



(51) International Patent Classification:

A24F 47/00 (2020.01) A61M 11/04 (2006.01)

A61M 11/00 (2006.01) A61M 15/06 (2006.01)

(21) International Application Number:

PCT/EP2020/057345

(22) International Filing Date:

17 March 2020 (17.03.2020)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

19164404.6 21 March 2019 (21.03.2019) EP

(71) Applicant: **NERUDIA LIMITED** [GB/GB]; Wellington House, Physics Road, Speke, Liverpool, Merseyside L24 9HP (GB).

(72) Inventors: **LORD, Chris**; c/o NERUDIA LIMITED, Wellington House, Physics Road, Speke, Liverpool, Merseyside L24 9HP (GB). **SUDLOW, Thomas**; c/o NERUDIA LIMITED, Wellington House, Physics Road, Speke, Liverpool, Merseyside L24 9HP (GB). **ILLIDGE, Ben**; c/o NERUDIA LIMITED, Wellington House, Physics Road, Speke, Liverpool, Merseyside L24 9HP (GB). **MADDEN, Alfred**; c/o NERUDIA LIMITED, Wellington House, Physics Road, Speke, Liverpool, Merseyside L24 9HP (GB). **ASTBURY, Ben**; c/o NERUDIA LIMITED, Wellington House, Physics Road, Speke, Liverpool, Merseyside L24 9HP (GB).

(74) Agent: **MEWBURN ELLIS LLP**; City Tower, 40 Basinghall Street, London, Greater London EC2V 5DE (GB).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,

(54) Title: AEROSOL DELIVERY SYSTEM

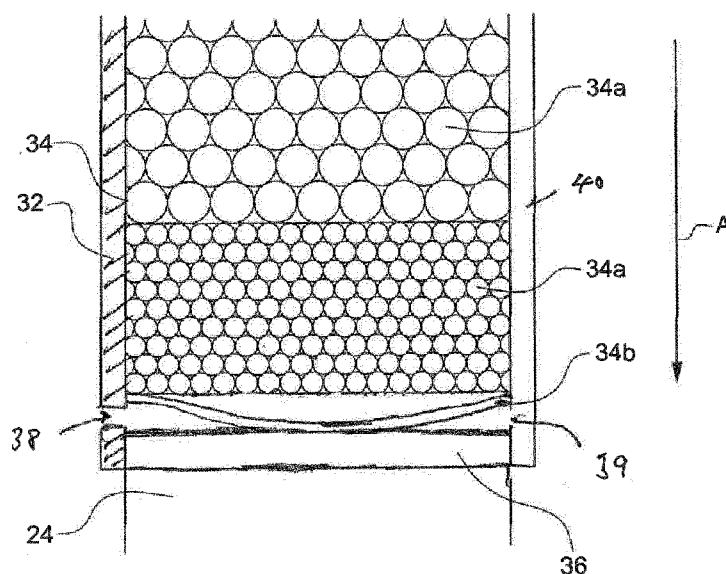


Fig. 5

(57) Abstract: An aerosol delivery system has a fluid transfer article with a first region for holding an aerosol precursor and a second region in the form of a flexible diaphragm to which the aerosol precursor is transferred from the first region. The second region includes an activation surface which interacts thermally with a heater of the aerosol delivery system to form an aerosol from said aerosol precursor. When the user sucks or inhales through the aerosol delivery system, the diaphragm flexes to open an air-flow pathway between the activation surface and the heater, so that aerosol passes from the heater to the user in the air-flow. When the user ceases to suck or inhale, the flexible diaphragm flexes to close the air-flow pathway and reduce escape of aerosol precursor from the second part of the fluid transfer article.



DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

AEROSOL DELIVERY SYSTEM

Field of the Invention

The present invention relates to an aerosol delivery system, an aerosol-generation apparatus and a fluid-transfer article for an aerosol delivery system. The present invention preferably relates to an aerosol
5 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 and a fluid-transfer article therefor.

Background

Pharmaceutical medicament, physiologically active substances and flavourings for example may be
10 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
15 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
20 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
25 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
30 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
35 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 is provided in which part of the region which holds the aerosol precursor is in the form of a flexible diaphragm. When the fluid-transfer article is in position adjacent a heater of an aerosol-generation apparatus, the flexible diaphragm is then able to move to alter the positional relationship between the diaphragm and the heater. For example, the diaphragm may move between a position in which it is in contact with the heater, and a position in which it is spaced from the heater. In the first of these positions, contact between the flexible diaphragm and the heater may prevent, or at least limit, the leakage of aerosol precursor from the diaphragm. In the second position, aerosol precursor may pass to the heater more freely.

Thus, the present invention may provide a fluid-transfer article comprising a first region for holding an aerosol precursor and for transferring said aerosol precursor to an activation surface of a second region of said article, said activation surface being disposed at an end of said article configured for thermal interaction with a heater of an aerosol-generation apparatus, wherein said second region is a flexible diaphragm.

Preferably, the flexible diaphragm is formed from a polymeric wicking material. That polymeric wicking material may comprise Polyetherimide (PEI) and/or Polyether ether ketone (PEEK) and/or Polytetrafluoroethylene (PTFE) and/or Polyimide (PI) and/or Polyethersulphone (PES) and/or Ultra-High Molecular Weight Polyethylene (UHMWPE) and/or Polypropylene (PP) and/or Polyethylene Terephthalate (PET). Preferably, the polymeric wicking material is porous.

According to a second aspect of the present invention, the present invention may provide an aerosol-generation apparatus comprising a heater and a fluid-transfer article comprising a first region for holding an aerosol precursor and for transferring said aerosol precursor to an activation surface of a second region of said article, said activation surface being disposed at an end of said article configured for

thermal interaction with a heater of an aerosol-generation apparatus, wherein said second region is a flexible diaphragm.

In such an apparatus, the flexible diaphragm may be arranged to be movable between the first position in which part of the flexible diaphragm is in contact with the heater and the second position in which said part of the flexible diaphragm is spaced from the heater. Preferably, in such an arrangement, the flexible diaphragm is biased towards the first position.

The aerosol-generation apparatus may form part of an aerosol delivery system which has a carrier and include 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. That air-flow pathway may pass between the flexible diaphragm and the heater, and be obstructed when the flexible diaphragm is in the first position.

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

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;

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;

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;

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, in an alternative configuration from that of Figure 5;

Figure 7. is a cross-section side view of aerosol carrier according to one or more embodiments of the present invention;

Figure 8. is a perspective cross-section side view of the aerosol carrier of Figure 7, and;

Figure 9. 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.

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 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".

Referring now to Figure 1, there is illustrated a perspective view of an aerosol delivery system 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 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, 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

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.

- 5 A fluid-transfer article (not shown in Figure 1, but described hereinafter with reference to Figs. 5 to 8 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
- 10 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.
- 15 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
- 20 (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.
- 25
- 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.
- 30 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 comprises a heater 24, which opposes an activation surface of the fluid-transfer article (not shown in Figure 2) of the aerosol carrier 14 when the 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.

5 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
10 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
15 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.

20 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
25 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.

30 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).
35 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). Figure 4 illustrates an exterior of the aerosol carrier 14, Figure 5 illustrates internal components of the aerosol carrier 14 in an optional configuration, and Fig. 6 illustrates internal components of the aerosol carrier 14 in another optional configuration.

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 and 6 illustrates some internal components of the aerosol carrier 14 and of the heater 24 of apparatus 12, in one embodiment of the invention.

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), 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 24 of the apparatus and receives heat directly from the heater 24 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. 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 and 6 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 and 6, 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 34a comprises a porous structure, whose pore diameter size varies 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.

The fluid transfer article 34 also comprises a second region 34b. Aerosol precursor is drawn from the first region of 34a to the second region 34b 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.

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

In Figures 5 and 6, the second region 34b is in the form of a flexible diaphragm. That flexible diaphragm is biased towards the position shown in Fig 5, which is convex towards the conduction element and such that a part of the second region 34b is in contact with the conduction element 36. The surface of the second region 34b which is closest to the conduction element 36 is the activation surface.

Figures 5 and 6 also illustrate an opening 38 in the housing 32, which opening 38 is in fluid communication with the air-intake apertures 20. A further opening 39 communicates with a duct 40 within the housing 32, which duct 40 communicates with the second end 18.

There is thus a fluid-flow path for air (hereinafter referred to as an air-flow pathway) between openings 38 and 39, linking the apertures 20 and the second end 18 of the aerosol carrier. In the arrangement shown in Figure 5, that air-flow pathway is blocked by the second region 34b, due to its contact with the conduction element 36.

However, when the user sucks or inhales, air is drawn along the air-flow pathway and the second region 34b flexes away from the conduction element 36 to the position shown in Fig 6. Air may then pass along the surface of the conduction element 36, between the conduction element 36 and the second region 34b.

5

The mechanism for this is believed to be as follows. In the position shown in Figure 5, some of the aerosol precursor which has passed to the second region 34b will contact or “pool” on the conduction element 36. When a user inhales, low pressure is created in the duct 40 and hence a low pressure region is formed adjacent the second region 34b. This will cause the second region 34b to deform from the position shown in Figure 6, thereby creating an air-flow path between the second region 36b and the conduction element 36. Since the heater 24 is activated at this time, the aerosol precursor which has pooled on the conduction element 36 will be vaporised and pass into the air flow in the air-flow pathway. Once the user ceases to inhale, the second region 34b returns to the position shown in Figure 5, thereby allowing more aerosol precursor to pool on the conduction element 36.

15

Thus, as the second region 34b moves away from the conduction element 36, one or more droplets of the aerosol precursor will be deposited on the conduction element and be heated, to release vapour or a mixture of aerosol and vapour from the conduction element 36 into the air flowing in the air-flow pathway between the openings 38, 39. The vapour or mixture passes, as the user sucks and inhales, to the second end 18. The configuration of the second region 34b may be chosen so as to deposit a specific amount of liquid on the conduction element 36 each time the second region 34b moves from the position shown in Figure 5 to the position shown in Figure 6, to ensure consistent amounts of vapour and/or a mixture of vapour and aerosol getting in to the airflow.

Once the user desists to inhale or suck, the airflow will stop and the second region 34b will return to the position shown in Figure 5 from the position shown in Figure 6. Hence the second region 34b is in contact with the conduction element 36 when there is no air flow, and the conduction element 36 will at least partially obstruct the end of the fluid-transfer article 34, reducing or preventing leakage of fluid from the fluid-transfer article 34 when the aerosol delivery system is not being actively used by the user.

30

As noted above, the conduction element 36 may be absent in some arrangements.

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).

35

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 and the second region 34b is located at a downstream" end of the fluid-transfer article 34. 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).

In the arrangement shown in Figures 5 and 6, the apertures 38, 39 are on opposite sides of the housing 32. Figures 7 and 8 show an alternative configuration, in which the fluid-transfer article is annular, and the second part 34b is then in the form of annular diaphragm. In Figures 7 and 8, the second part 34b is illustrated in a position corresponding to that shown in Fig 6, where it is spaced from the conduction element 36. This enables the air flow in the apparatus to be illustrated. However, as in the arrangement of Figures 5 and 6, when there is no air flow the second part 34b takes up a configuration in which it is generally convex towards and in contact with the conduction element 36, that contact being itself annular. Thus, Figures 7 and 8 illustrate an aerosol carrier 14 according to one or more possible arrangements in more detail. Figure 7 is a cross-section side view illustration of the aerosol carrier 14 and Figure 8 is a perspective cross-section side view illustration of the aerosol carrier 14.

As can be seen from Figures 7 and 8, 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 7 and 8, 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 7 and 8, 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 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. As in the embodiment of Figures 5 and 6, this causes the diaphragm formed by the second part 34b to move to a position in which it is separated from the conduction element 36 and an air-flow pathway, passing between the conduction element 36 and the diaphragm is open.

5

An incoming air stream 42a from a first side of the aerosol carrier 14 is directed to a first 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). An incoming air stream 42b from a second side of the aerosol carrier 14 is directed to a second side of the second part 34a 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 second part 34b, the incoming air stream 42a from the first side of the aerosol carrier 14 flows between the second part 34b and the conduction element 36 (or between the second part 34b 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 second part 34b, the incoming air stream 42b from the second side of the aerosol carrier 14 flows between the second part 34b and the conduction element 36 (or between the second part 34b and heater 24). The air streams from each side are denoted by dashed lines 44a and 44b in Figure 8. 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 serves to 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 9 is an exploded perspective view illustration of a kit-of-parts for assembling an aerosol delivery system 10.

35

In any of the embodiments described above the second part 34b 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.

5

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.

10

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.

15

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 departing from the spirit and scope of the invention.

20

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.

25

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 “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.

30

It must be noted that, as used in the specification and the appended claims, the singular forms “a,” “an,” 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 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, and is not intended to exclude other embodiments from the scope of the disclosure, or from the scope of the claims.

Claims:

1. A fluid-transfer article comprising a first region for holding an aerosol precursor and for transferring said aerosol precursor to an activation surface of a second region of said article, said activation surface being disposed at an end of said article configured for thermal interaction with a heater of an aerosol-generation apparatus, wherein said second region is a flexible diaphragm
2. A fluid-transfer article according to claim 1, wherein said flexible diaphragm is formed from a polymeric wicking material.
3. A fluid-transfer article according to claim 2, wherein said polymeric wicking material comprises Polyetherimide (PEI).
4. A fluid-transfer article according to claim 2, wherein said polymeric wicking material comprises Polyether ether ketone (PEEK).
5. A fluid-transfer article according to claim 2, wherein said polymeric wicking material comprises Polytetrafluoroethylene (PTFE).
6. A fluid-transfer according to claim 2, wherein said polymeric wicking material comprises Polyimide (PI).
7. A fluid-transfer article according to claim 2, wherein said polymeric wicking material comprises Polyethersulphone (PES).
8. A fluid-transfer article according to claim 2, wherein said polymeric wicking material comprises Ultra-High Molecular Weight Polyethylene (UHMWPE).
9. A fluid-transfer article according to claim 2, wherein said polymeric wicking material comprises Polypropylene (PP).
10. A fluid-transfer article according to claim 2, wherein said polymeric wicking material comprises Polyethylene Terephthalate (PET).
11. A fluid-transfer article according to any one of claims 2 to 10, wherein said polymeric wicking material is porous.

12. An aerosol-generation apparatus comprising a heater and a fluid-transfer article according to any one of the preceding claims.
13. An aerosol-generation apparatus according to claim 12, wherein said flexible diaphragm is arranged to be movable between a first position in which a part of said flexible diaphragm is in contact with said heater, and a second position in which said part of said flexible diaphragm is spaced from said heater.
14. An aerosol-generation apparatus according to claim 13, wherein said flexible diaphragm is biased towards said first position
15. An aerosol delivery system comprising an aerosol-generation apparatus according to any one of claims 12 to 14 and a carrier comprising housing containing said heater and said fluid-transfer article, said housing having an inlet and an outlet, an air-flow pathway being defined between said inlet and said outlet, said air-flow pathway passing between said flexible diaphragm and said heater, said air-flow pathway being obstructed when said flexible diaphragm is in said first position

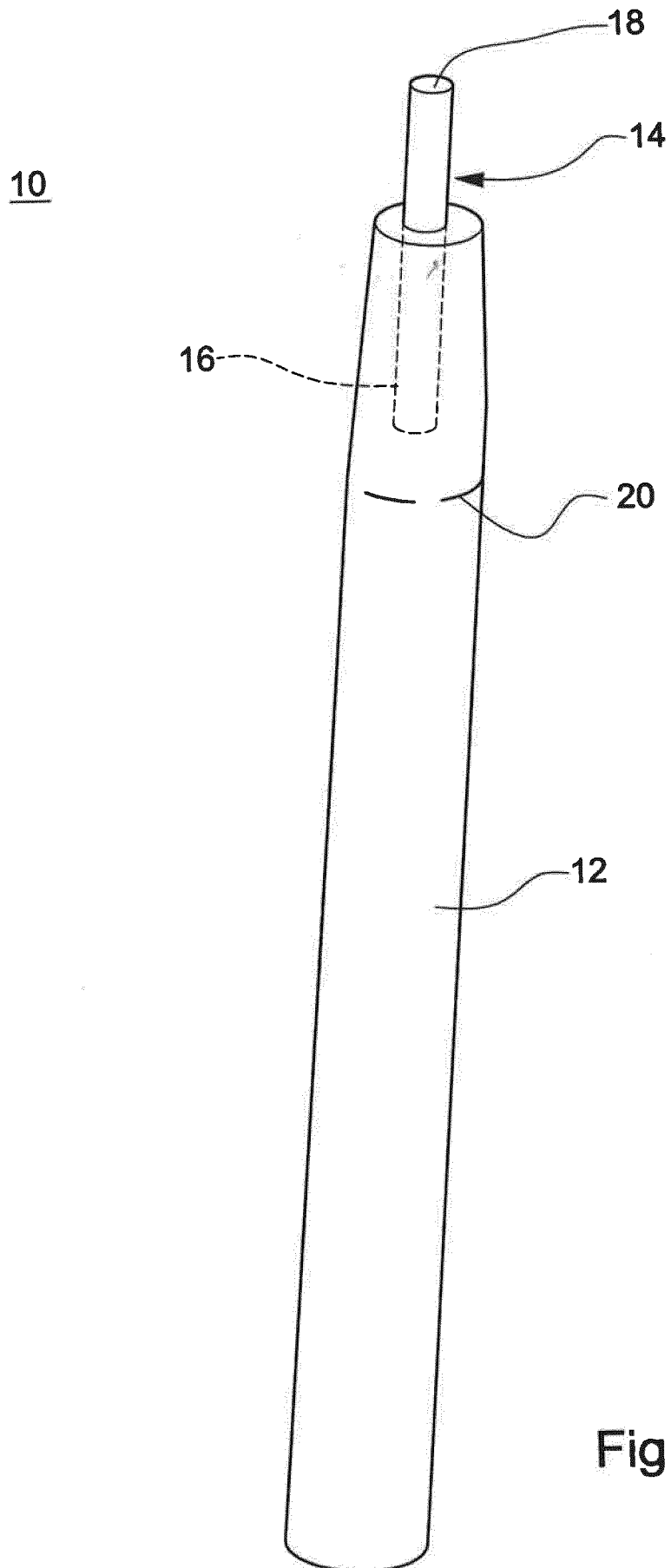
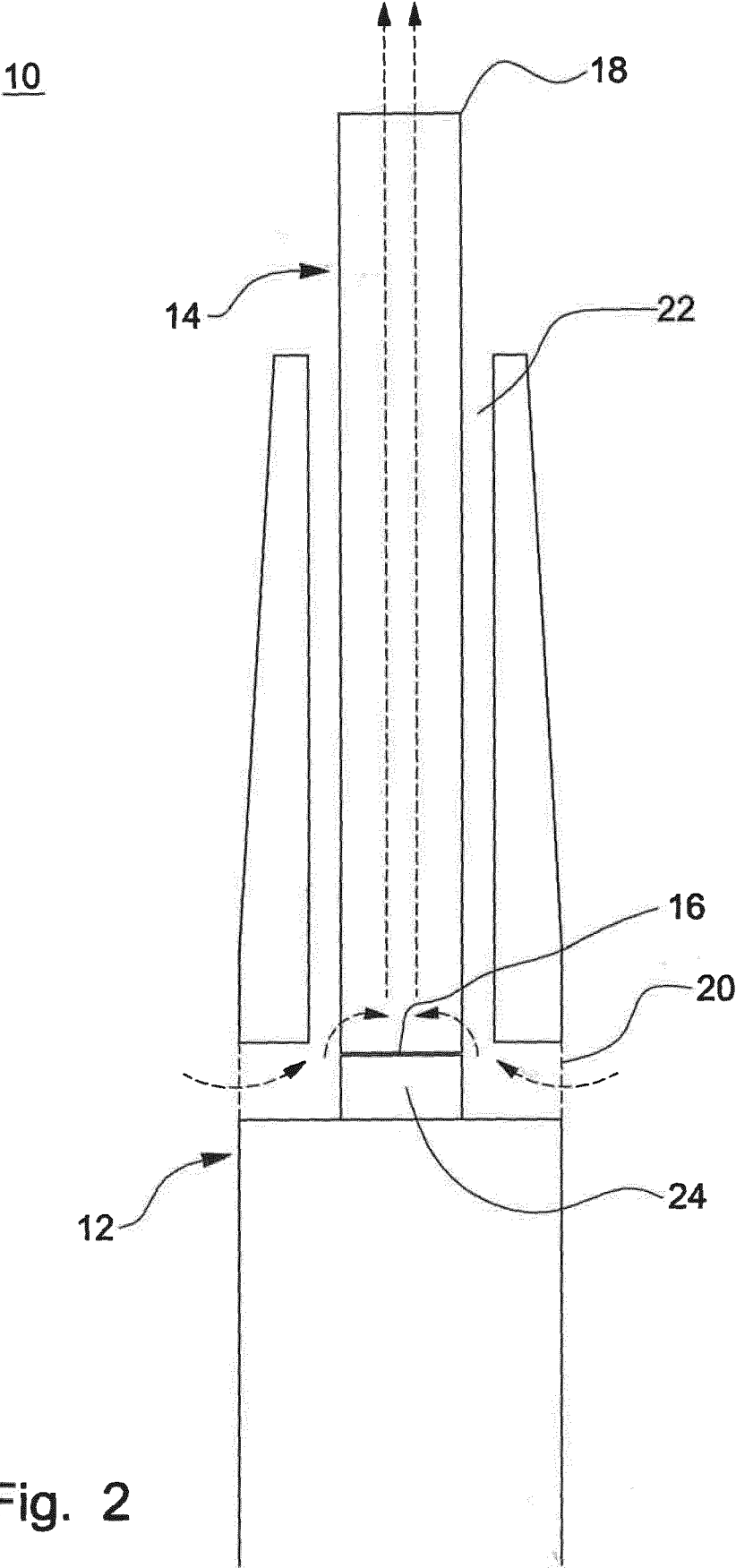


Fig. 1



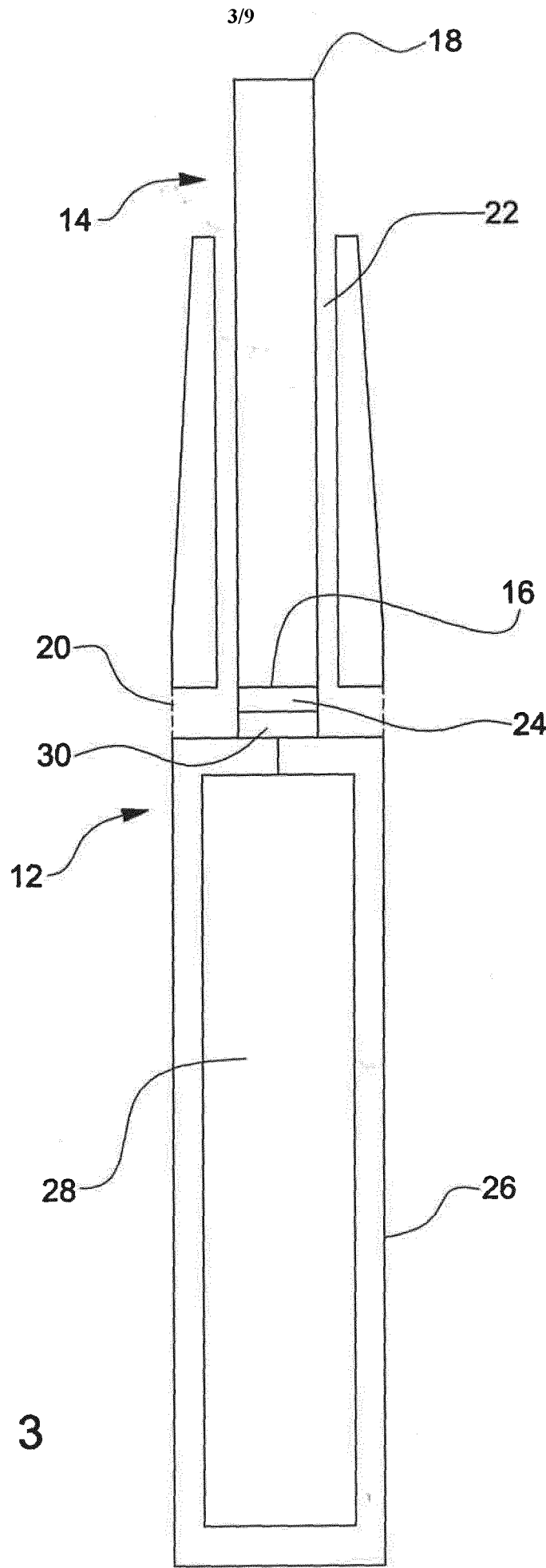


Fig. 3

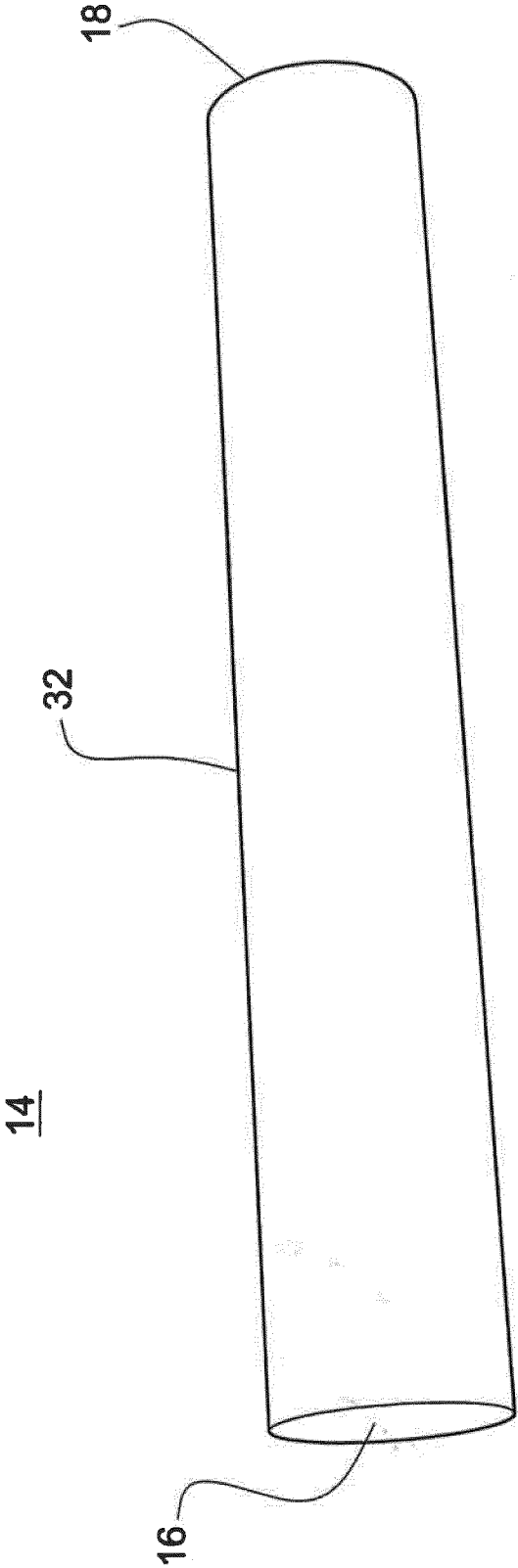


Fig. 4

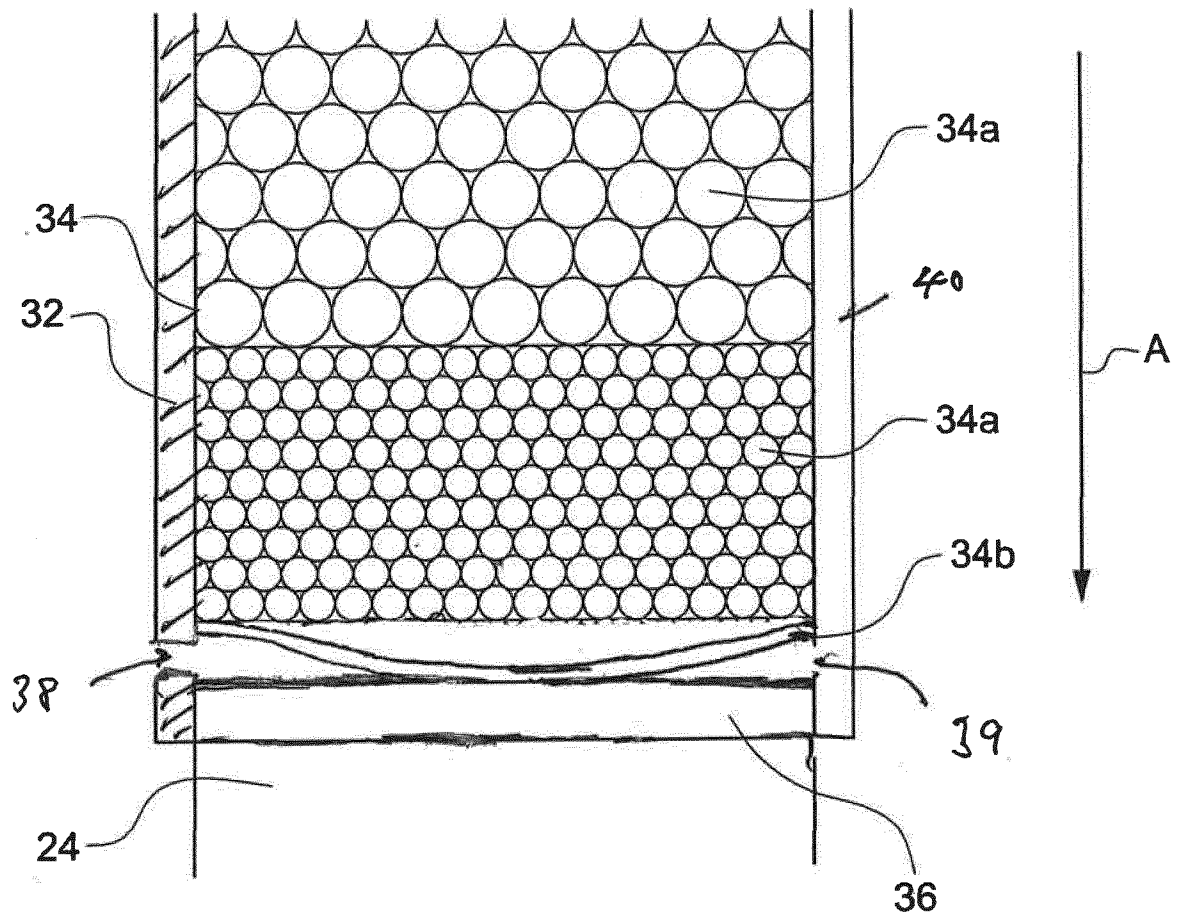


Fig. 5

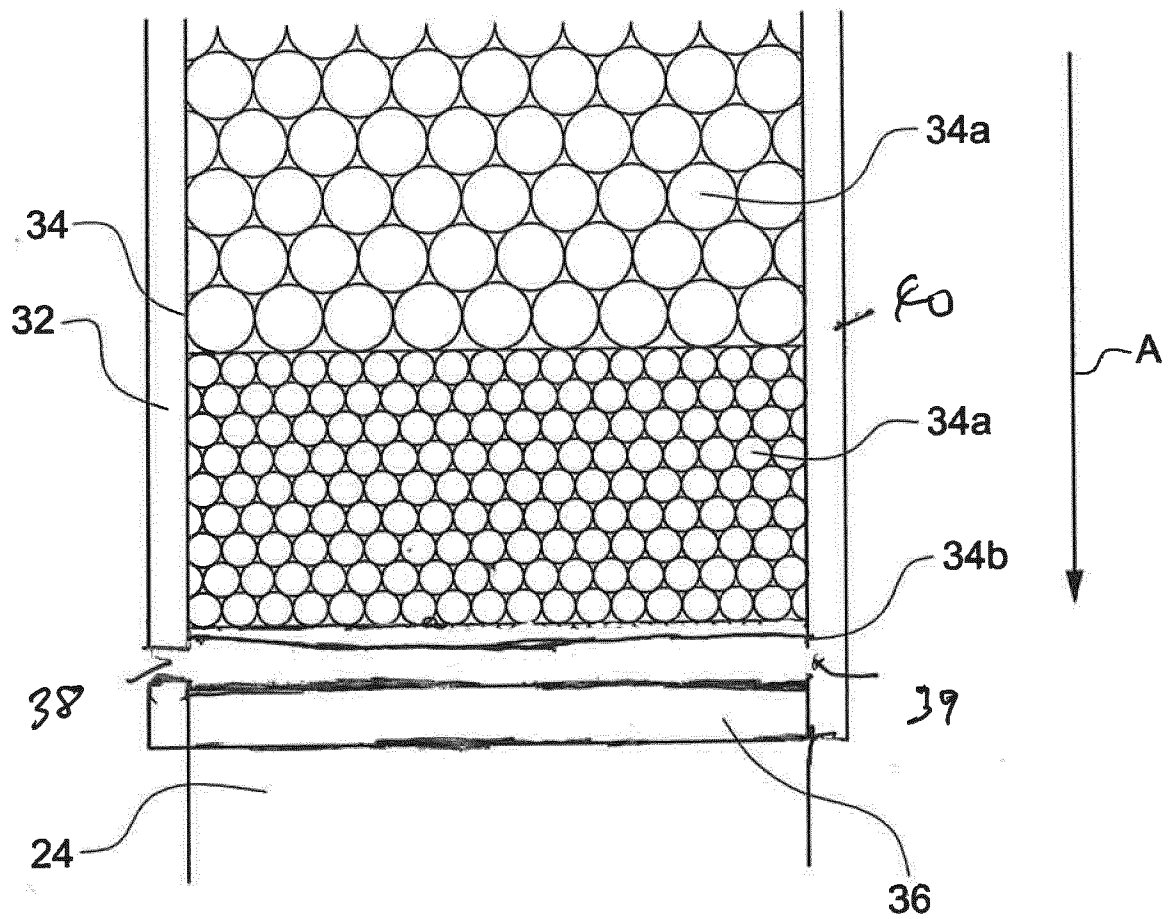


Fig. 6

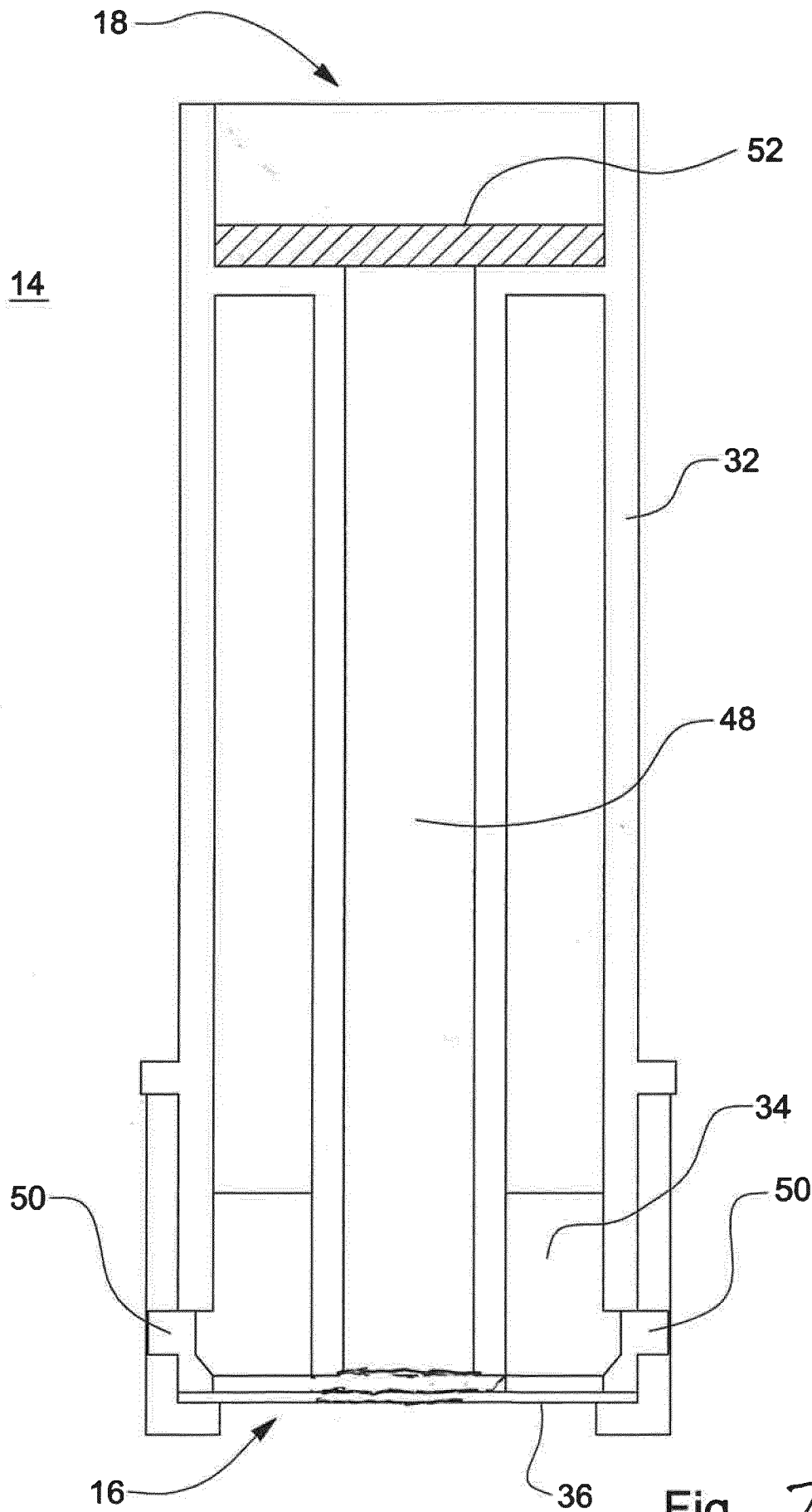
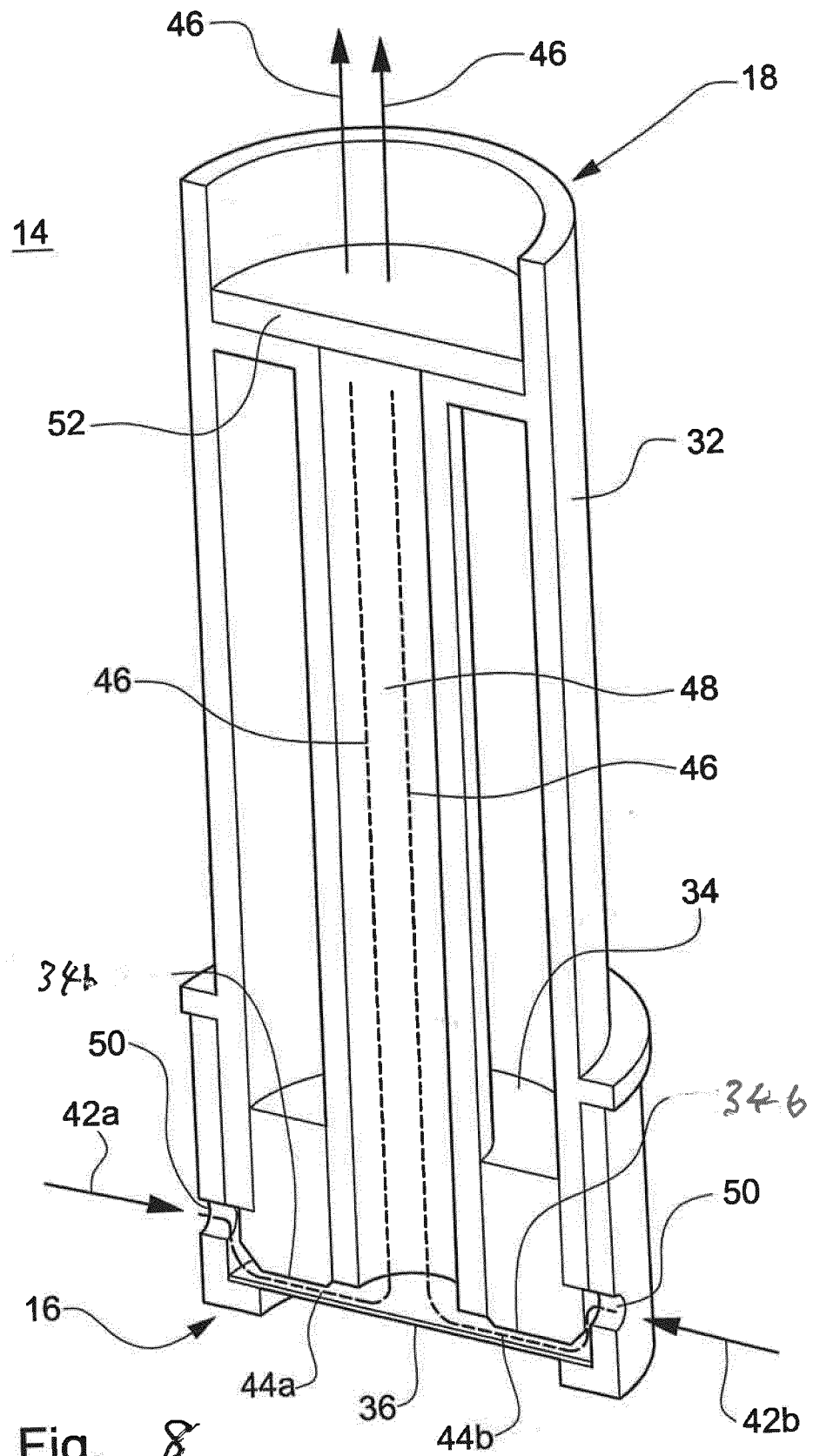


Fig. 7



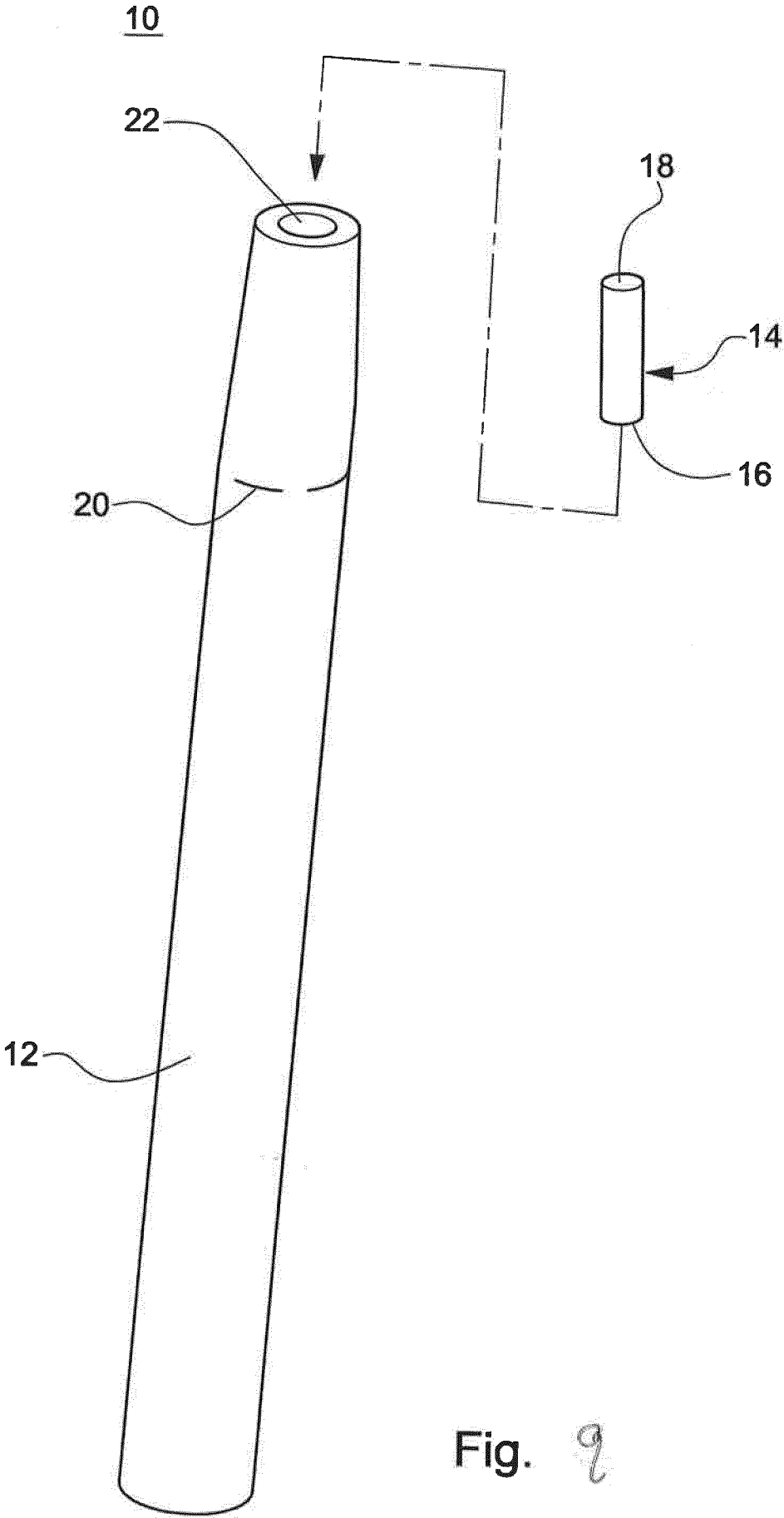


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/057345

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 2018/197515 A1 (NERUDIA LTD [GB]) 1 November 2018 (2018-11-01)	1-15
Y	abstract; claims 1-48 page 22 - page 23 -----	13,14
A	WO 2016/079155 A1 (MCNEIL AB [SE]) 26 May 2016 (2016-05-26) abstract; figures 1-18 -----	1-15
Y	WO 2014/085719 A1 (NICOTINE TECHNOLOGY INC E [US]) 5 June 2014 (2014-06-05) abstract; figure 9 -----	13,14
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents :		
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 22 April 2020		Date of mailing of the international search report 04/05/2020
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Weijland, Albert

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2020/057345

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
WO 2018197515	A1	01-11-2018	CN 110740773 A	31-01-2020
			CN 110769883 A	07-02-2020
			CN 110769884 A	07-02-2020
			CN 110769885 A	07-02-2020
			EP 3615114 A1	04-03-2020
			EP 3615115 A1	04-03-2020
			EP 3615116 A1	04-03-2020
			EP 3615117 A1	04-03-2020
			GB 2561867 A	31-10-2018
			GB 2561953 A	31-10-2018
			GB 2561954 A	31-10-2018
			GB 2561955 A	31-10-2018
			GB 2561956 A	31-10-2018
			GB 2561957 A	31-10-2018
			GB 2561958 A	31-10-2018
			GB 2561959 A	31-10-2018
			WO 2018197511 A1	01-11-2018
			WO 2018197513 A1	01-11-2018
			WO 2018197514 A1	01-11-2018
			WO 2018197515 A1	01-11-2018
WO 2016079155	A1	26-05-2016	DK 3220987 T3	29-07-2019
			EP 3220987 A1	27-09-2017
			EP 3524304 A1	14-08-2019
			ES 2738730 T3	24-01-2020
			HR P20191212 T1	04-10-2019
			HU E045363 T2	30-12-2019
			LT 3220987 T	10-07-2019
			PL 3220987 T3	29-11-2019
			PT 3220987 T	27-08-2019
			TR 201910352 T4	22-07-2019
			US 2017360092 A1	21-12-2017
			US 2019116885 A1	25-04-2019
			US 2020113231 A1	16-04-2020
			WO 2016079155 A1	26-05-2016
WO 2014085719	A1	05-06-2014	AU 2013352004 A1	28-05-2015
			CA 2890204 A1	05-06-2014
			CN 104955508 A	30-09-2015
			CN 204147375 U	11-02-2015
			DE 202013105420 U1	03-04-2014
			EP 2925395 A1	07-10-2015
			GB 2508520 A	04-06-2014
			HK 1215799 A1	15-09-2016
			JP 6429788 B2	28-11-2018
			JP 6429788 B6	30-01-2019
			JP 2016501588 A	21-01-2016
			KR 20150095709 A	21-08-2015
			PL 2925395 T3	30-08-2019
			SG 11201504008P A	29-06-2015
			US 2014190496 A1	10-07-2014
			WO 2014085719 A1	05-06-2014
			ZA 201503522 B	31-07-2019