device (10), the vaporizer unit (30, 130, 230, 330) comprising:

a liquid store (32) for containing a vapour generating liquid;
a heating element (36) in fluid communication with a vapour outlet (24) of the vapour generating device (10) and configured to heat vapour generating liquid from the liquid store (32) to generate a vapour to be inhaled;
a liquid transfer unit (40) configured to transfer vapour generating liquid from the liquid store (32) to the heating element (36), the liquid transfer unit (40) comprising:

a liquid regulating arrangement (42) for actively controlling the flow of vapour generating liquid from the liquid store (32); and
a hollow liquid distribution element (46) in communication with the liquid regulating arrangement (42), the hollow liquid distribution element (46) comprising a liquid distribution surface (48) having a plurality of liquid outlets (50) arranged to transfer the vapour generating liquid to the heating element (36).

2. A vaporizer unit according to claim 1, wherein the hollow liquid distribution element (46) includes at least two liquid inlets (54a, 54b) in communication with the liquid regulating arrangement (42).

3. A vaporizer unit according to claim 1 or claim 2, wherein the liquid distribution surface (48) comprises a porous surface or a perforated surface.

4. A vaporizer unit according to any preceding claim, wherein the hollow liquid distribution element (46) comprises a hollow tube (52) in communication with the liquid regulating arrangement (42), the plurality of liquid outlets (50) are formed as openings (51) in a side wall (52a) of the hollow tube (52), and preferably wherein the heating element (36) comprises a heating coil disposed around the hollow tube (52).

5. A vaporizer unit according to any preceding claim, wherein the heating element (36) is positioned externally of the hollow liquid distribution element (46), adjacent to the plurality of liquid outlets (50).

6. A vaporizer unit according to any preceding claim, wherein the hollow liquid distribution element (46) comprises a wicking material or wherein the vaporizer unit further comprises a wicking element (60) positioned between the hollow liquid distribution element (46) and the heating element (36).

7. A vaporizer unit according to any preceding claim, wherein:

the vaporizer unit comprises a first liquid store (132a) for containing a first vapour generating liquid and a second liquid store (132b) for containing a second vapour generating liquid;
the liquid transfer unit (40) comprises a first liquid regulating arrangement (42a) for actively controlling the flow of the first vapour generating liquid from the first liquid store (132a) and a second liquid regulating arrangement (42b) for actively controlling the flow of the second vapour generating liquid from the second liquid store (132b); and
the hollow liquid distribution element (46) has a first end (53a) in communication with the first liquid regulating arrangement (42a) and a second end (53b) in communication with the second liquid regulating arrangement (42b).

8. A vaporizer unit according to claim 7, wherein one or both of the first liquid regulating arrangement (42a) and the second liquid regulating arrangement (42b) comprises a ring element (62a, 62b) configured to change between a first cross-section to at least partially close a flow path (56a, 56b) from the first or second liquid store (132a, 132b) to the hollow liquid distribution element (46) and a second cross-section to at least partially open the flow path (56a, 56b) from the first or second liquid store (132a, 132b) to the hollow liquid distribution element (46), wherein the second cross-section is larger than the first cross-section.

9. A vaporizer unit according to claim 8, wherein the ring element (62a, 62b) is configured to change between the first cross-section and the second cross-section based on the temperature of the ring element (62a, 62b), preferably wherein the ring element (62a, 62b) includes a shape memory alloy.

10. A vaporizer unit according to claim 8 or claim 9, wherein the ring element (62a, 62b) is positioned around the hollow liquid distribution element (46) at a position between an end (53a, 53b) of the liquid distribution element (46) and the heating element (36) to increase or decrease the pressure applied to the liquid distribution element (46).

11. A vapour generating device (10) comprising:

a vaporizer unit (30, 130, 230, 330) according to any preceding claim;
a vapour outlet (24);
a sensor (28) in fluid communication with the vapour outlet (24) for generating a signal indicative of the amount of vapour generated by the vaporizer unit during a predetermined time period; and
a controller (20) configured to control the operation of at least one of the heating element (36) and the liquid regulating arrangement (42) in response to the signal to thereby control the amount of vapour generated by the vaporizer unit.

12. A vapour generating device according to claim 11, wherein the controller (20) is configured to control the operation of the heating element (36) by varying the electrical power supplied to the heating element (36) and/or to control the operation of the liquid regulating arrangement (42) to actively control the flow rate of vapour generating liquid from the liquid store (32) to the heating element (36).

13. A vapour generating device according to claim 11 or claim 12, wherein the sensor (28) comprises one or more selected from the group consisting of a humidity sensor, a temperature sensor, and a vapour concentration sensor.

14. A method for controlling vapour generation in the vapour generating device (10) according to any of claims 11 to 13, the method comprising controlling, by the controller (20), the operation of the at least one heating element (36) by varying the electrical power supplied to the heating element and/or controlling, by the controller (20), the liquid regulating arrangement (42) to actively control the flow rate of vapour generating liquid from the liquid store (32) to the heating element (36).

15. A method according to claim 14, wherein the method comprises:

in response to an activation of the vapour generating device (10), supplying electrical power to the heating element (36) and the liquid regulating arrangement (42) to generate a vapour;
determining, by the controller (20), the amount of vapour generated during a predetermined time period based on the signal from the sensor (28);
evaluating, by the controller (20), whether an increased or decreased quantity of vapour is needed; and
increasing or decreasing the electrical power supplied to one or both of the heating element (36) and the liquid regulating arrangement (42) to thereby control the amount of vapour generated by the vaporizer unit.

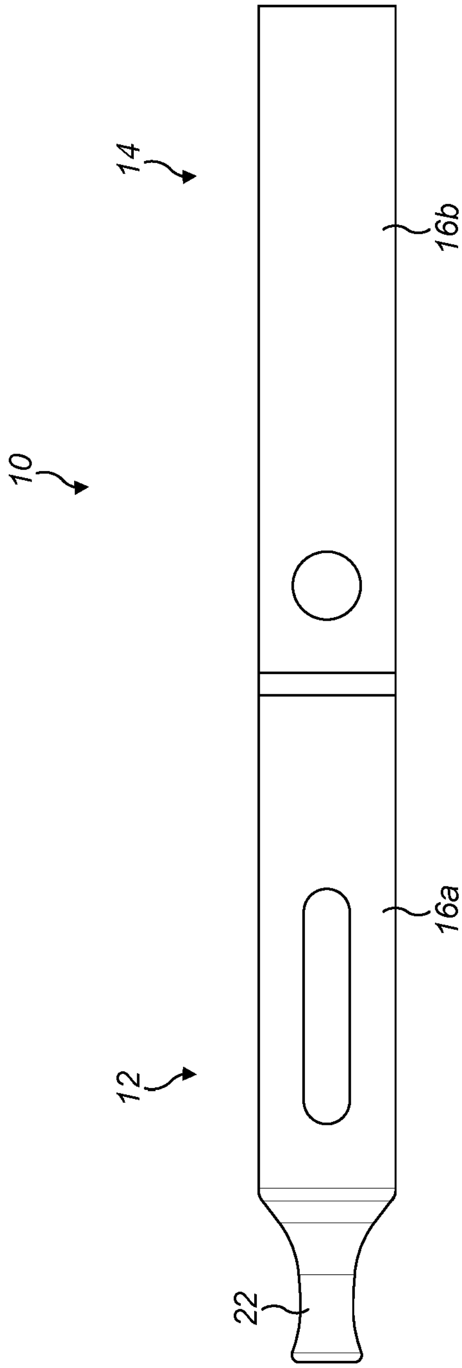


FIG. 1a

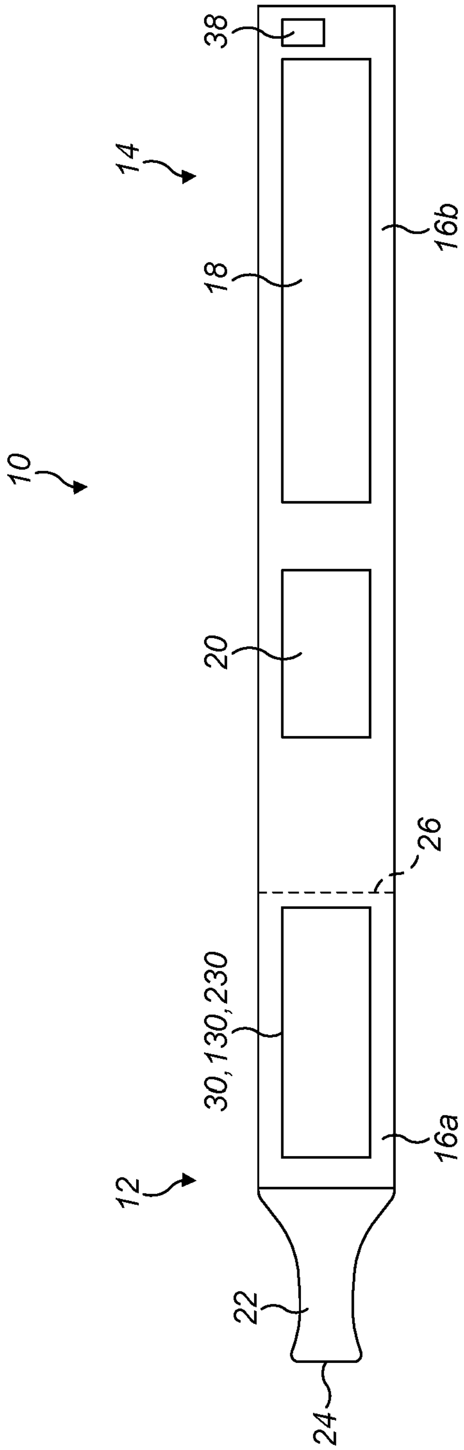
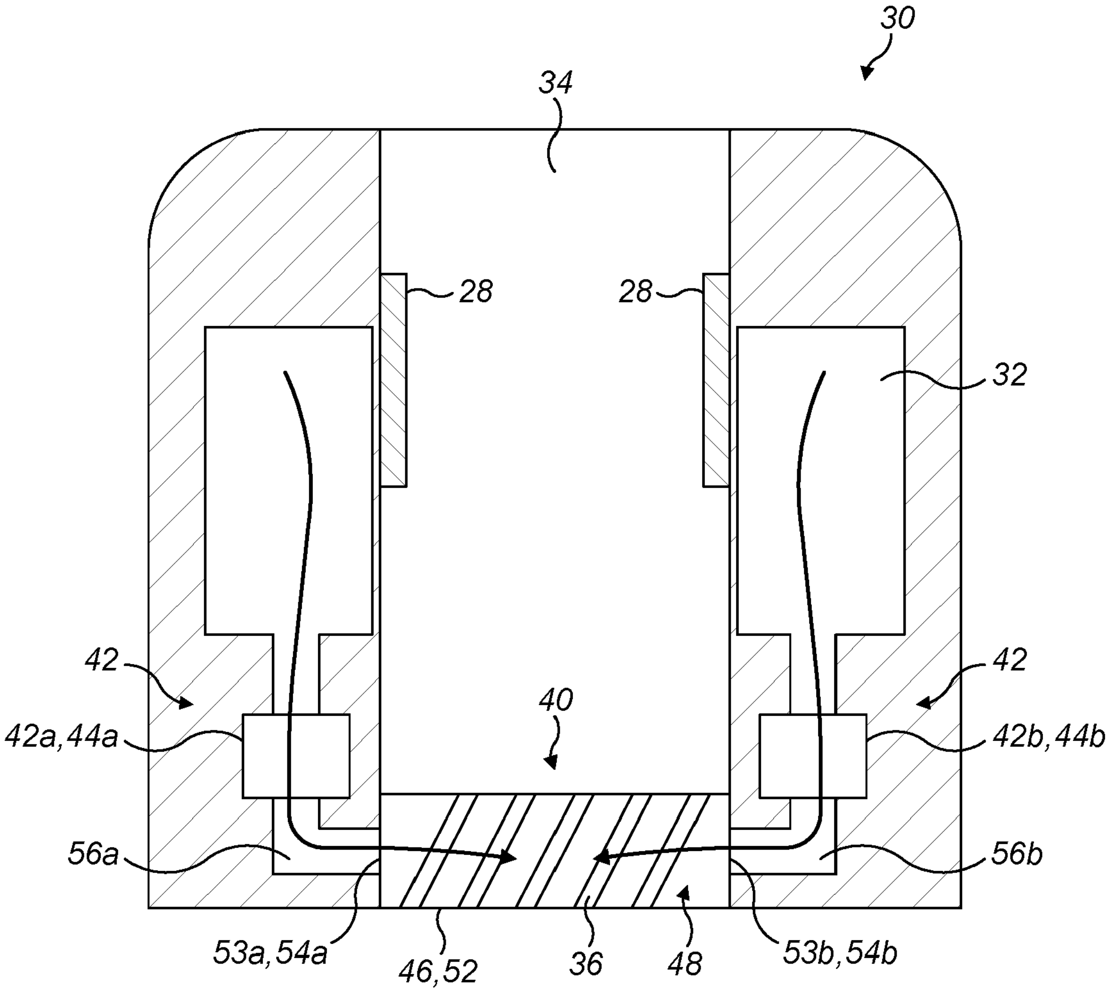


FIG. 1b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34
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28
32
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42
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56b
53a,54a
46,52
36
48
53b,54b

FIG. 2

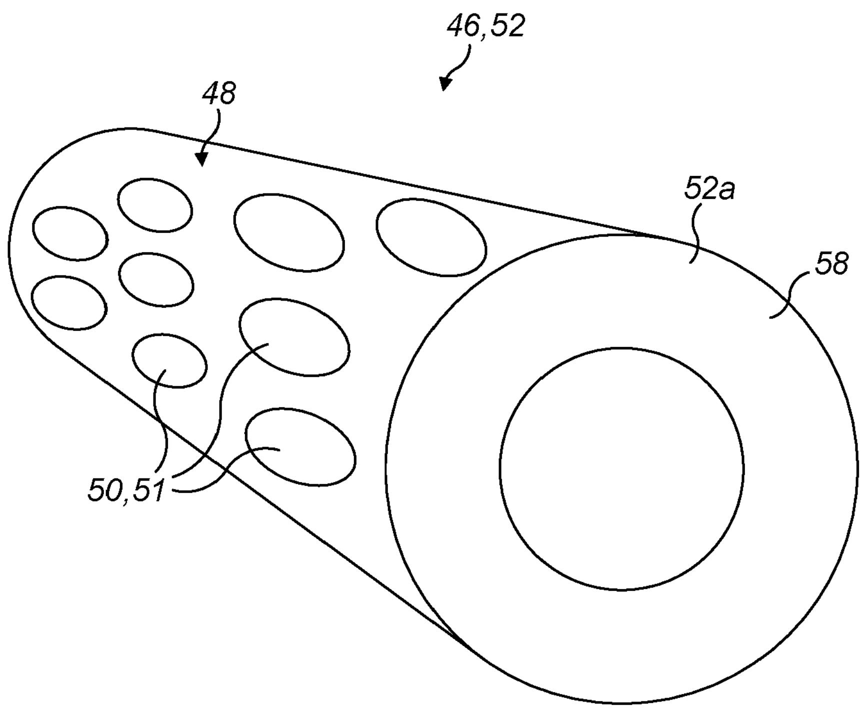


FIG. 3

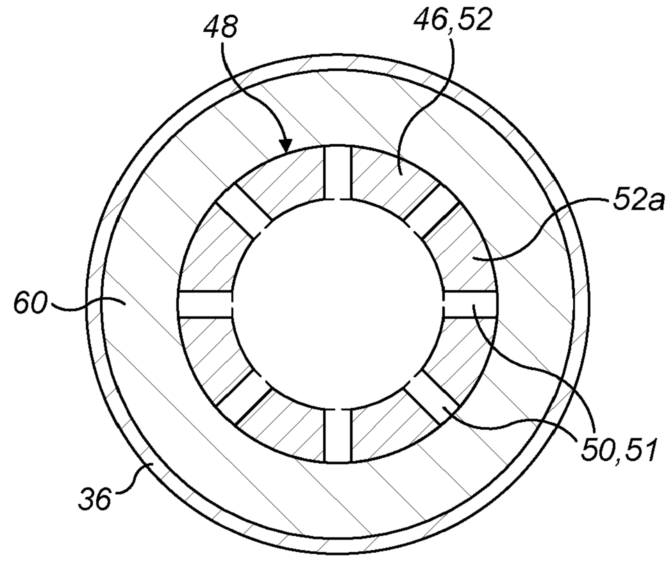


FIG. 4

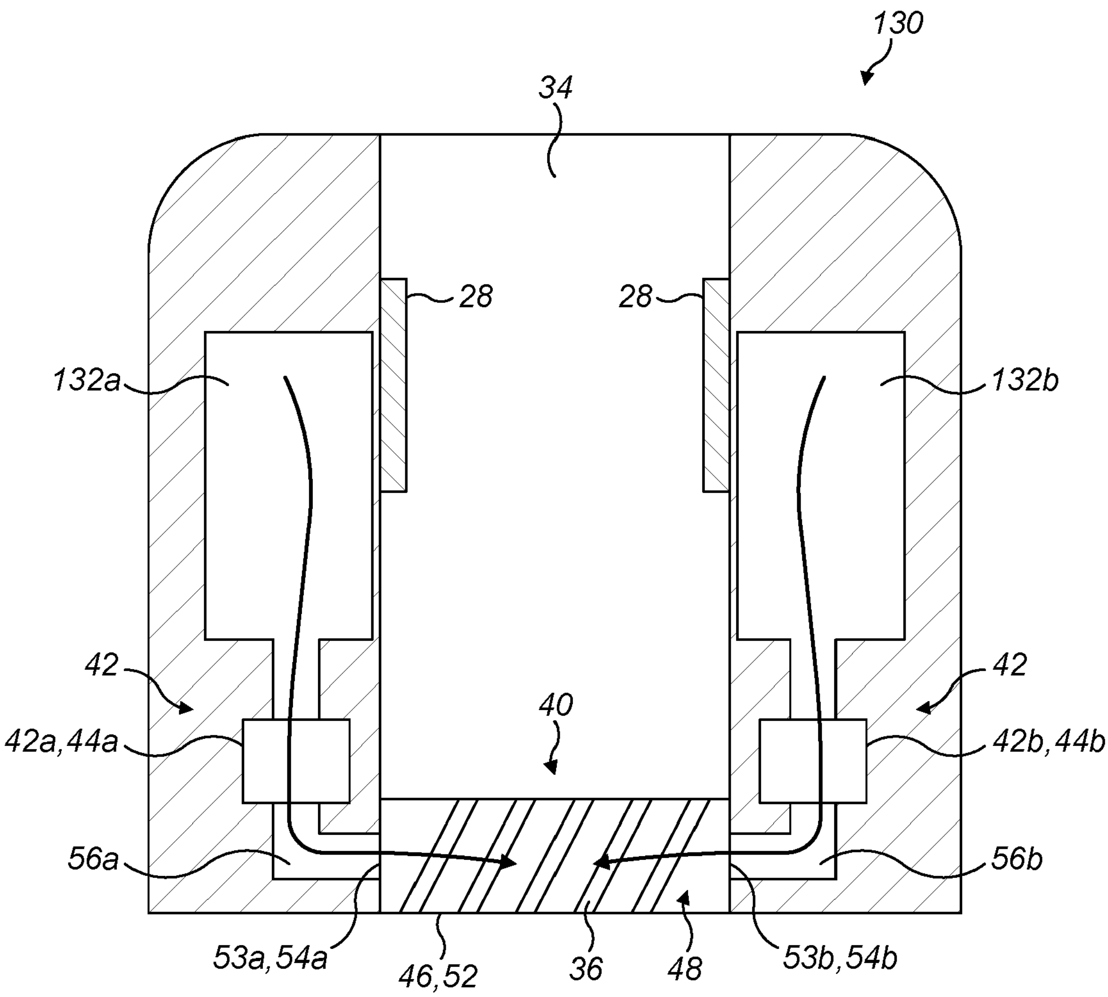
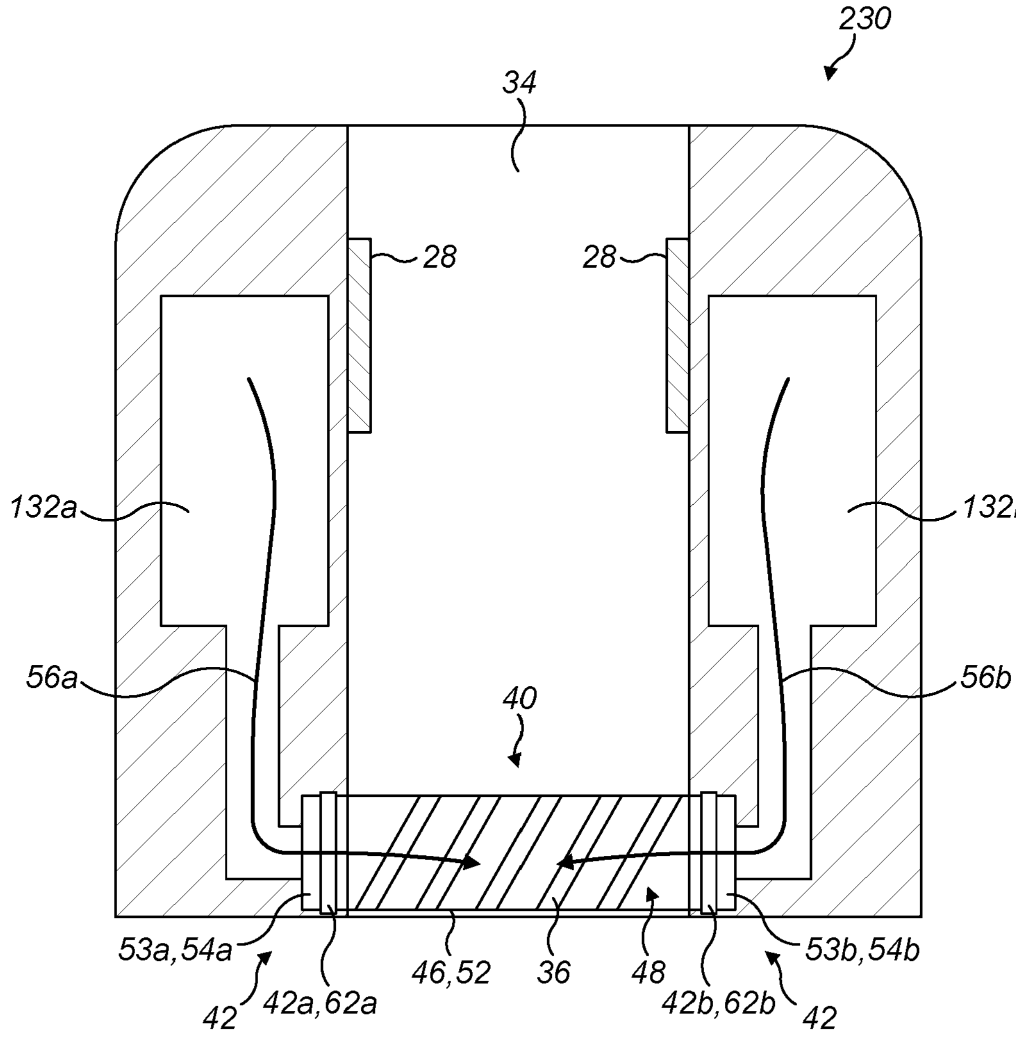

130
34
28
28
132a
132b
42
42
40
42a,44a
42b,44b
56a
56b
53a,54a
46,52
36
48
53b,54b

FIG. 5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132a
132b
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56b
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53a,54a
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42a,62a
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42b,62b
53b,54b
42

FIG. 6

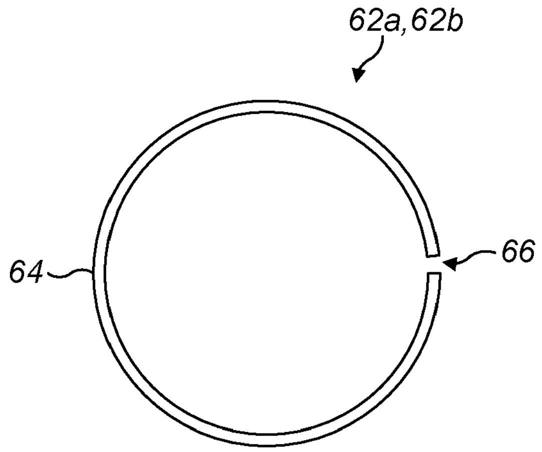

FIG. 7a

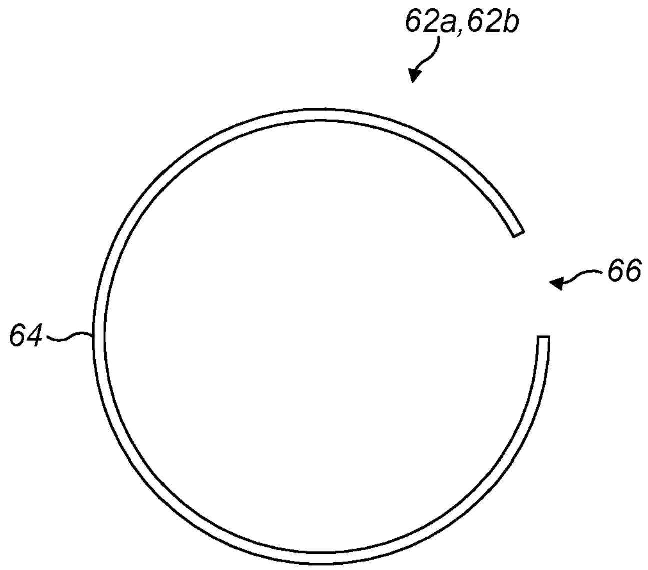

FIG. 7b

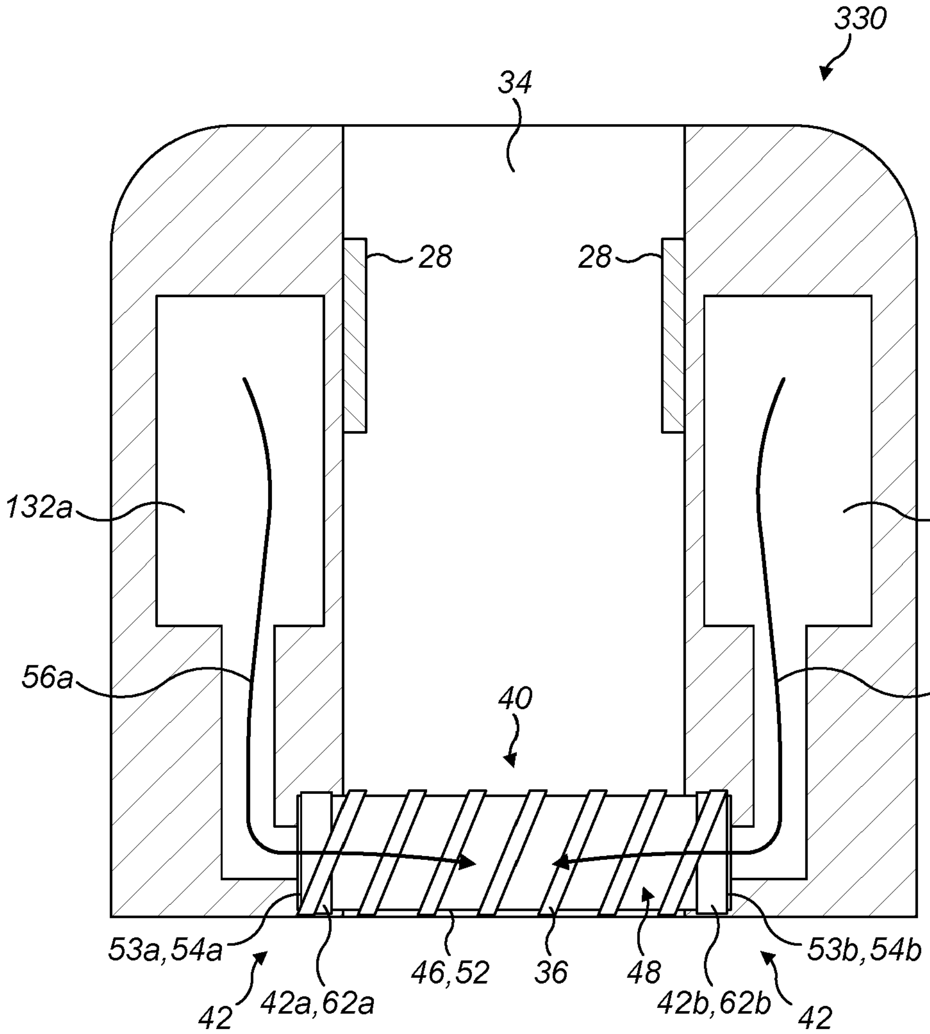
330
34
28
28
132a
132b
56a
56b
40
53a,54a
42
42a,62a
46,52
36
48
42b,62b
53b,54b
42

FIG. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 21 17 8219

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Place of search	Date of completion of the search	Examiner
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CATEGORY OF CITED DOCUMENTS

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