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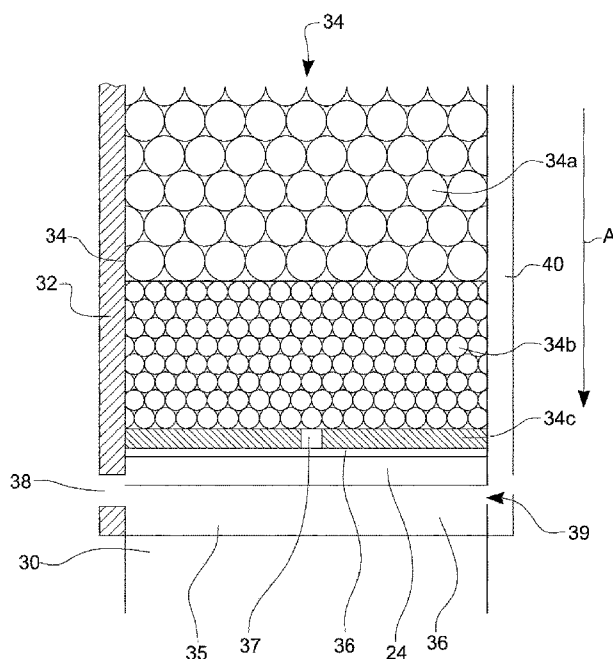


Fig. 5

(57) Abstract: An aerosol delivery system has a fluid-transfer article that has a first region for holding an aerosol precursor and a second region to which the aerosol precursor is transferred from the first region. The second region includes a hole therein, through which hole aerosol precursor may pass. At least a part of the heater is deformable, in response to a temperature change between a first and a second temperature. When at the second temperature, which normally is higher than the first temperature, the deformable part of the heater is spaced from the second region to define an air-flow pathway between the heater and the second region, through which air can flow to transfer the aerosol to the user. At the first temperature, the deformable part of the heater moves into contact with the second region, to block the hole and to obstruct the air-flow pathway, so as to reduce escape of aerosol precursor from the second region of the fluid-transfer article.



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AEROSOL DELIVERY SYSTEM

Field of the Invention

The present invention relates to an aerosol delivery system, and an aerosol-generation apparatus for an aerosol delivery system. The present invention preferably relates to an aerosol delivery system including a heater configured to heat an aerosol precursor to generate an aerosolised composition for inhalation by a user, and to an aerosol-generation apparatus therefor.

Background

Pharmaceutical medicament, physiologically active substances and flavourings for example may be delivered to the human body by inhalation through the mouth and/or nose. Such material or substances may be delivered directly to the mucosa or mucous membrane lining the nasal and oral passages and/or the pulmonary system. For example, nicotine is consumed for therapeutic or recreational purposes and may be delivered to the body in a number of ways. Nicotine replacement therapies are aimed at people who wish to stop smoking and overcome their dependence on nicotine. Nicotine is delivered to the body in the form of aerosol delivery devices and systems, also known as smoking-substitute devices or nicotine delivery devices. Such devices may be non-powered or powered.

Devices or systems that are non-powered may comprise nicotine replacement therapy devices such as "inhalators", e.g. Nicorette® Inhalator. These generally have the appearance of a plastic cigarette and are used by people who crave the behaviour associated with consumption of combustible tobacco - the so-called hand-to-mouth aspect - of smoking tobacco. Inhalators generally allow nicotine-containing aerosol to be inhaled through an elongate tube in which a container containing a nicotine carrier, for example, a substrate, is located. An air stream caused by suction through the tube by the user carries nicotine vapours into the lungs of the user to satisfy a nicotine craving. The container may comprise a replaceable cartridge, which includes a cartridge housing and a passageway in the housing in which a nicotine reservoir is located. The reservoir holds a measured amount of nicotine in the form of the nicotine carrier. The measured amount of nicotine is an amount suitable for delivering a specific number of "doses". The form of the nicotine carrier is such as to allow nicotine vapour to be released into a fluid stream passing around or through the reservoir. This process is known as aerosolization and or atomization.

Aerosolization is the process or act of converting a physical substance into the form of particles small and light enough to be carried on the air i.e. into an aerosol. Atomization is the process or act of separating or reducing a physical substance into fine particles and may include the generation of aerosols. The passageway generally has an opening at each end for communication with the exterior of the housing and for allowing the fluid stream through the passageway. A nicotine-impermeable barrier seals the reservoir from atmosphere. The barrier includes passageway barrier portions for sealing the passageway on both sides of the reservoir. These barrier portions are frangible so as to be penetrable for opening the passageway to atmosphere.

A device or a system that is powered can fall into two sub-categories. In both subcategories, such devices or systems may comprise electronic devices or systems that permit a user to simulate the act of smoking by producing an aerosol mist or vapour that is drawn into the lungs through the mouth and then exhaled. The electronic devices or systems typically cause the vaporization of a liquid containing nicotine and entrainment of the vapour into an airstream. Vaporization of an element or compound is a phase transition from the liquid phase to vapour i.e. evaporation or boiling. In use, the user experiences a similar satisfaction and physical sensation to those experienced from a traditional smoking or tobacco product, and exhales an aerosol mist or vapour of similar appearance to the smoke exhaled when using such traditional smoking or tobacco products.

A person of ordinary skill in the art will appreciate that devices or systems of the second, powered category as used herein include, but are not limited to, electronic nicotine delivery systems, electronic cigarettes, e-cigarettes, e-cigs, vaping cigarettes, pipes, cigars, cigarillos, vaporizers and devices of a similar nature that function to produce an aerosol mist or vapour that is inhaled by a user. Such nicotine delivery devices or systems of the second category incorporate a liquid reservoir element generally including a vaporizer or misting element such as a heating element or other suitable element, and are known, inter alia, as atomizers, cartomizers, or clearomizers. Some electronic cigarettes are disposable; others are reusable, with replaceable and refillable parts.

Aerosol delivery devices or systems in a first sub-category of the second, powered category generally use heat and/or ultrasonic agitation to vaporize a solution comprising nicotine and/or other flavouring, propylene glycol and/or glycerine-based base into an aerosol mist of vapour for inhalation.

Aerosol delivery devices or systems in a second sub-category of the second, powered category may typically comprise devices or systems in which tobacco is heated rather than combusted. During use, volatile compounds may be released from the tobacco by heat transfer from the heat source and entrained in air drawn through the aerosol delivery device or system. Direct contact between a heat source of the aerosol delivery device or system and the tobacco heats the tobacco to form an aerosol. As the aerosol containing the released compounds passes through the device, it cools and condenses to form an aerosol for inhalation by the user. In such devices or systems, heating, as opposed to burning, the tobacco may reduce the odour that can arise through combustion and pyrolytic degradation of tobacco.

Aerosol delivery devices or systems falling into the first sub-category of powered devices or systems may typically comprise a powered unit, comprising a heater element, which is arranged to heat a portion of a carrier that holds an aerosol precursor. The carrier comprises a substrate formed of a "wicking" material, which can absorb aerosol precursor liquid from a reservoir and hold the aerosol precursor liquid. Upon activation of the heater element, aerosol precursor liquid in the portion of the carrier in the vicinity of the heater element is vaporised and released from the carrier into an airstream flowing around the heater and carrier. Released aerosol precursor is entrained into the airstream to be borne by the airstream to an outlet of the device or system, from where it can be inhaled by a user.

The heater element is typically a resistive coil heater, which is wrapped around a portion of the carrier and is usually located in the liquid reservoir of the device or system. Consequently, the surface of the heater may always be in contact with the aerosol precursor liquid, and long-term exposure may result in the degradation of either or both of the liquid and heater. Furthermore, residues may build up upon the surface of the heater element, which may result in undesirable toxicants being inhaled by the user. Furthermore, as the level of liquid in the reservoir diminishes through use, regions of the heater element may become exposed and overheat.

The present invention has been devised in light of the above considerations.

Summary of the Invention

At its most general, the present invention proposes that a fluid-transfer article for holding an aerosol precursor includes a hole therein. Adjacent the hole is a heater, which is deformable in response to temperature change, the deformation being between a position in which a part of the heater (typically, part of the heating surface of the heater) blocks the hole, and a position in which the heater is spaced from the fluid-transfer article. With such an arrangement, the heater may prevent or reduce escape of aerosol precursor from the fluid-transfer article when it is not being used, but allow aerosol precursor to reach the heater and be vaporized when the aerosol-generation apparatus is in use.

There may be more than one hole in the fluid transfer article, in which case the deformation of the heater will normally need to block all, or at least most of the holes when in the first position.

Hence, the present invention may provide an aerosol-generation apparatus comprising a heater and a fluid-transfer article, the fluid-transfer article comprising a first region for holding an aerosol precursor and for transferring said aerosol precursor to a second region of said article, said second region having at least one hole therein for passage of said aerosol precursor therethrough, wherein at least a part of a heating surface of said heater is deformable in response to a temperature change between a first temperature and a second temperature said at least a part of said heating surface of said heater being in a first position at the first temperature and a second position at the second temperature, and wherein: in the first position said at least a part of the heating surface is in contact with said second region so as to obstruct said at least one hole, and in the second position said at least part of the heating surface is spaced from said second region.

Preferably, an air-flow pathway is defined between an inlet and an outlet of said aerosol-generation apparatus, and wherein: when said at least a part of said heating surface is in contact with said second region, a part of said air-flow pathway between said at least a part of said heating surface and said second region is obstructed by said heater: and when said at least a part of said heating

surface is spaced from said second region, said air-flow pathway between said at least a part of said heating surface and said second region is not obstructed by said heater.

Optionally, said second region may include a plate having said hole therein and wherein: in said first position said at least a part of the heating surface is in contact with said plate so as to obstruct said at least one hole, and in the second position said at least part of the heating surface is spaced from said second plate.

In some embodiments, said plate may be formed from metal. In other embodiments, said plate may be formed of plastic material.

In addition to the plate, the second region may include a part formed of polymer wicking material. In such a case, the part of polymeric wicking material will be between the first region and the plate, it can then transfer aerosol precursor from the first part to the hole in the plate.

Preferably, the first region and said part of the second region (if present) is formed from a polymeric wicking material.

The polymeric wicking material is preferably porous. It may be configured so that the pore diameter in the first region of the fluid-transfer article is greater than the pore diameter in the second region of the fluid-transfer article.

Normally, the second temperature is higher than the first temperature, so the deformation of the heater surface to the second position occurs as the heater temperature rises. In such circumstances, the first temperature may be e.g. room or ambient temperature, with the second temperature corresponding to operating temperature of the heater when the user is using the apparatus.

In a second aspect of the invention, the present invention may also provide an aerosol delivery system including an aerosol-generation apparatus discussed above, and a carrier. The carrier may then be in a housing containing the heater and the fluid-transfer article. This housing may have an inlet and an outlet, the former being in communication with the inlet of the aerosol-generation apparatus and the latter being in communication with the outlet of the aerosol-generation apparatus. The air-flow pathway then may extend between the inlet and the outlet of the housing, so that movable air can be drawn in to the housing from the exterior, through the inlet, and out from the outlet to the user. When the apparatus is being used, aerosol and/or vapour due to the action of the heater on the aerosol precursor will be present in the air that passes to the user from the outlet.

The aerosol-generation apparatus may form part of an aerosol delivery system which has a carrier which includes a housing containing the heater and the fluid-transfer apparatus. The housing may have an inlet and outlet, to define an air-flow pathway between the inlet and outlet.

Preferably, that air-flow pathway may pass between the second region (and optionally the plate thereof, if provided) and said at least a part of the heating surface of the heater, and be obstructed when said at least part of said heating surface is in the first position.

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The invention includes the combination of the aspects and preferred features described except where such a combination is clearly impermissible or expressly avoided.

Summary of the Figures

10 So that the invention may be understood, and so that further aspects and features thereof may be appreciated, embodiments illustrating the principles of the invention will now be discussed in further detail with reference to the accompanying figures, in which:

Figure 1. is a perspective view illustration of a system for aerosol delivery according to one or more embodiments of the present invention;

15 **Figure 2.** is a cross-section side view illustration of part of an apparatus of the system for aerosol delivery of Figure 1;

Figure 3. is a cross-section side view illustration of the system and apparatus for aerosol delivery of Figure 1;

20 **Figure 4.** is a perspective view illustration of an aerosol carrier for use in the system for aerosol delivery according to one or more embodiments of the present invention;

Figure 5. is a cross-section side view of elements of an aerosol carrier and a part of an apparatus of the system for aerosol delivery according to one or more embodiments of the present invention;

25 **Figure 6.** is a cross-section side view of elements of an aerosol carrier and a part of an apparatus of the system for aerosol delivery according to one or more embodiments of the present invention, perpendicular to Figure 5, and with the heater in a heated condition;

Figure 7. is a cross-section side view of elements of an aerosol carrier and a part of an apparatus of the system for aerosol delivery according to one or more embodiments of the present invention, Figure 7 corresponding to Figure 5 but with the heater in a heated condition;

30 **Figure 8.** is a cross-section side view of an aerosol carrier according to one or more embodiments of the present invention;

Figure 9. is a perspective cross-section side view of the aerosol carrier of Figure 9; and

Figure 10. is an exploded perspective view illustration of a kit-of-parts for assembling the system according to one or more embodiments of the present invention.

Detailed Description of the Invention

Aspects and embodiments of the present invention will now be discussed with reference to the accompanying figures. Further aspects and embodiments will be apparent to those skilled in the art. All documents mentioned in this text are incorporated herein by reference.

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In general outline, one or more embodiments in accordance with the present invention may provide a system for aerosol delivery in which an aerosol carrier may be inserted into a receptacle (e.g. a "heating chamber") of an apparatus for initiating and maintaining release of an aerosol from the aerosol carrier. Another end, or another end portion, of the aerosol carrier may protrude from the apparatus and can be
10 inserted into the mouth of a user for the inhalation of aerosol released from the aerosol carrier cartridge during operation of the apparatus.

Hereinafter, and for convenience only, "system for aerosol delivery" shall be referred to as "aerosol delivery system".

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Referring now to Figure 1, there is illustrated a perspective view of an aerosol delivery system 10 comprising an aerosol generation apparatus 12 operative to initiate and maintain release of aerosol from a fluid-transfer article in an aerosol carrier 14. In the arrangement of Figure 1, the aerosol carrier 14 is shown with a first end 16 thereof and a portion of the length of the aerosol carrier 14 located within a
20 receptacle of the apparatus 12. A remaining portion of the aerosol carrier 14 extends out of the receptacle. This remaining portion of the aerosol carrier 14, terminating at a second end 18 of the aerosol carrier, is configured for insertion into a user's mouth. A vapour and/or aerosol is produced when a heater (not shown in Figure 1) of the apparatus 12 heats a fluid-transfer article in the aerosol carrier 14 to release a vapour and/or an aerosol, and this can be delivered to the user, when the user sucks or inhales,
25 via a fluid passage in communication with an outlet of the aerosol carrier 14 from the fluid-transfer article to the second end 18.

The device 12 also comprises air-intake apertures 20 in the housing of the apparatus 12 to provide a passage for air to be drawn into the interior of the apparatus 12 (when the user sucks or inhales) for
30 delivery to the first end 16 of the aerosol carrier 14, so that the air can be drawn across an activation surface of a fluid-transfer article located within a housing of the aerosol carrier cartridge 14 during use. Optionally, these apertures may be perforations in the housing of the apparatus 12.

A fluid-transfer article (not shown in Figure 1, but described hereinafter with reference to Figs. 5, 6, 7, 8,
35 9, 10, 11 and 12) is located within a housing of the aerosol carrier 14. The fluid-transfer article contains

an aerosol precursor material, which may include at least one of: nicotine; a nicotine precursor material; a nicotine compound; and one or more flavourings. The fluid-transfer article is located within the housing of the aerosol carrier 14 to allow air drawn into the aerosol carrier 14 at, or proximal, the first end 16 to flow across an activation surface of the fluid-transfer article. As air passes across the activation surface of the fluid-transfer article, an aerosol may be entrained in the air stream from a substrate forming the fluid-transfer article, e.g. via diffusion from the substrate to the air stream and/or via vaporisation of the aerosol precursor material and release from the fluid-transfer article under heating.

The substrate forming the fluid-transfer article 34 comprises a porous material where pores of the porous material hold, contain, carry, or bear the aerosol precursor material. In particular, the porous material of the fluid-transfer article may be a polymeric wicking material such as, for example, a sintered material. Particular examples of material suitable for the fluid-transfer article include: Polyetherimide (PEI); Polytetrafluoroethylene (PTFE); Polyether ether ketone (PEEK); Polyimide (PI); Polyethersulphone (PES); and Ultra-High Molecular Weight Polyethylene. Other suitable materials may comprise, for example, BioVyon™ (by Porvair Filtration Group Ltd) and materials available from Porex®. Further optionally, a substrate forming the fluid-transfer article may comprise Polypropylene (PP) or Polyethylene Terephthalate (PET). All such materials may be described as heat resistant polymeric wicking material in the context of the present invention.

The aerosol carrier 14 is removable from the apparatus 12 so that it may be disposed of when expired. After removal of a used aerosol carrier 14, a replacement aerosol carrier 14 can be inserted into the apparatus 12 to replace the used aerosol carrier 14.

Figure 2 is a cross-sectional side view illustration of a part of apparatus 12 of the aerosol delivery system 10. The apparatus 12 comprises a receptacle 22 in which is located a portion of the aerosol carrier 14. In one or more optional arrangements, the receptacle 22 may enclose the aerosol carrier 14. The apparatus 12 also comprise a heater 24, which opposes an activation surface of the fluid-transfer article (not shown in Figure 2) of the aerosol carrier 14 when an aerosol carrier 14 is located within the receptacle 22.

Air flows into the apparatus 12 (in particular, into a closed end of the receptacle 22) via air-intake apertures 20. From the closed end of the receptacle 22, the air is drawn into the aerosol carrier 14 (under the action of the user inhaling or sucking on the second end 18) and expelled at the second end 18. As the air flows into the aerosol carrier 14, it passes across the activation surface of the fluid-transfer article. Heat from the heater 24, which opposes the activation surface of the fluid-transfer article, causes vaporisation of aerosol precursor material at the activation surface of the fluid-transfer article and an aerosol is created in the air flowing over the activation surface. Thus, through the application of heat in

the region of the activation surface of the fluid-transfer article, an aerosol is released, or liberated, from the fluid-transfer article, and is drawn from the material of the aerosol carrier unit by the air flowing across the activation surface and is transported in the air flow to via outlet conduits (not shown in Figure 2) in the housing of the aerosol carrier 14 to the second end 18. The direction of air flow is illustrated by arrows in Figure 2.

To achieve release of the captive aerosol from the fluid-transfer article, the fluid-transfer article of the aerosol carrier 14 is heated by the heater 24. As a user sucks or inhales on second end 18 of the aerosol carrier 14, the aerosol released from the fluid-transfer article and entrained in the air flowing across the activation surface of the fluid-transfer article is drawn through the outlet conduits (not shown) in the housing of the aerosol carrier 14 towards the second end 18 and onwards into the user's mouth.

Turning now to Figure 3, a cross-sectional side view of the aerosol delivery system 10 is schematically illustrated showing the features described above in relation to Figures 1 and 2 in more detail. As can be seen, apparatus 12 comprises a housing 26, in which are located the receptacle 22 and heater 24. The housing 26 also contains control circuitry (not shown) operative by a user, or upon detection of air and/or vapour being drawn into the device 12 through air-intake apertures 20, i.e. when the user sucks or inhales. Additionally, the housing 26 comprises an electrical energy supply 28, for example a battery. Optionally, the battery comprises a rechargeable lithium ion battery. The housing 26 also comprises a coupling 30 for electrically (and optionally mechanically) coupling the electrical energy supply 28 to control circuitry (not shown) for powering and controlling operation of the heater 24.

Responsive to activation of the control circuitry of apparatus 12, the heater 24 heats the fluid-transfer article (not shown in Figure 3) of aerosol carrier 14. This heating process initiates (and, through continued operation, maintains) release of vapour and/or an aerosol from the activation surface of the fluid-transfer article. The vapour and/or aerosol formed as a result of the heating process is entrained into a stream of air being drawn across the activation surface of the fluid-transfer article (as the user sucks or inhales). The stream of air with the entrained vapour and/or aerosol passes through the aerosol carrier 14 via outlet conduits (not shown) and exits the aerosol carrier 14 at second end 18 for delivery to the user. This process is briefly described above in relation to Figure 2, where arrows schematically denote the flow of the air stream into the device 12 and through the aerosol carrier 14, and the flow of the air stream with the entrained vapour and/or aerosol through the aerosol carrier cartridge 14.

Figures 4 to 6 schematically illustrate the aerosol carrier 14 in more detail (and, in Figures 5 and 6, features within the receptacle in more detail).

Fig. 4 illustrates the exterior of the aerosol carrier 14, which comprises housing 32 for housing said fluid-transfer article (not shown) and at least one other internal component. The particular housing 32 illustrated in Figure 4 comprises a tubular member, which may be generally cylindrical in form, and which is configured to be received within the receptacle of the apparatus. First end 16 of the aerosol carrier 14 is for location to oppose the heater of the apparatus, and second end 18 (and the region adjacent the second end 18) is configured for insertion into a user's mouth.

Figures 5 to 7 illustrate some internal components of the aerosol carrier 14 and of the heater 24 of apparatus 12.

As described above, the aerosol carrier 14 comprises a fluid-transfer article 34. Optionally, there may be a conduction element 36 (as shown in Figure 5) facing the fluid-transfer article, the conduction element 36 being part of the heater 24. In one or more arrangements, the aerosol carrier 14 is located within the receptacle of the apparatus such that the activation surface of the fluid-transfer article opposes the heater of the apparatus and receives heat directly from the heater of the apparatus. When aerosol carrier 14 is located within the receptacle of the apparatus such that the activation surface of the fluid-transfer article is located to oppose the heater of the apparatus, the conduction element 36 is disposed between the rest of the heater 24 and the activation surface of the fluid-transfer article 34. Heat may be transferred to the activation surface via conduction through conduction element 36 (i.e. application of heat to the activation surface is indirect).

Further components not shown in Figures 5 to 7 comprise: an inlet conduit, via which air can be drawn into the aerosol carrier 14; an outlet conduit, via which an air stream entrained with aerosol can be drawn from the aerosol carrier 14; a filter element; and a reservoir for storing aerosol precursor material and for providing the aerosol precursor material to the fluid-transfer article 34.

In Figures 5 to 7, the aerosol carrier is shown as comprising the fluid-transfer article 34 located within housing 32. The fluid transfer article 34 comprises a first region 34a holding an aerosol precursor. In one or more arrangements, the first region of 34a of the fluid transfer article 34 comprises a reservoir for holding the aerosol precursor. The first region 34a can be the sole reservoir of the aerosol carrier 14, or it can be arranged in fluid communication with a separate reservoir, where aerosol precursor is stored for supply to the first region 34a. As shown in Figures 5 and 6, the material forming the first region of 34a comprises a porous structure, whose pore diameter size may vary between one end of the first region 34a and another end of the first region 34a. In the illustrated examples of Figures 5 and 6, the pore diameter size decreases from a first end remote from heater 24 (the upper end is as shown in the figure) to a second end. Although the figure illustrates the pore diameter size changing in a step-wise manner (i.e. a first part with pores having a diameter of first size, and a second part with pores having a diameter

of second, smaller size), the change in pore size in the first region 34a may be gradual rather than step-wise. This configuration of pores having a decreasing diameter size can provide a wicking effect, which can serve to draw fluid through the first region 34a, towards heater 24.

5 The fluid transfer article 34 also comprises a second region having a first part 34b and another part in the form of a plate 34c. Aerosol precursor is drawn from the first region of 34a to the first part 34b of the second region by the wicking effect of the material forming the first region of 34a. Thus, the first region 34a is configured to transfer the aerosol precursor to the second region 34b of the article 34.

10 The first part 34b of the second region may itself comprise a porous structure. It is then preferable that the pore diameter size of the porous structure of the first part 34b of the second region is smaller than the pore diameter size of the immediately adjacent part of the first region 34a.

The first region 34a of the fluid-transfer article need not be of porous polymer material as described
15 above. It may instead be a simple hollow reservoir filled with liquid aerosol precursor. The liquid aerosol precursor will then pass directly from the first region 34a to the second region 34b. Similarly, the first part 34b of the second region, need not be of porous polymer material. Instead, it may be of any material with a "wicking" action which will transfer aerosol precursor from the first region 34a to the activation
20 surface 35, for example a fibrous wick. It may even be possible for both the first region 34a and the first part 34b of the second region to form a hollow reservoir, with that reservoir being partly bounded by the plate 34c.

As mentioned above, the second region of the fluid-transfer article has a plate 34c with a hole 37 (or possibly a plurality of holes) therethrough. Aerosol precursor can pass through the hole 37 from the first
25 part 34b of the second region, provided the hole 37 is not blocked. The plate 34c may be formed from metal, or from a plastic material.

Figure 5 then illustrates the configuration of the device with the heater 24 at a first temperature, such as room temperature. As shown in Figure 5, the heater 24 occupies a position such that a part of the
30 conduction element 36 of the heater 24 is in contact with the plate 34c so as to block the hole 37. There is also a gap 35 between the heater 24 and the coupling 30. The housing 32 has an opening 38 therein, which may receive air from the apertures 20, and another opening 39 leading to a duct 40 within the housing 32, which duct 40 leads to the second downstream end 18 of the aerosol carrier 14. Thus, in the position shown in Figure 5, air can pass from the apertures 20 through the opening 38 into gap 35
35 between the heater 24 and the coupling 30, and from the gap 35 through the opening 38 into the duct 40 and hence to the second end 18. In the configuration illustrated in Figure 5, the aforementioned air flow

is obstructed by the heater 24 from reaching the plate 34c, particularly that part of the plate 34c in which the hole 37 is formed.

In the position shown in Figure 5, the parts of the periphery of the heater 24 visible in the Figure are not attached to the housing 32, and are free to move. On the other hand, the parts of the periphery of the heater 24 perpendicular to the view of Figure 5 are attached to the housing 32, or to a mechanical barrier or seating adjacent the housing 32, to hold those parts of the periphery of the heater 24 in place.

When the heater 24 is activated, it will heat up. The materials of the heater 24, including the conduction element 36, are chosen so that they expand under such heating, and so the heater 24, including the conduction element 36, will deform, as part of its periphery is held in position and part is free to move. In particular, the heater 24 will deform from the position shown in Figure 5 to the position shown in Figure 6, with the view of Figure 6 being perpendicular to the view of Figure 5. The effect of this deformation is to create a space 42 between the conduction element 36 and the plate 34c, which space 42 is in communication with the openings 38 and 39. Thus, space 42 now forms part of an air-flow pathway between the openings 38 and 39, which air-flow pathway passes between the hole 37 and the conduction element 36.

Figure 6 illustrates how, because parts of the periphery of the heater 24 are held in place due to their attachment to the housing 32 or by a mechanical barrier or seating, the heater 24 adopts a domed shape perpendicular to the view in Figure 5. Figure 7 shows a view perpendicular to Figure 6, and hence corresponding to Figure 5 but with the heater 24 at an elevated temperature, to illustrate that the space 42 communicates with the openings 38 and 39. Thus, the movement of the heater between the position shown in Figure 5, and the position shown in Figures 6 and 7, has the effect of unblocking, or removing the obstruction from, the air-flow pathway from the opening 38 to the opening 39 which passes between the plate 34c and the conduction element 36 of the heater 24. In the obstructed position of Figure 5, the heater 24 blocks or occludes the hole 37 and prevents aerosol precursor reaching any air flowing between the openings 38 and 39, whereas in the position shown in Figures 6 and 7, the hole 37 opened and is exposed to air flowing between the openings 38 and 39.

When the device is not being used, and the heater 24 is in the position shown in Figure 5, aerosol precursor will pass through the hole 37, and will be deposited on the conduction element 36 of the heater 24. When the device is in use, and the heater heats up, such aerosol precursor on the conduction element 36, will be heated by the heat generated by the heater 24, and vaporised in the space 42. That vapour, or a mixture of aerosol and vapour, will then mix with air flowing between the openings 38 and 39 through the space 42 as the user draws on the mouthpiece at end 18, and air and the vapour or mixture

of vapour and aerosol will pass through the opening 39, and through the duct 40, to the end 18, and hence to the user.

Thus, droplets of aerosol precursor will be transferred from the second part 34b of the second region through the hole 37 to the conduction element 36, and move away from the plate 34c as the heater 24 changes from the position shown in Figure 5 to the position shown in Figures 6 and 7. Those droplets of aerosol precursor will then be wholly or partially vaporised by the elevated temperature of the conduction element 36, with any additional aerosol precursor passing through the hole 37 into the space 42 also being vaporised. In practice, aerosol precursor may “pool” in the space 42, until it is vaporised, although the amount of aerosol precursor which is on the conduction element 36 or in the space 42 is preferably determined so that substantially all of it will be vaporised when the heater 24 is active.

The configurations of the second part 34b of the second region, the plate 34c and the hole 37 may be chosen so as to deposit a specific amount of liquid on the conduction element 36 each time the conduction element 36 moves from the position shown in Figure 5 to the positions shown in Figures 6 and 7, to ensure consistent amounts of vapour and/or a mixture of vapour and aerosol getting in to the airflow. There may be a single hole 37, or a plurality of holes, through the plate 34c. In the latter case, the movement of the heater 24 (particularly the conduction element 36) needs to be sufficient to block all, or at least most of, the holes when the heater 24 is not active.

Once the user desists to inhale or suck, the air flow will stop. The heater may be allowed to cool in this state, to return to the position shown in Figure 5 from the position shown in Figure 6 so that there is a cyclic operation with the air-flow pathway between the plate 34c and the conduction element 36 being closed or opened (obstructed or un-obstructed) through a cycle of inhalations by the user. Alternatively, the heater 24 may remain heated between inhalations by the user, with the space 41 being filled with vaporised aerosol precursor between inhalations.

The materials of the heater 24, including the conduction element 36, are preferably chosen such that their thermal expansion is consistent, allowing there to be a known relationship between the temperature of the heater 24 and the distance over which the central part of the heater 24 moves away from the plate 34c. In this way, the distance between the plate 34c and the conduction element 36, and hence the size of the air-flow pathway between the plate 34c and the conduction element 36, can be chosen to achieve a satisfactory volumetric flow rate when the user inhales. Attachment of parts of the periphery of the heater 24 to the housing 32, and the non-attachment of other parts of the periphery, allows the heater to “dome” as illustrated in Figure 6, to open or un-obstruct the air-flow pathway between the plate 34c and the conduction element 36.

As noted above, the conduction element 36 may be absent in some arrangements, in which case the plate 34c and the second part 34b will receive heat directly from the heater 24.

- 5 Also, in the arrangements of Figures 5 to 7, the whole of the heater 24 deforms as the temperature changes. It may be possible to have an arrangement in which only part of the heater, such as the conduction element 36, deforms as the temperature changes. In general, it is the heating surface of the heater which must deform to allow air to reach the space 42 between the plate 34c and the heater 24.
- 10 The conduction element 36, if present, may comprise a thin film of thermally conductive material, such as, for example, a metal foil (for example, aluminium, brass, copper, gold, steel, silver, or an alloy comprising anyone of the foregoing together with thermally conductive plastics and/or ceramics).

15 In the illustrative examples of Figures 5 and 6, the first region 34a of the fluid-transfer article 34 is located at an "upstream" end of the fluid-transfer article 34, the first part 34b of the second region is located towards a downstream" end of the fluid-transfer article 34 relative to the first region 34a, and the plate 34c is at the "downstream" end. That is, aerosol precursor is wicked, or is drawn, from the "upstream" end of the fluid-transfer article 34 to the "downstream" end of the fluid-transfer article 34 (as denoted by arrow A in Figure 5).

20 In the arrangements shown in Figures 5 to 7, the air flow apertures 38, 39 are on opposite sides of the housing 32. Figures 8 and 9 show an alternative configuration, in which the fluid-transfer article is annular. In Figures 8 and 9, the conduction element 36 is illustrated in a position corresponding to that shown in Figures 6 and 7, where it is spaced from the plate 34c. This enables the air flow in the apparatus to be illustrated. However, as in the arrangement of Figures 5 to 7, when the heater is cool, the conduction element 36 is deformed and is in contact with the plate 34c. The deformation of the heater 24 may have to be slightly greater than in the arrangement shown in Figure 5, to ensure that the conduction element 36 makes sufficient contact with the plate 34c, which itself is annular due to the annular configuration. The operation of the embodiment of Figures 8 and 9 is otherwise similar to that of the embodiments of Figures 5 to 7. The hole 37 in the plate 34c may be a single annular opening, or a plurality of holes may be formed in an annular arrangement around the plate 34c.

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Thus, Figures 8 and 9 illustrate an aerosol carrier 14 according to one or more possible arrangements in more detail. Figure 8 is a cross-section side view illustration of the aerosol carrier 14 and Figure 9 is a perspective cross-section side view illustration of the aerosol carrier 14.

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As can be seen from Figures 8 and 9, the aerosol carrier 14 is generally tubular in form. The aerosol carrier 14 comprises housing 32, which defines the external walls of the aerosol carrier 14 and which defines therein a chamber in which are disposed the fluid-transfer article 34 (adjacent the first end 16 of the aerosol carrier 14) and internal walls defining the fluid communication pathway 48. Fluid communication pathway 48 defines a fluid pathway for an outgoing air stream from the channels 40 to the second end 18 of the aerosol carrier 14. In the examples illustrated in Figures 8 and 9, the fluid-transfer article 34 is an annular shaped element located around the fluid communication pathway 48.

In walls of the housing 32, there are provided inlet apertures 50 to provide a fluid communication pathway for an incoming air stream to reach the fluid-transfer article 34, and particularly the one or more channels 40 defined between the activation surface of the fluid-transfer article 34 and the conduction element 36 (or between the activation surface and the heater).

In the illustrated example of Figures 8 and 9, the aerosol carrier 14 further comprises a filter element 52. The filter element 52 is located across the fluid communication pathway 48 such that an outgoing air stream passing through the fluid communication pathway 48 passes through the filter element 52.

With reference to Figure 8, when the heater is activated and a user sucks on a mouthpiece of the apparatus (or on the second end 18 of the aerosol carrier 14, if configured as a mouthpiece), air is drawn into the carrier through inlet apertures 50 extending through walls in the housing 32 of the aerosol carrier 14. On activation of the heater, the heater 24 (and particularly the conduction element 36) will deform to move the conduction element 36 clear of the plate 34c, thereby to unblock the hole or holes 37. There is then, as in other embodiments, an air-flow pathway between the plate 34c and the conduction element 36. An incoming air stream 42a from a first side of the aerosol carrier 14 is directed to a first side of the plate 34c of the fluid-transfer article 34 (e.g. via a gas communication pathway within the housing of the carrier). When the incoming air stream 42b from a second side of the aerosol carrier 14 is directed to a second side of the second part 34b of the fluid-transfer article 34 (e.g. via a gas communication pathway within the housing of the carrier). When the incoming air stream 42a from the first side of the aerosol carrier 14 reaches the first side of the plate 34c, the incoming air stream 42a from the first side of the aerosol carrier 14 flows between the plate 34c and the conduction element 36 (or between the plate 34c and heater 24). Likewise, when the incoming air stream 42b from the second side of the aerosol carrier 14 reaches the second side of the plate 34c, the incoming air stream 42b from the second side of the aerosol carrier 14 flows between the second part 34a and the conduction element 36 (or between the plate 34c and heater 24). The air streams from each side flowing are denoted by dashed lines 44a and 44b in Figure 9. As these air streams 44a and 44b flow, aerosol precursor on the conduction element 36 (or on the heater 24) is entrained in air streams 44a and 44b.

In use, the heater 24 of the apparatus 12 should raise a temperature of the conduction element 36 to a sufficient temperature to release, or liberate, captive substances (i.e. the aerosol precursor) to form a vapour and/or aerosol, which is drawn downstream. As the air streams 44a and 44b continue their passages, more released aerosol precursor is entrained within the air streams 44a and 44b. When the air streams 44a and 44b entrained with aerosol precursor meet at a mouth of the outlet fluid communication pathway 48, they enter the outlet fluid communication pathway 48 and continue until they pass through filter element 52 and exit outlet fluid communication pathway 48, either as a single outgoing air stream, or as separate outgoing air streams 46 (as shown). The outgoing air streams 46 are directed to an outlet, from where it can be inhaled by the user directly (if the second end 18 of the aerosol capsule 14 is configured as a mouthpiece), or via a mouthpiece. The outgoing air streams 46 entrained with aerosol precursor are directed to the outlet (e.g. via a gas communication pathway within the housing of the carrier).

Figure 10 is an exploded perspective view illustration of a kit-of-parts for assembling an aerosol delivery system 10.

In any of the embodiments described above the plate 34c may have a thickness of less than 5mm. In other embodiments it may have a thickness of: less than 3.5mm, less than 3mm, less than 2.5mm, less than 2mm, less than 1.9mm, less than 1.8mm, less than 1.7mm, less than 1.6mm, less than 1.5mm, less than 1.4mm, less than 1.3mm, less than 1.2mm, less than 1.1mm, less than 1mm, less than 0.9mm, less than 0.8mm, less than 0.7mm, less than 0.6mm, less than 0.5mm, less than 0.4mm, less than 0.3mm, less than 0.2mm, or less than 0.1mm.

As will be appreciated, in the arrangements described above, the fluid-transfer article 34 is provided within a housing 32 of the aerosol carrier 14. In such arrangements, the housing of the carrier 14 serves to protect the aerosol precursor-containing fluid-transfer article 34, whilst also allowing the carrier 14 to be handled by a user without his/her fingers coming into contact with the aerosol precursor liquid retained therein. In such arrangements, it will be appreciated that the carrier 14 has a multi-part construction.

The features disclosed in the foregoing description, or in the following claims, or in the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for obtaining the disclosed results, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

While the invention has been described in conjunction with the exemplary embodiments described above, many equivalent modifications and variations will be apparent to those skilled in the art when given this disclosure. Accordingly, the exemplary embodiments of the invention set forth above are considered to be illustrative and not limiting. Various changes to the described embodiments may be made without
5 departing from the spirit and scope of the invention.

For the avoidance of any doubt, any theoretical explanations provided herein are provided for the purposes of improving the understanding of a reader. The inventors do not wish to be bound by any of these theoretical explanations.

Any section headings used herein are for organizational purposes only and are not to be construed as limiting the subject matter described.

Throughout this specification, including the claims which follow, unless the context requires otherwise, the words "have", "comprise", and "include", and variations such as "having", "comprises", "comprising", and
15 "including" will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

It must be noted that, as used in the specification and the appended claims, the singular forms "a," "an,"
20 and "the" include plural referents unless the context clearly dictates otherwise. Ranges may be expressed herein as from "about" one particular value, and/or to "about" another particular value. When such a range is expressed, another embodiment includes from the one particular value and/or to the other particular value. Similarly, when values are expressed as approximations, by the use of the antecedent "about," it will be understood that the particular value forms another embodiment. The term "about" in relation to a
25 numerical value is optional and means, for example, +/- 10%.

The words "preferred" and "preferably" are used herein refer to embodiments of the invention that may provide certain benefits under some circumstances. It is to be appreciated, however, that other embodiments may also be preferred under the same or different circumstances. The recitation of one or more preferred embodiments therefore does not mean or imply that other embodiments are not useful,
30 and is not intended to exclude other embodiments from the scope of the disclosure, or from the scope of the claims.

Claims:

1. An aerosol-generation apparatus comprising a heater and a fluid-transfer article, the fluid-transfer article comprising a first region for holding an aerosol precursor and for transferring said aerosol precursor to a second region of said article, said second region having at least one hole therein for passage of said aerosol precursor therethrough, wherein at least a part of a heating surface of said heater is deformable in response to a temperature change between a first temperature and a second temperature, said at least a part of said heating surface being in a first position at the first temperature and a second position at the second temperature, and wherein: in the first position said at least a part of the heating surface is in contact with said second region so as to obstruct said at least one hole, and in the second position said at least part of the heating surface is spaced from said second region.
2. An aerosol-generation apparatus according to claim 1, wherein an air-flow pathway is defined between an inlet and an outlet of said aerosol-generation apparatus, and wherein: when said at least a part of said at least a part of said heating surface is in contact with said second region, a part of said air-flow pathway between said heating surface and said second region is obstructed by said heater, and when said at least a part of said heating surface is spaced from said second region, said air-flow pathway is between said at least a part of said heating surface and plate is not obstructed by said heater.
3. An aerosol-generation apparatus according to claim 1 or claim 2, wherein said second region includes a plate having said hole therein, and wherein: in said first position said at least a part of said heating surface is in contact with said plate so as to obstruct said at least one hole, and in said second position said at least a part of said heating surface is spaced from said plate.
4. An aerosol-generation apparatus according to claim 3, wherein said second region further includes a part of polymeric wicking material between said first region and said plate.
5. An aerosol-generation apparatus according to any one of the preceding claims, wherein said first region is formed from a polymeric wicking material.
6. An aerosol-generation apparatus according to claim 4 or claim 5, wherein said polymeric wicking material is porous.
7. An aerosol-generation apparatus according to any one of the preceding claims, wherein said second temperature is higher than said first temperature.

8. An aerosol delivery system comprising an aerosol-generation apparatus according to any one of the preceding claims and a carrier, the carrier comprising a housing containing said heater and said fluid-transfer article.

- 5 9. An aerosol delivery system according to claim 7, wherein said housing has an inlet in communication with said inlet of said aerosol-generation apparatus and an outlet in communication with said outlet of said aerosol-generation apparatus, and an outlet in communication with said outlet of said aerosol-generation apparatus, and said air-flow pathway extends between said inlet and said outlet of said housing.

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10. An aerosol delivery system according to claim 8, wherein said air-flow pathway extends between said plate and said at least a part of said heating surface, and is blocked when said at least a part of said heating surface is in the first position.

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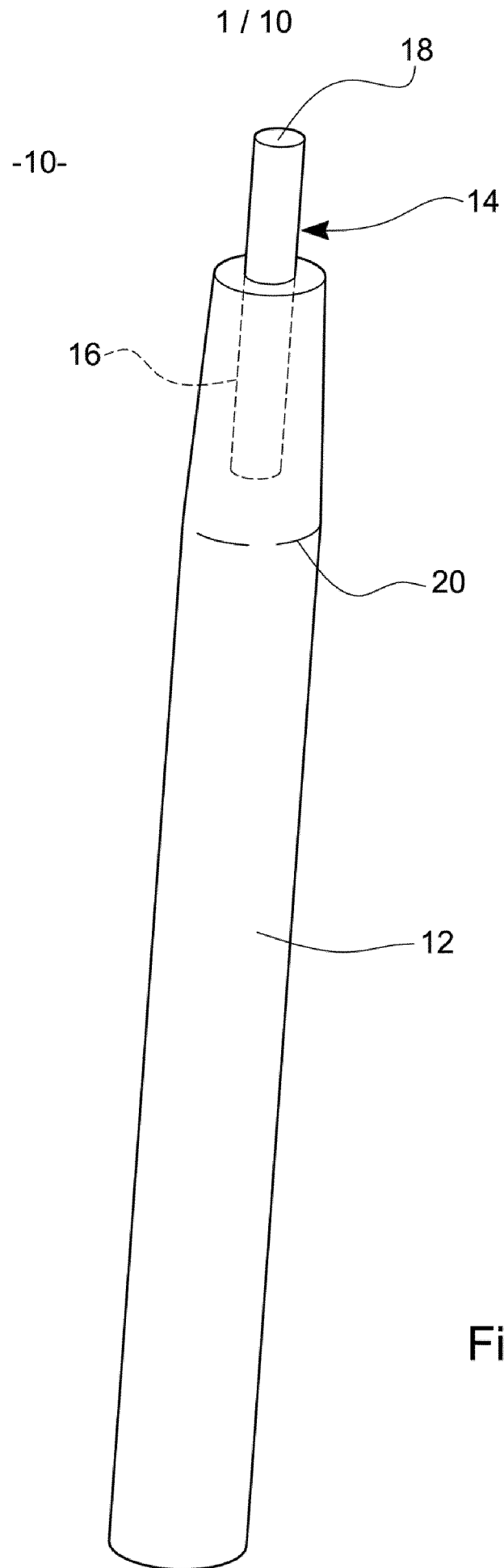


Fig. 1

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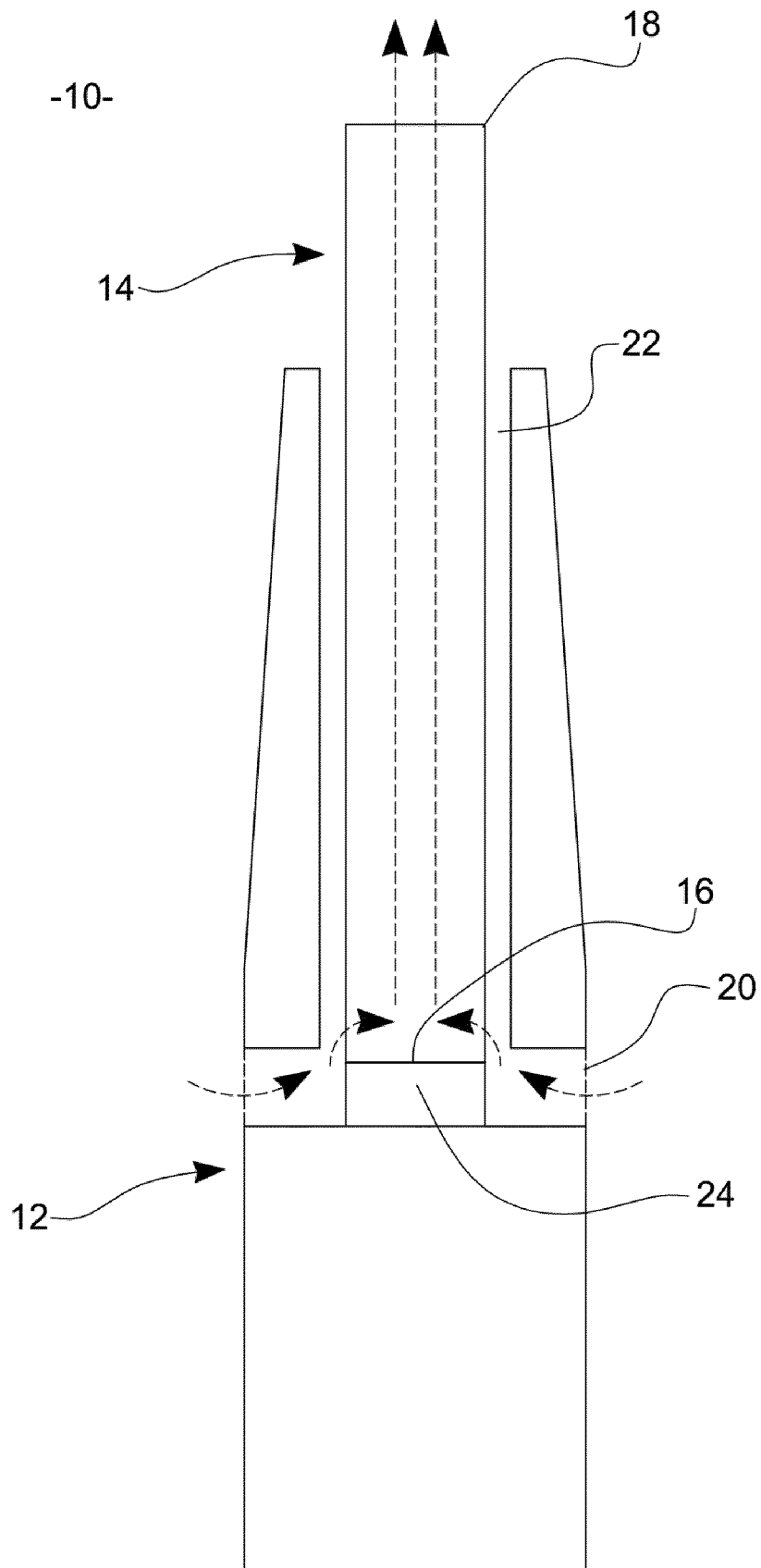


Fig. 2

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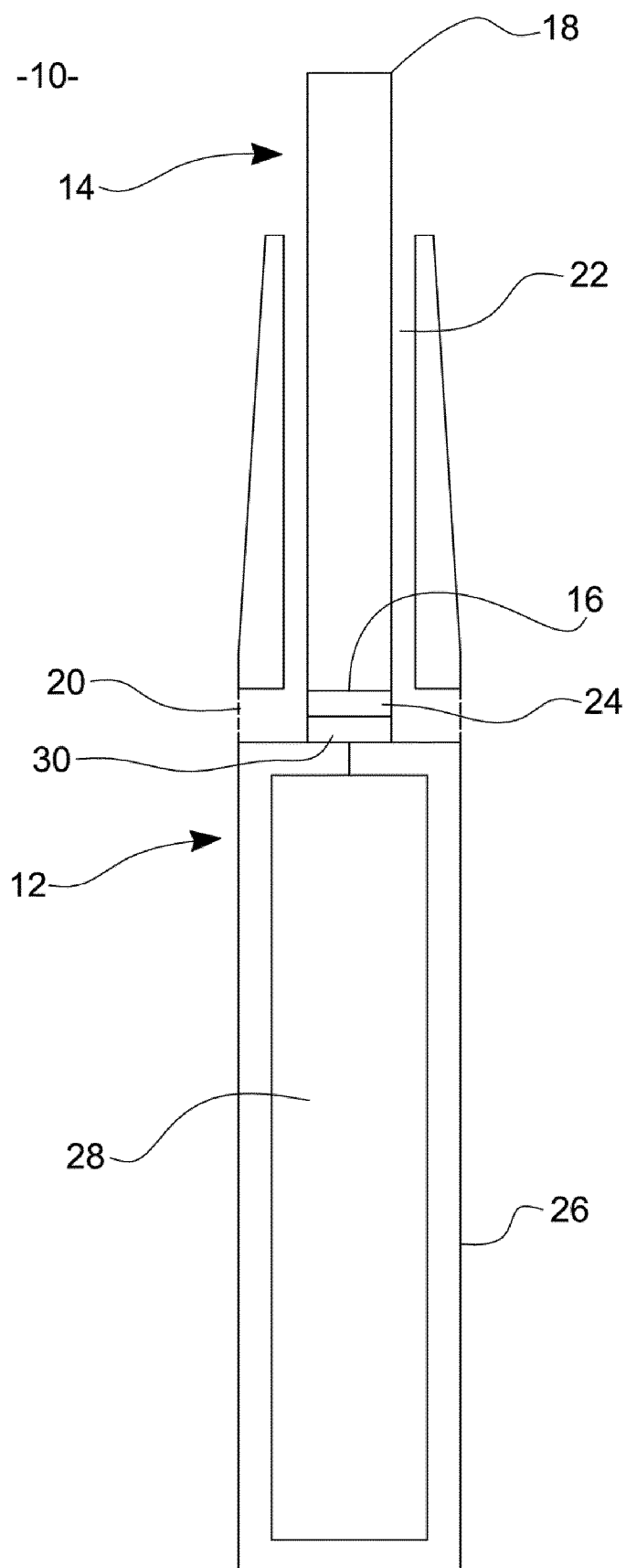


Fig. 3

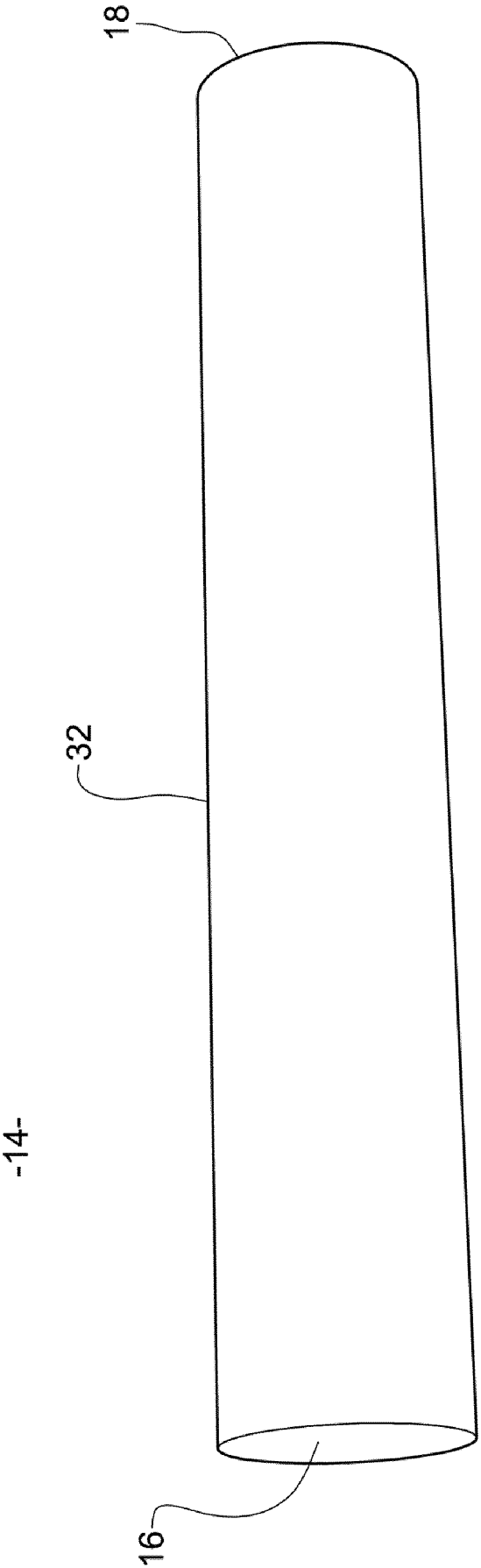


Fig. 4

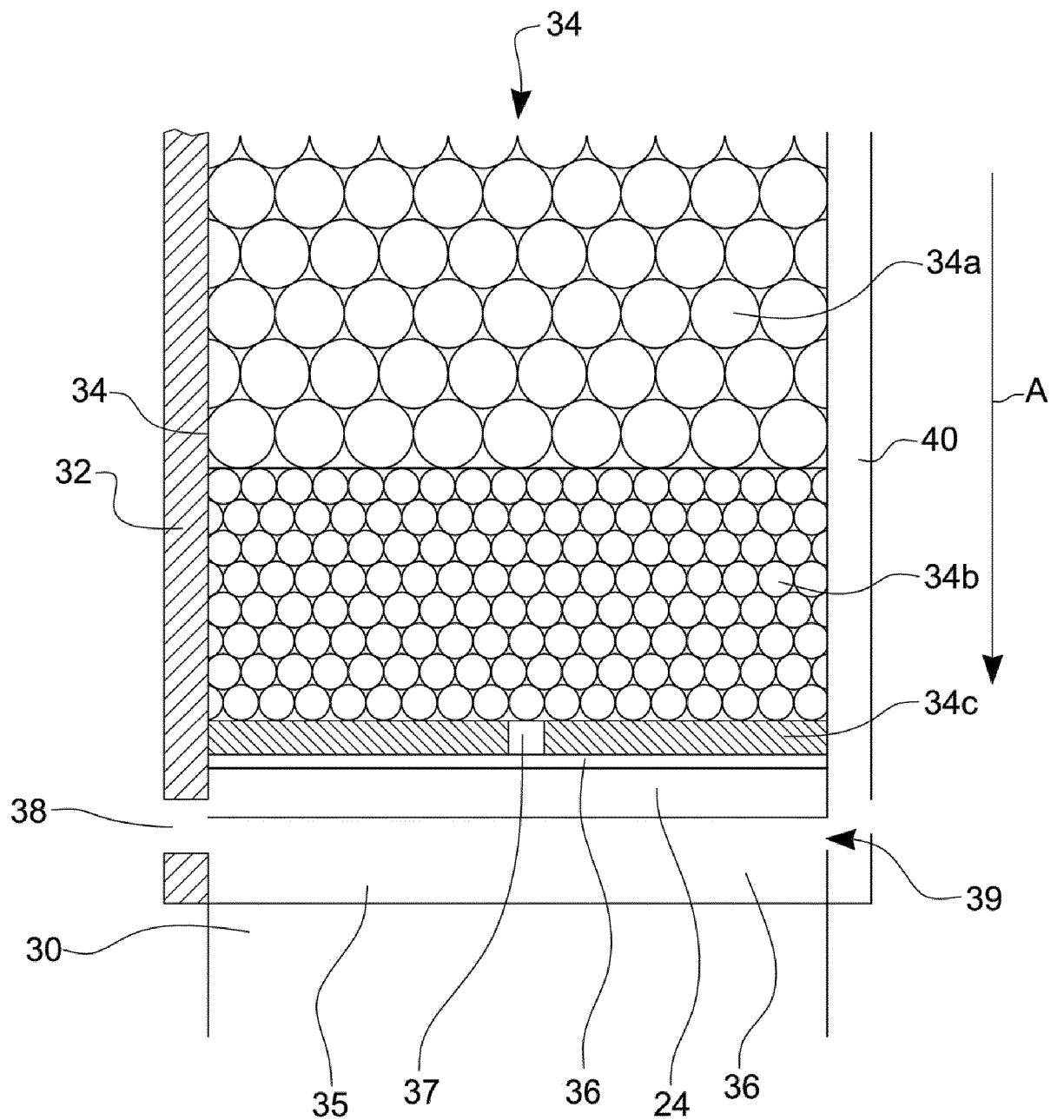


Fig. 5

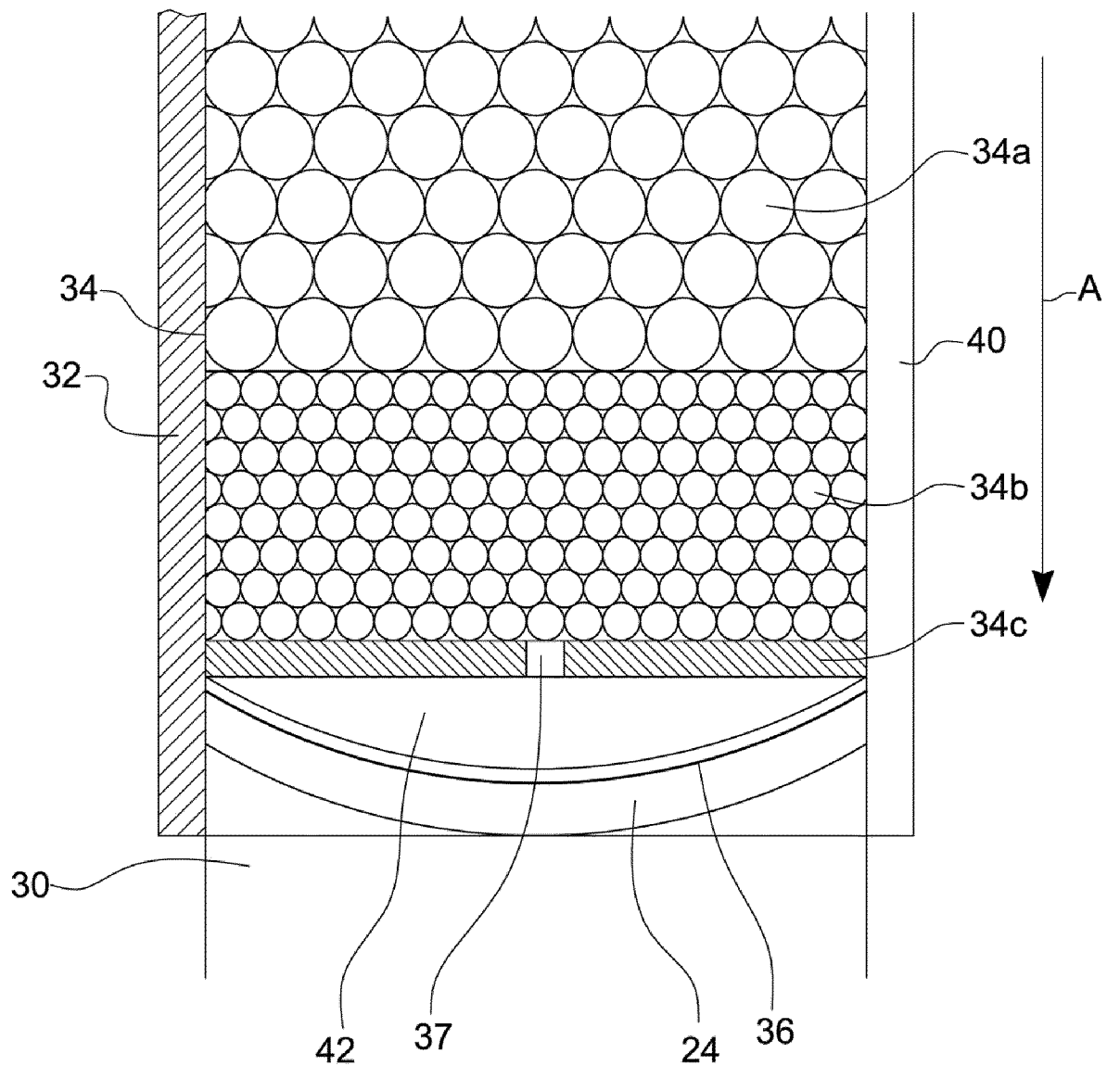


Fig. 6

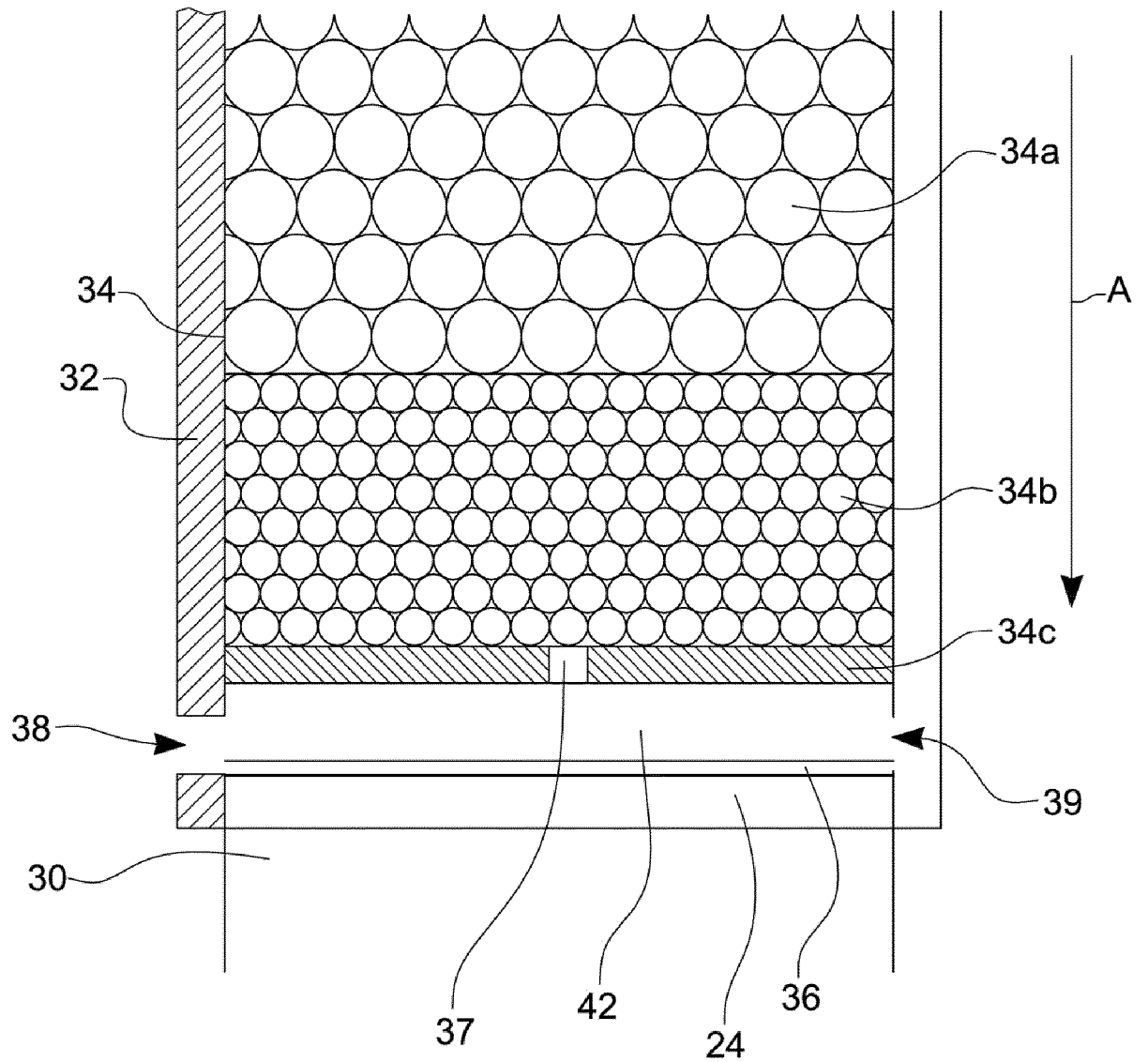


Fig. 7

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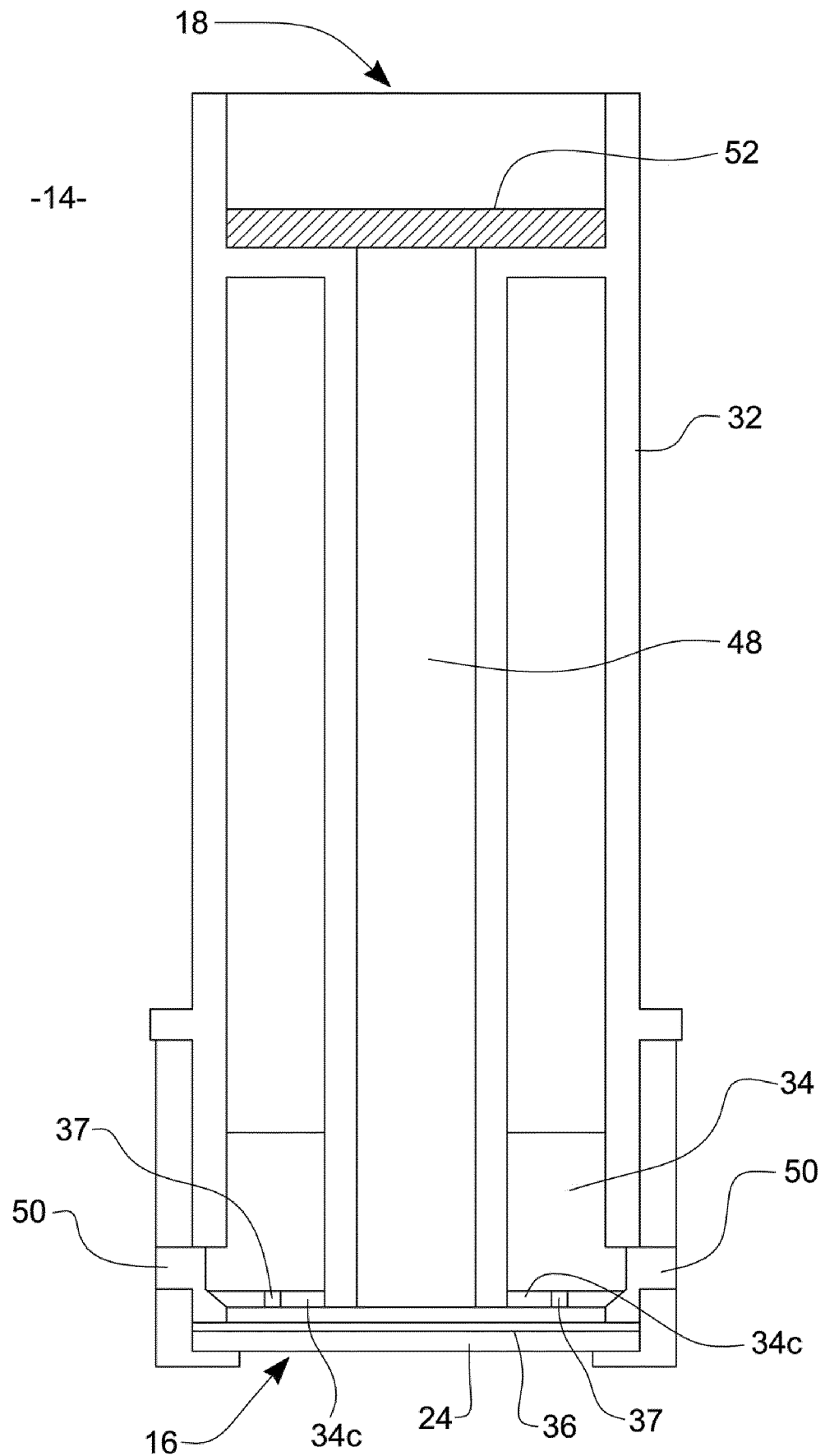


Fig. 8

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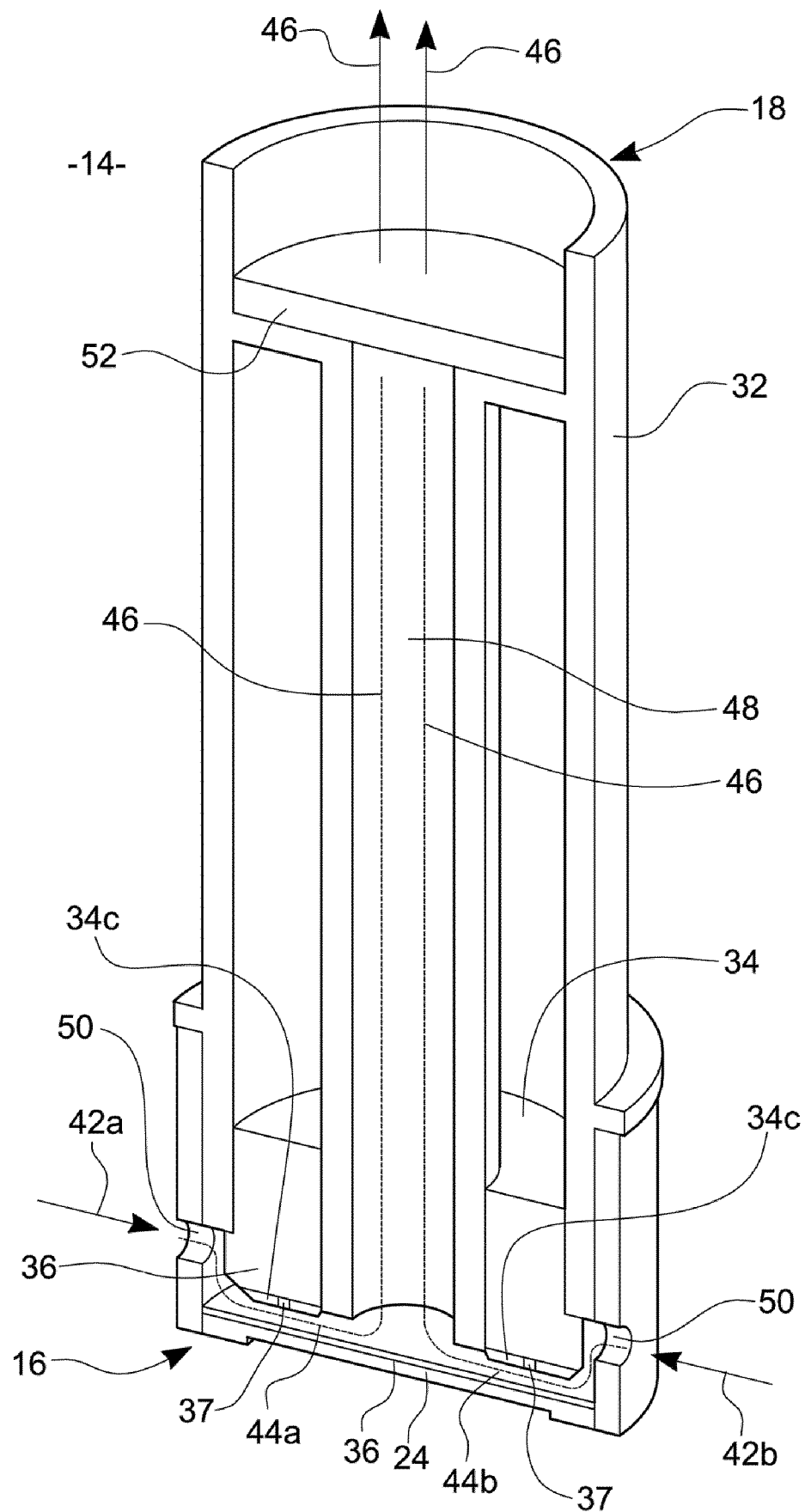


Fig. 9

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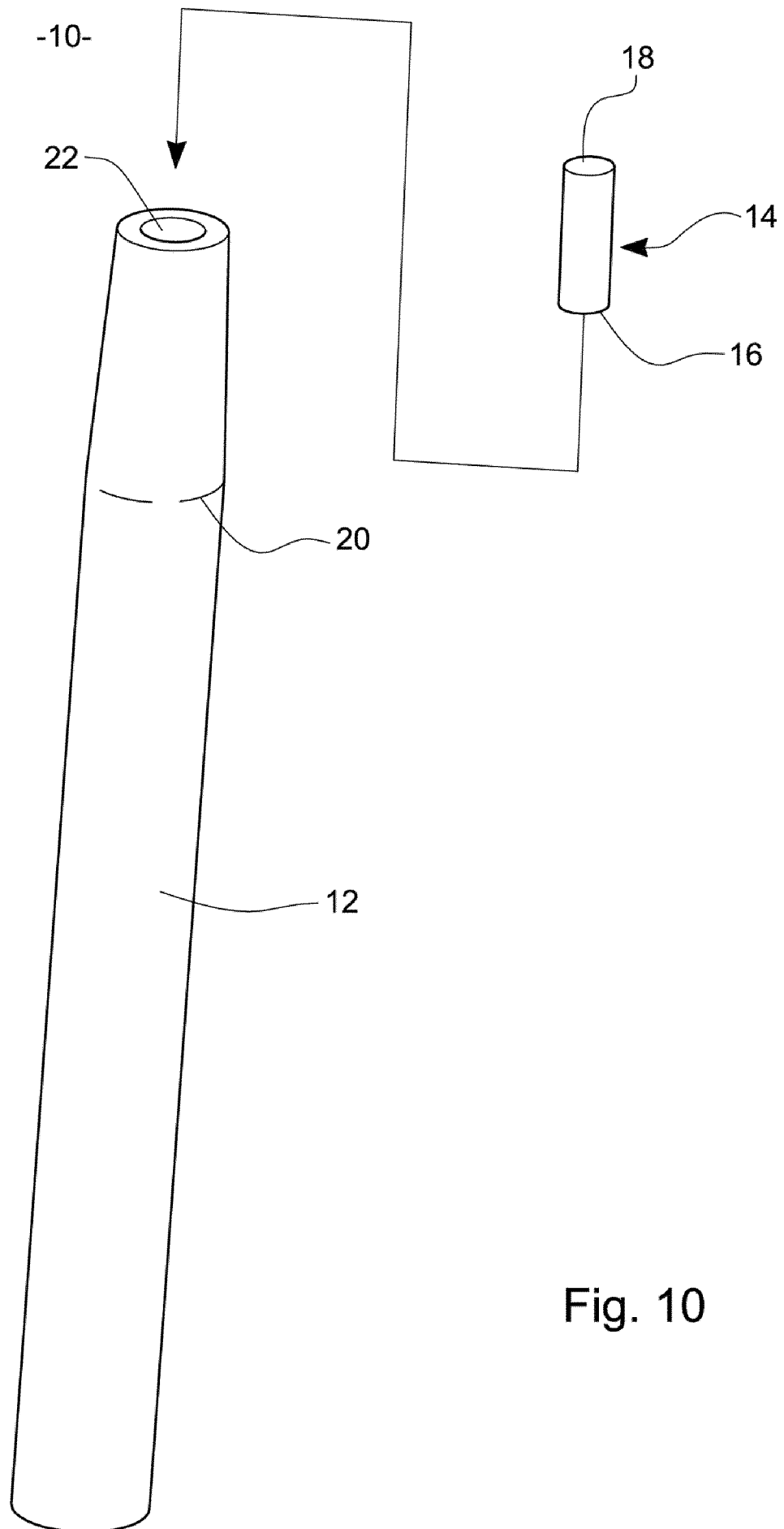


Fig. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/057351

A. CLASSIFICATION OF SUBJECT MATTER

INV. A24F47/00 A61M11/00 A61M11/04 A61M15/06
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A24F A61M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, BIOSIS, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2016/193365 A1 (FONTEM HOLDINGS 1 BV [NL]) 8 December 2016 (2016-12-08) abstract; figures 6-10 page 9, paragraph 2 page 10, last paragraph page 11, column 12 -----	1-10
X	US 2014/190496 A1 (WENSLEY MARTIN [US] ET AL) 10 July 2014 (2014-07-10) abstract; claims 1-86; figure 9 paragraph [0155] -----	1-3,7-10
A	GB 2 561 953 A (NERUDIA LTD [GB]) 31 October 2018 (2018-10-31) abstract; figures 5, 6 page 25 - page 26 -----	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of the international search

24 April 2020

Date of mailing of the international search report

06/05/2020

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Authorized officer

Weijland, Albert

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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