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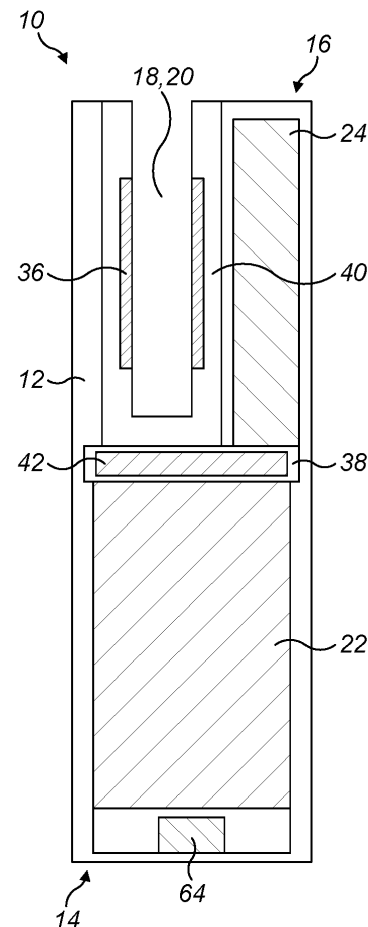
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(54) AEROSOL GENERATING DEVICE

(57) An aerosol generating device (10) is described. The aerosol generating device (10) includes a heater (36) adapted to heat aerosol generating material and a first energy storage device (22). A second energy storage device (42) is located between the heater (36) and the first energy storage device (22). The second energy storage device (42) is a solid-state energy storage device which is tolerant to the high temperatures generated by the heater (36) when the aerosol generating material is being heated.

**FIG. 3****EP 4 563 018 A1**

Description

Technical Field

[0001] The present disclosure relates generally to an aerosol generating device, and in particular to a device that is configured to heat aerosol generating material to generate an aerosol for inhalation by a user. The present disclosure is particularly applicable to a portable (hand-held) aerosol generating device. The aerosol generating material may be part of an aerosol generating article that may be received in the device in use.

Technical Background

[0002] Devices which heat, rather than burn, an aerosol generating material to produce an aerosol for inhalation have become popular with consumers in recent years. A commonly available reduced-risk or modified-risk device is the heated material aerosol generating device, or so-called heat-not-burn device. Devices of this type generate an aerosol or vapour by heating an aerosol generating material to a temperature typically in the range 150°C to 300°C. This temperature range is quite low compared to an ordinary cigarette. Heating the aerosol generating material to a temperature within this range, without burning or combusting the aerosol generating material, generates a vapour which typically cools and condenses to form an aerosol for inhalation by a user of the device.

[0003] It is known for such aerosol generating devices to include one or more air insulating spaces or layers of suitable insulating material as thermal insulation between the heater of the aerosol generating device and the outer housing or other heat-sensitive components such as energy storage devices or control components, for example. The air insulating spaces or insulating material takes up valuable space within the outer housing.

[0004] Solid-state energy storage devices (e.g., solid-state batteries) use solid electrodes and a solid electrolyte. Solid-state energy storage devices may typically tolerate higher external temperatures and have a higher thermal stability than conventional energy storage devices that use a liquid electrolyte instead of the solid electrolyte. The construction of solid-state energy storage devices may also allow them to act as thermal insulators.

Summary of the Disclosure

[0005] According to a first aspect of the present disclosure, there is provided an aerosol generating device comprising a heater adapted to heat aerosol generating material, a first energy storage device, and a second energy storage device located between the heater and the first energy storage device, wherein the second energy storage device is a solid-state energy storage device. In other words, the second energy storage device is

physically positioned between the heater and the first energy storage device within an outer housing or main body of the aerosol generating device.

[0006] The term "solid-state energy storage device" as used herein includes a semi-solid-state energy storage device that may use a combination of solid and liquid electrolyte (e.g., a gel-like electrolyte) and an all-solid-state energy storage device that may use only a solid electrolyte.

[0007] The first energy storage device may be the main power source for the aerosol generating device, e.g., it may have a larger energy storage capacity than the second energy storage device. The first energy storage device may be a rechargeable Lithium-ion secondary battery, for example. The second energy storage device (e.g., a rechargeable solid-state battery) may have any suitable solid-state construction, e.g., with solid-state electrodes and a solid-state electrolyte or a combination of solid and liquid electrolyte. In one arrangement, the second energy storage device is an all-solid-state energy storage device. The first and second energy storage devices may be charged by an external power source using a single charging circuit, e.g., a battery charger integrated circuit (IC), which may use a power path function. The first and second energy storage devices may also be charged by separate charging circuits, e.g., by dedicated battery charger ICs.

[0008] Because the second energy storage device is a solid-state energy storage device, it has high tolerance to the heat generated by the heater when heating the aerosol generating material. The second energy storage device does not normally need to be thermally insulated from the heater, although in some cases, a small amount of insulating material may still be located between the heater and the second energy storage device. The air insulating space or insulating material that would normally be located between the heater and the first energy storage device in a known aerosol generating device may effectively be replaced by the second energy storage device. This means that some of the thermal insulation within the outer housing of the aerosol generating device is replaced with additional energy storage capacity and the physical size and energy storage capacity of the first energy storage device may be reduced. This may result in a reduction in the overall size and weight of the aerosol generating device. Physically positioning the second energy storage device between the heater and the first energy storage device also means that the first energy storage device is at least partially thermally insulated from the heat generated by the heater by the second energy storage device.

[0009] The aerosol generating device may comprise an air insulating space between the heater and the first energy storage device. The second energy storage device may be located in the air insulating space. The second energy storage device may substantially fill the air insulating space.

[0010] The aerosol generating device may further

comprise a printed circuit board assembly (PCBA) with a printed circuit board (PCB) and one or more electronic components. The PCB of the PCBA may be a rigid PCB. The PCBA may be part of a control component of the aerosol generating device.

[0011] The second energy storage device may be electrically connected to the control component (e.g., to the PCBA) by a flexible PCB (or flexible printed circuit (FPC)) that uses a flexible dielectric substrate or base material that may be bent or twisted without damaging the printed circuit. The flexible PCB may be single-sided with a conductive layer on one side of the flexible substrate or base layer, or double-sided with a first conductive layer on one side of the flexible substrate or base layer and a second conductive layer on the other side of the flexible substrate or base layer. The flexible PCB may be multi-layer with multiple conductive layers. The flexible PCB will typically also include one or more protective cover-lays (or cover layers) and adhesive layers.

[0012] Each conductive layer will define a pattern of conductive pathways or traces to which the one or more electronic components may be electrically connected, e.g., using solder.

[0013] Electrical connections to and between the conductive layer(s) may be facilitated by plated through holes or vias, for example.

[0014] The second energy storage device may be mounted directly on the flexible PCB. For example, the terminals of the second energy storage device may be soldered directly to one or more conductive layers of the flexible PCB.

[0015] The second energy storage device may also be removably mounted to the flexible PCB. For example, the flexible PCB may comprise a mounting means such as one or more magnets that are adapted to removably or releasably mount the second energy storage device in such a way that the terminals of the second energy storage device are electrically connected to one or more conductive layers of the flexible PCB. Using such a mounting means may make it easier to assemble the aerosol generating device. It may also make it possible to remove the second energy storage device if it is faulty or reaches the end of its normal operating lifetime.

[0016] The flexible PCB may comprise a first conductive layer on one side of the flexible substrate or base layer and a second conductive layer on the other side of the flexible substrate or base layer. The second energy storage device may comprise a first terminal (e.g., a positive terminal) and a second terminal (e.g., a negative terminal). The first terminal may be electrically connected to the first conductive layer and the second terminal may be electrically connected to the second conductive layer.

[0017] One or more electronic components may be mounted directly on the flexible PCB. For example, the terminals of the one or more electronic components may be soldered directly to one or more conductive layers of the flexible PCB.

[0018] The second energy storage device may be

mounted on a first side of the flexible PCB and one or more electronic components may be mounted on a second side of the flexible PCB.

[0019] The second energy storage device may comprise a plurality of energy storage device units (e.g., rechargeable solid-state battery units). In one arrangement, the energy storage device units may be mounted on both sides of the flexible PCB. In another arrangement, the energy storage device units may be mounted only on one side of the flexible PCB - i.e., no energy storage device units are mounted on the other side of the flexible PCB. The one or more electronic components may be mounted on both sides of the flexible PCB or only on one side of the flexible PCB. For example, one side of the flexible PCB may have only energy storage device units mounted to it and the other side may have only one or more electronic components mounted to it. In this arrangement, there are no electronic components mounted on the same side of the flexible PCB as the energy storage device units. The particular arrangement or positioning of energy storage device units and other electronic components may depend on the circumstances and the design of the aerosol generating device.

[0020] The aerosol generating device may further comprise a temperature sensor mounted directly on the flexible PCB and adapted to measure a temperature of the first energy storage device and/or the second energy storage device. Mounting the temperature sensor to the flexible PCB may simplify the structure and assembly of the aerosol generating device, for example.

[0021] The heater may be electrically connected to or mounted directly on the flexible PCB. The aerosol generating device may further comprise a temperature sensor adapted to measure a temperature of the heater. The temperature sensor may be mounted directly on the flexible PCB. Mounting the temperature sensor to the flexible PCB may simplify the structure and assembly of the aerosol generating device, for example.

[0022] The heater may be located at a first end (e.g., a proximal end) of the aerosol generating device. The first energy storage device may be located at a second end (e.g., a distal end) of the aerosol generating device. The second energy storage device may be located at a middle portion of the aerosol generating device, i.e., between the heater and the first energy storage device. The control component (or PCBA) may also be located at the first end of the aerosol generating device. The control component (or PCBA) may be located adjacent the heater at the first end of the aerosol generating device, but may be spaced apart the heater by an air insulating space or suitable insulating material, for example. The air insulating space or insulating material may extend around the heater.

[0023] The second energy storage device may be located adjacent a first side of the first energy storage device. The aerosol generating device may further comprise a gas leakage valve located on a second side of the first energy storage device opposite the first side.

[0024] The aerosol generating material may form part

of an aerosol generating article (or "consumable") and may be surrounded by a paper wrapper. The aerosol generating article may be adapted to be received in a heating chamber of the aerosol generating device.

[0025] The aerosol generating article may be formed substantially in the shape of a stick, and may broadly resemble a cigarette, having a tubular region with an aerosol generating material or substrate arranged in a suitable manner. The aerosol generating article may include a filter segment, for example comprising cellulose acetate fibres, at a proximal end of the aerosol generating article. The filter segment may constitute a mouthpiece filter and may be in coaxial alignment with the aerosol generating material. One or more vapour collection regions, cooling regions, and other structures may also be included in some designs. For example, the aerosol generating article may include at least one tubular segment upstream of the filter segment. The tubular segment may act as a vapour cooling region. The vapour cooling region may advantageously allow the heated vapour generated by heating the aerosol generating material to cool and condense to form an aerosol with suitable characteristics for inhalation by a user, for example through the filter segment.

[0026] The aerosol generating material may comprise any type of solid or semi-solid material. Example types of aerosol generating solids include powder, granules, pellets, shreds, strands, particles, gel, strips, loose leaves, cut filler, porous material, foam material or sheets. The aerosol generating material may comprise plant derived material and in particular, may comprise tobacco. It may advantageously comprise reconstituted tobacco, for example including tobacco and any one or more of cellulose fibres, tobacco stalk fibres and inorganic fillers.

[0027] The aerosol generating material may comprise an aerosol-former. Examples of aerosol-formers include polyhydric alcohols and mixtures thereof such as glycerine or propylene glycol. Typically, the aerosol generating material may comprise an aerosol-former content of between approximately 5% and approximately 50% on a dry weight basis. In some embodiments, the aerosol generating material may comprise an aerosol-former content of between approximately 10% and approximately 20% on a dry weight basis, and possibly approximately 15% on a dry weight basis.

[0028] The aerosol generating device may be configured to heat the aerosol generating material or substrate, without burning the aerosol generating material, to volatilise at least one component of the aerosol generating material and thereby generate a heated vapour which cools and condenses to form an aerosol for inhalation by a user of the aerosol generating device. The volatile compounds released from the aerosol generating material may include nicotine or flavour compounds such as tobacco flavouring.

[0029] In general terms, a vapour is a substance in the gas phase at a temperature lower than its critical temperature, which means that the vapour may be condensed to a liquid by increasing its pressure without

reducing the temperature, whereas an aerosol is a suspension of fine solid particles or liquid droplets, in air or another gas. It should, however, be noted that the terms 'aerosol' and 'vapour' may be used interchangeably in this specification, particularly with regard to the form of the inhalable medium that is generated for inhalation by a user.

[0030] The aerosol generating device is typically a hand-held, portable, device.

Brief Description of the Drawings

[0031]

Figure 1 is a diagrammatic cross-sectional view of an aerosol generating system comprising an aerosol generating device and an aerosol generating article ready to be positioned in a heating chamber of the aerosol generating device;

Figure 2 is a diagrammatic cross-sectional view of an aerosol generating device with an air insulating space;

Figure 3 is a diagrammatic cross-sectional view of an aerosol generating device with an additional solid-state energy storage device; and

Figures 4A to 4F are diagrammatic cross-section views of solid-state energy storage device units and electronic components mounted on a flexible printed circuit board.

Detailed Description of Embodiments

[0032] Embodiments of the present disclosure will now be described by way of example only and with reference to the accompanying drawings.

[0033] Referring initially to Figure 1, there is shown diagrammatically an example of an aerosol generating system 1. The aerosol generating system 1 comprises an aerosol generating device 10 and an aerosol generating article 100 for use with the device 10. The aerosol generating device 10 comprises a main body 12 housing various components of the aerosol generating device 10. The main body 12 may have any shape that is sized to fit the components described in the various embodiments set out herein and to be comfortably held by a user unaided, in a single hand.

[0034] A first end 14 of the aerosol generating device 10, shown towards the bottom of Figure 1, is described for convenience as a distal, bottom, base or lower end of the aerosol generating device 10. A second end 16 of the aerosol generating device 10, shown towards the top of Figure 1, is described as a proximal, top or upper end of the aerosol generating device 10. During use, the user typically orients the aerosol generating device 10 with the first end 14 downward and/or in a distal position with respect to the user's mouth and the second end 16 upward and/or in a proximate position with respect to

the user's mouth.

[0035] The aerosol generating device 10 comprises a heating chamber 18 positioned in the main body 12. The heating chamber 18 defines an interior volume in the form of a cavity 20 having a substantially cylindrical cross-section for receiving an aerosol generating article 100. The heating chamber 18 has a longitudinal axis defining a longitudinal direction and is formed of a heat-resistant plastics material, such as polyether ether ketone (PEEK). The aerosol generating device 10 further comprises a main power source 22, for example one or more batteries which may be rechargeable, and a control component 24. The control component 24 may comprise one or more integrated circuits (ICs) and other electronic components. For example, an integrated circuit may comprise at least one of a microcontroller unit (MCU) and micro-processor unit (MPU). The control component 24 may comprise a printed circuit board assembly (PCBA) with a rigid printed circuit board (PCB) on which the one or more electronic components or ICs are mounted. In addition to the main power source 22, the aerosol generating device 10 also includes a solid-state battery 42 as a secondary power source.

[0036] The heating chamber 18 is open towards the second end 16 of the aerosol generating device 10. In other words, the heating chamber 18 has an open first end 26 towards the second end 16 of the aerosol generating device 10. The heating chamber 18 is typically held spaced apart from the inner surface of the main body 12 to minimise heat transfer to the main body 12.

[0037] The aerosol generating device 10 may optionally include a sliding cover 28 movable transversely between a closed position (shown in Figure 1) in which it covers the open first end 26 of the heating chamber 18 to prevent access to the heating chamber 18 and an open position (not shown) in which it exposes the open first end 26 of the heating chamber 18 to provide access to the heating chamber 18. The sliding cover 28 may be biased to the closed position in some embodiments.

[0038] The heating chamber 18, and specifically the cavity 20, is arranged to receive a correspondingly shaped generally cylindrical or rod-shaped aerosol generating article 100. Typically, the aerosol generating article 100 comprises a pre-packaged aerosol generating material or substrate 102. The aerosol generating article 100 is a disposable and replaceable article (also known as a "consumable") which may, for example, contain tobacco as the aerosol generating material 102. The aerosol generating article 100 has a proximal end 104 (or mouth end) and a distal end 106. The aerosol generating article 100 further comprises a mouthpiece segment 108 positioned downstream of the aerosol generating material 102. The aerosol generating material 102 and the mouthpiece segment 108 are arranged in coaxial alignment inside a wrapper 110 (e.g., a paper wrapper) to hold the components in position to form the rod-shaped aerosol generating article 100.

[0039] The mouthpiece segment 108 may comprise

one or more of the following components (not shown in detail) arranged sequentially and in co-axial alignment in a downstream direction, in other words from the distal end 106 towards the proximal (mouth) end 104 of the aerosol generating article 100: a cooling segment, a centre hole segment and a filter segment. The cooling segment typically comprises a hollow paper tube having a thickness which is greater than the thickness of the wrapper 110. The centre hole segment may comprise a cured mixture containing cellulose acetate fibres and a plasticizer, and functions to increase the strength of the mouthpiece segment 108. The filter segment typically comprises cellulose acetate fibres and acts as a mouthpiece filter. As heated vapour flows from the aerosol generating material 102 towards the proximal (mouth) end 104 of the aerosol generating article 100, the vapour cools and condenses as it passes through the cooling segment and the centre hole segment to form an aerosol with suitable characteristics for inhalation by a user through the filter segment.

[0040] The heating chamber 18 has a side wall (or chamber wall) 30 extending between a base 32, located at a second end 34 of the heating chamber 18, and the open first end 26. The side wall 30 and the base 32 are connected to each other and may be integrally formed as a single piece. In the illustrated embodiment, the side wall 30 is tubular and, more specifically, cylindrical. The side wall 30 may be formed so that the cross-section of the heating chamber 18 is a perfect circle or an ellipse. In other embodiments, the side wall 30 may have other suitable shapes, such as a tube with an elliptical or polygonal cross section. In yet further embodiments, the side wall 30 may be tapered.

[0041] In the illustrated embodiment, the base 32 of the heating chamber 18 is closed, e.g., sealed or air-tight. That is, the heating chamber 18 is cup-shaped. This may ensure that air drawn from the open first end 26 is prevented by the base 32 from flowing out of the second end 34 and is instead guided through the aerosol generating material 102. It may also ensure that a user inserts the aerosol generating article 100 into the heating chamber 18 an intended distance and no further.

[0042] The device 10 includes a heater 36, which is configured to heat the aerosol generating material 102 when the aerosol generating article 100 is received in the heating chamber 18.

[0043] Figure 2 shows how in a known aerosol generating device without a solid-state battery, the main power source 22 is spaced apart from the heater 36 by a first air insulating space 38. The control component 24 which includes the PCBA is also separated apart from the heater 36 by a second air insulating space 40 that surrounds the heater 36.

[0044] In Figure 3, the first air insulating space 38 between the heater 36 and the main power source 22 is substantially filled by the solid-state battery 42. The solid-state battery 42 has high tolerance to high external temperatures such as those generated by the heater 36

when it is being used to heat the aerosol generating article 100. The solid-state battery 42 may therefore be located close to the heater 36 and in particular the solid-state battery 42 does not need to be spaced apart from the heater 36 by an air insulating space or by any significant amount of insulating material. This makes good use of the available space within the main body 12. Including a solid-state battery 42 provides additional energy storage capacity. As a result, the energy storage capacity of the main power source 22 may be reduced. This may mean that the physical size and weight of the main power source 22 may also be reduced, which may result in a smaller and/or lighter aerosol generating device 10. The solid-state battery 42 thermally insulates the main power source 22 from the heater 36. In other words, the solid-state battery acts as a thermal barrier between the main power source 22 and the heat that is generated by the heater 36 when the aerosol generating device 10 is being used.

[0045] Referring now to Figures 4A to 4F, the solid-state battery 42 may comprise a plurality of solid-state battery units 44a, 44b and 44c, for example. The individual solid-state battery units 44a, 44b and 44c may be mounted directly on a flexible PCB 46 which is electrically connected to the rigid PCB of the PCBA of the control component 24. Although in Figures 4A to 4F the flexible PCB 46 is shown to be completely flat, it will be understood that in practice it may be bent or twisted so as to conform to a desired shape in use. The location of the various components - including the solid-state battery units 44a, 44b and 44c - that are mounted to the flexible PCB 46 must allow it to conform to that desired shape. Put another way, the mounted components should be positioned or spaced apart so that they do not interfere with or hinder the bending or flexing of the flexible PCB 46 within the main body 12 of the aerosol generating device 10.

[0046] In Figure 4A, a single-sided flexible PCB 46 includes a flexible dielectric substrate or base layer 48. A conductive layer 50 (e.g., a copper foil layer) is formed on one side of the flexible substrate or base layer 48. Although the conductive layer 50 is shown in Figure 4A as a solid layer, it will be readily understood that it defines a pattern of conductive pathways or traces. A protective coverlay 52 (e.g., a polyimide layer or film) is coated with a thermoset adhesive 54 and bonded to the conductive layer 50 with heat and pressure. A pattern of openings in the coverlay 52 exposes the conductive layer 50 in the areas where the one or more electronic components are to be electrically connected to the conductive layer 50. A second protective coverlay (not shown) may be bonded to the flexible substrate or base layer 48.

[0047] A pair of solid-state battery units 44a, 44b are mounted directly to the flexible PCB 46 as shown. In particular, each solid-state battery unit 44a, 44b includes a positive terminal 56 and a negative terminal 58. The positive terminal 56 of each solid-state battery unit 44a, 44b is electrically connected to a positive electrode (not shown) of the solid-state battery unit 44a, 44b. The

negative terminal 58 of each solid-state battery unit 44a, 44b is electrically connected to a negative electrode (not shown) of the solid-state battery unit 44a, 44b. The positive and negative terminals 56, 58 of each solid-state battery unit 44a, 44b are soldered directly to the conductive pathways or traces defined by the conductive layer 50.

[0048] Other electronic components 60 are also mounted directly to the conductive layer 50 as shown. In particular, terminals of each electronic component 60 are soldered directly to the conductive pathways or traces defined by the conductive layer 50.

[0049] Although the structure shown in Figure 4A appears to be relatively simple, it would require a complicated pattern of conductive pathways or traces to be formed in the single conductive layer 50. For example, the conductive pathways would have to define a ground connection.

[0050] Figure 4B shows a detail view of an alternative arrangement where the solid-state battery units are removably mounted to the flexible PCB 46. In particular, Figure 4B shows how one of the solid-state battery units 44b is removably mounted to the flexible PCB 46 by one or more magnets 62. Although only one magnet 62 is shown, it will be understood that two or more magnets may be spaced around each solid-state battery unit. Each magnet 62 may be provided on the coverlay 52 as shown in Figure 4B, for example, and may be positioned to magnetically attract and contact the facing underside of each solid-state battery unit. When the solid-state battery unit 44b is mounted to the flexible PCB 46, the positive and negative terminals 56, 58 are electrically connected to the conductive pathways or traces defined by the conductive layer 50. Using one or more magnets 62 to mount the solid-state battery unit 44b to the flexible PCB 46 may make it easier to assemble the device. It may also allow one or more of the solid-state battery units 44a, 44b to be removed and replaced if necessary. Other mounting means for removably mounting each solid-state battery unit 44a, 44b to the flexible PCB 46 may also be used.

[0051] In Figure 4C, a double-sided flexible PCB 46 includes a flexible dielectric substrate or base layer 48. A first conductive layer 50a (e.g., a first copper foil layer) is formed on one side of the flexible substrate or base layer 48 and a second conductive layer 50b (e.g., a second copper foil layer) is formed on the other side of the flexible substrate or base layer 48. Although the conductive layers 50a, 50b are shown in Figure 4C as solid layers, it will be readily understood that each defines a pattern of conductive pathways or traces. A first protective coverlay 52a (e.g., a first polyimide layer) is coated with a thermoset adhesive 54a and bonded to the first conductive layer 50a with heat and pressure. A second protective coverlay 52b (e.g., a second polyimide layer) is coated with a thermoset adhesive 54b and bonded to the second conductive layer 50b with heat and pressure. A pattern of openings in the first coverlay 52a exposes the first con-

ductive layer 50a in the areas where the one or more electronic components are to be electrically connected to the conductive layer.

[0052] A pair of solid-state battery units 44a, 44b are mounted directly to the flexible PCB 46 as shown. The positive terminal 56 of each solid-state battery unit 44a, 44b is soldered directly to the conductive pathways or traces defined by the first conductive layer 50a. The negative terminal 58 of each solid-state battery unit 44a, 44b is soldered directly to the conductive pathways or traces defined by the first conductive layer 50a but is also electrically connected to the conductive pathways or traces defined by the second conductive layer 50b by plated through holes or vias. This may simplify the pattern of conductive pathways or traces to be formed in the first conductive layer 50a, and also in the second conductive layer 50b. For example, the conductive pathways or traces formed in the second conductive layer 50b may define a ground connection for the mounted components.

[0053] In Figure 4C both of the solid-state battery units 44a, 44b and the other electronic components 60 are mounted on one side of the flexible PCB 46.

[0054] In Figures 4D to 4F components are mounted on both sides of the double-sided flexible PCB 46. In Figure 4D the pair of solid-state battery units 44a, 44b are mounted on one side of the flexible PCB 46. One or more first electronic components 60a are mounted on the same side of the flexible PCB 46 as the solid-state battery units 44a, 44b. One or more second electronic components 60b are mounted on the other side of the flexible PCB 46. More components may be mounted to the flexible PCB 46 if they are mounted on both sides. The solid-state battery units 44a, 44b may occupy a lot of the surface area of the flexible PCB 46 so it may be convenient to mount larger electronic components such as integrated circuits (ICs) on the other side of the flexible PCB 46.

[0055] In Figure 4E only the pair of solid-state battery units 44a, 44b are mounted on one side of the flexible PCB 46 and only one or more other electronic components 60 are mounted on the other side of the flexible PCB 46. In particular, there are no other electronic components mounted on the same side as the solid-state battery units 44a, 44b. This may be a particularly convenient structure, and may simplify the pattern of conductive pathways or traces to be formed in both of the first conductive layer 50a and the second conductive layer 50b.

[0056] In Figure 4F a pair of solid-state battery units 44a, 44b are mounted on one side of the flexible PCB 46 and a third solid-state battery unit 44c is mounted on the other side of the flexible PCB 46. In other words, solid-state battery units are mounted on both sides of the flexible PCB 46. One or more other electronic components 60a, 60b are also mounted on both sides of the flexible PCB 46 as shown. Such a structure may allow additional solid-state battery units to be mounted to the flexible PCB, but it may also increase the complexity of

the conductive pathways or traces defined by the conductive layers, for example.

[0057] One or more temperature sensors may be mounted directly on the flexible PCB 46, e.g., as one of the other electronic components described above. The temperature sensor(s) may be adapted to measure a temperature of the main power source 22 or one or more of the solid-state battery units 44a, 44b and 44c. Each power source or battery unit may be associated with its own respective temperature sensor. One of the temperature sensors may be adapted to measure a temperature of the heater 36. The heater 36 may also be electrically connected to (or mounted directly on) the flexible PCB 46.

[0058] Temperature measurements from each temperature sensor may be transmitted to the control component 24 through the flexible PCB 46 - e.g., directly to the PCMA of the control component.

[0059] A gas leakage valve 64 is located on the opposite side of the main power source 22 to the solid-state battery 42 as shown in Figures 2 and 3.

[0060] Although exemplary embodiments have been described in the preceding paragraphs, it should be understood that various modifications may be made to those embodiments without departing from the scope of the appended claims. Thus, the breadth and scope of the claims should not be limited to the above-described exemplary embodiments.

[0061] Any combination of the above-described features in all possible variations thereof is encompassed by the present disclosure unless otherwise indicated herein or otherwise clearly contradicted by context.

[0062] Unless the context clearly requires otherwise, throughout the description and the claims, the words "comprise", "comprising", and the like, are to be construed in an inclusive as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to".

Claims

1. An aerosol generating device (10) comprising a heater (36) adapted to heat aerosol generating material (102), a first energy storage device (22), and a second energy storage device (42; 44a, 44b, 44c) located between the heater (36) and the first energy storage device (22), wherein the second energy storage device (42; 44a, 44b, 44c) is a solid-state energy storage device.
2. An aerosol generating device (10) according to claim 1, further comprising an air insulating space (38) between the heater (36) and the first energy storage device (22), and wherein the second energy storage device (42) is located in the air insulating space (38).
3. An aerosol generating device (10) according to claim 1 or claim 2, further comprising a control component

- (24) electrically connected to the second energy storage device (44a, 44b; 44c) by a flexible PCB (46).
4. An aerosol generating device (10) according to claim 3, wherein the second energy storage device (44a, 44b, 44c) is mounted directly on the flexible PCB (46). 5
 5. An aerosol generating device (10) according to claim 4, wherein the flexible PCB (46) comprises a magnet (62) adapted to connect with the second energy storage device (44b). 10
 6. An aerosol generating device (10) according to any of claims 3 to 5, wherein the flexible PCB (46) comprises a first conductive layer (50a) and a second conductive layer (50b), wherein a first terminal (56) of the second energy storage device (44a, 44b, 44c) is electrically connected to the first conductive layer (50a) and a second terminal (58) of the second energy storage device (44a, 44b, 44c) is electrically connected to the second conductive layer (50b). 15 20
 7. An aerosol generating device (10) according to any of claims 3 to 6, wherein the second energy storage device (44a, 44b, 44c) is mounted directly to the flexible PCB (46) on a first side of the flexible PCB (46), and wherein one or more electronic components (60b) are mounted directly to the flexible PCB (46) on a second, opposite, side of the flexible PCB (46). 25 30
 8. An aerosol generating device (10) according to claim 7, wherein the second energy storage device (42) comprises a plurality of energy storage device units (44a, 44b, 44c), wherein the energy storage device units (44a, 44b, 44c) are only mounted directly to the flexible PCB (46) on the first side of the flexible PCB (46). 35 40
 9. An aerosol generating device (10) according to claim 7 or claim 8, wherein the one or more electronic components (60b) are only mounted directly to the flexible PCB (46) on the second side of the flexible PCB (46). 45
 10. An aerosol generating device (10) according to any of claims 3 to 9, wherein:
 - the heater (46) is located at a first end (16) of the aerosol generating device (10), 50
 - the first energy storage device (22) is located at a second end (14) of the aerosol generating device (10), and
 - the second energy storage device (42; 44a, 44b, 44c) is located at a middle portion of the aerosol generating device (10). 55
 11. An aerosol generating device (10) according to claim 10, wherein the control component (22) is located at the first end (16) of the aerosol generating device (10) and is spaced apart from the heater (36) by a second air insulating space (40) or insulating material.
 12. An aerosol generating device (10) according to any of claims 3 to 11, further comprising a temperature sensor mounted directly on the flexible PCB (46) and adapted to measure a temperature of the first energy storage device (22) and/or the second energy storage device (42; 44a, 44b, 44c).
 13. An aerosol generating device (10) according to any of claims 3 to 12, wherein the heater (36) is electrically connected to the flexible PCB (46).
 14. An aerosol generating device (10) according to claim 13, further comprising a temperature sensor mounted directly on the flexible PCB (46) and adapted to measure a temperature of the heater (36).
 15. An aerosol generating device (10) according to any preceding claim, wherein the second energy storage device (42; 44a, 44b, 44c) is located adjacent a first side of the first energy storage device (22), and further comprising a gas leakage valve (64) located on a second side of the first energy storage device (22) opposite the first side.

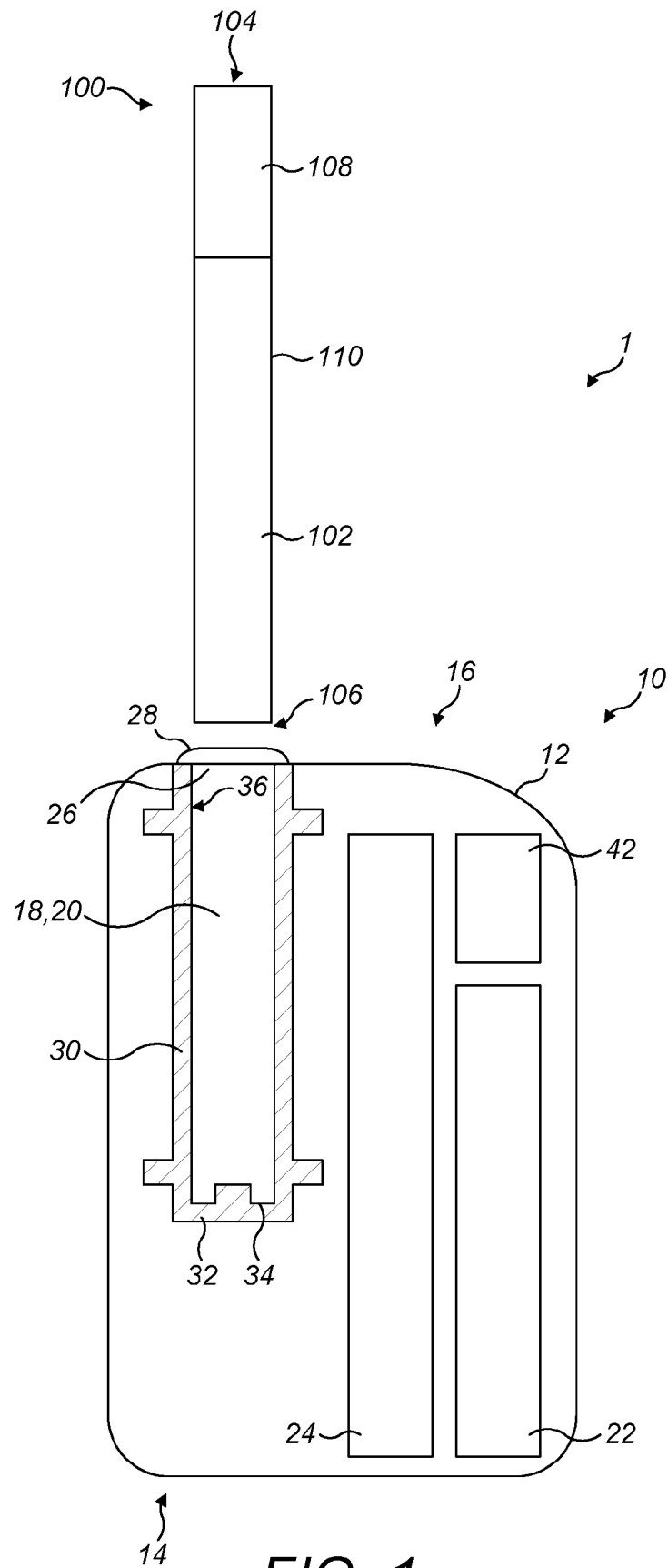


FIG. 1

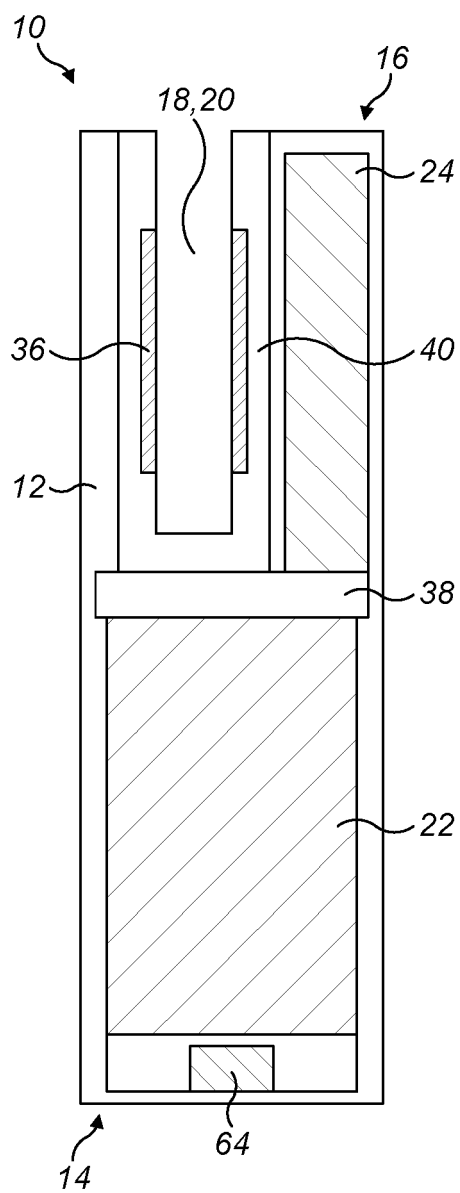


FIG. 2

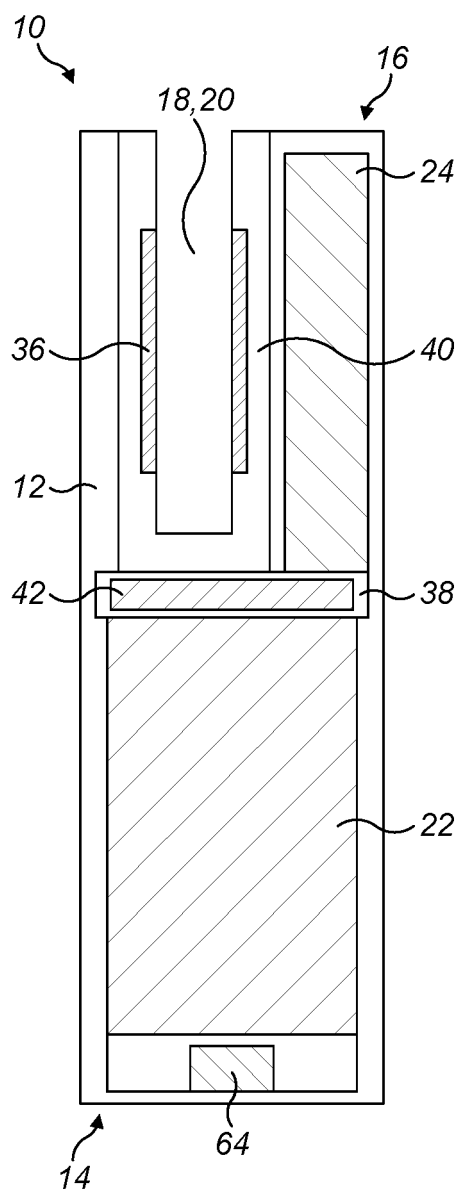


FIG. 3

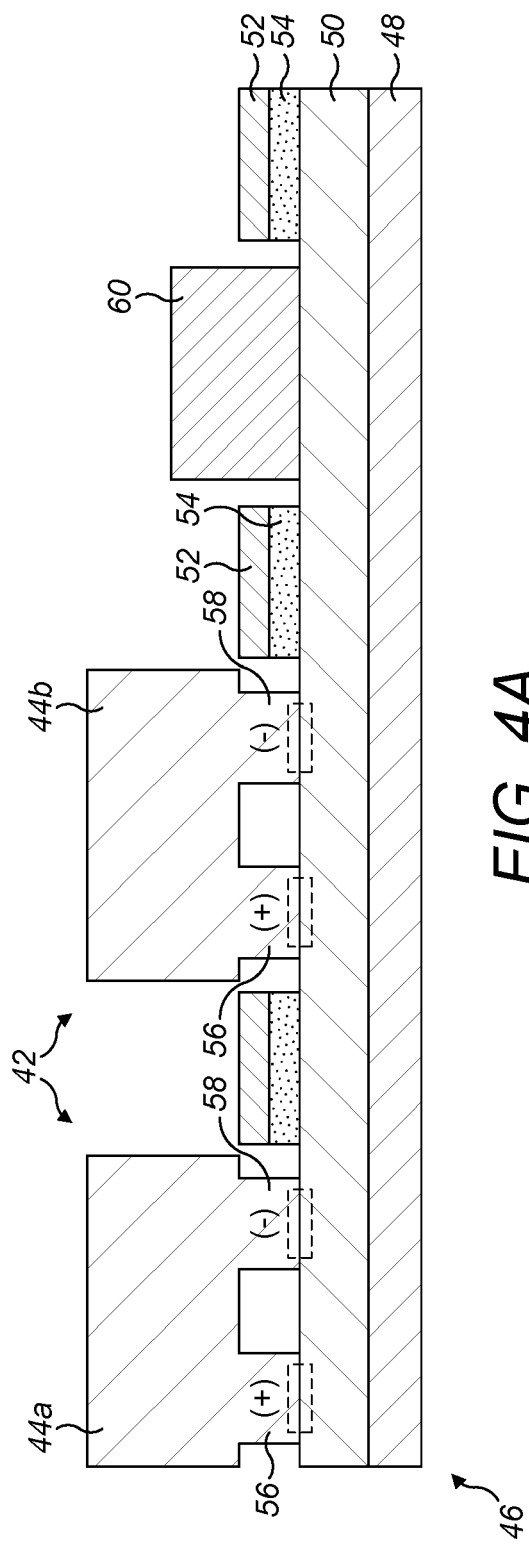


FIG. 4A

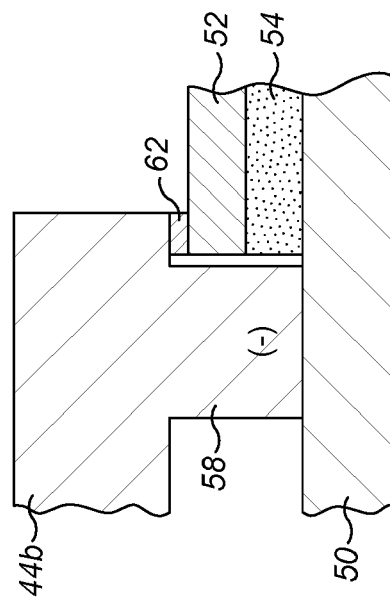


FIG. 4B

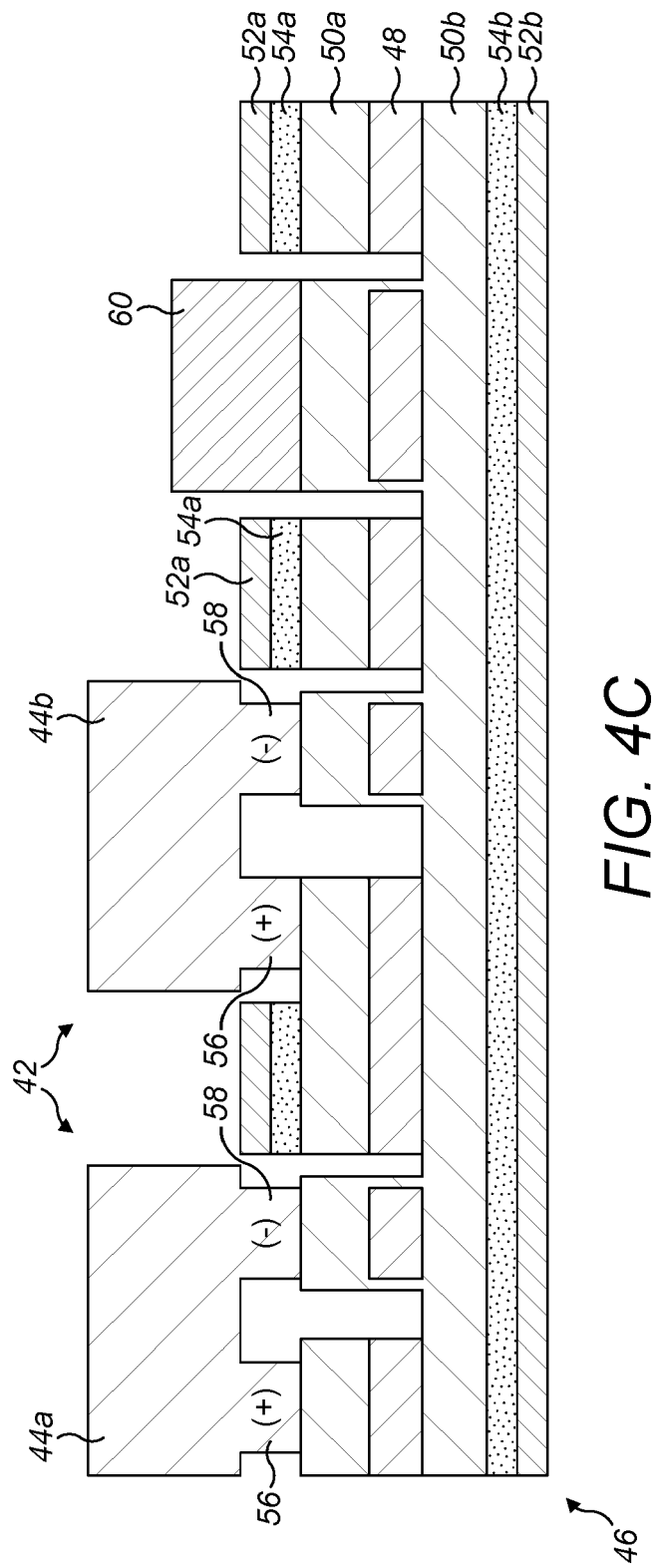
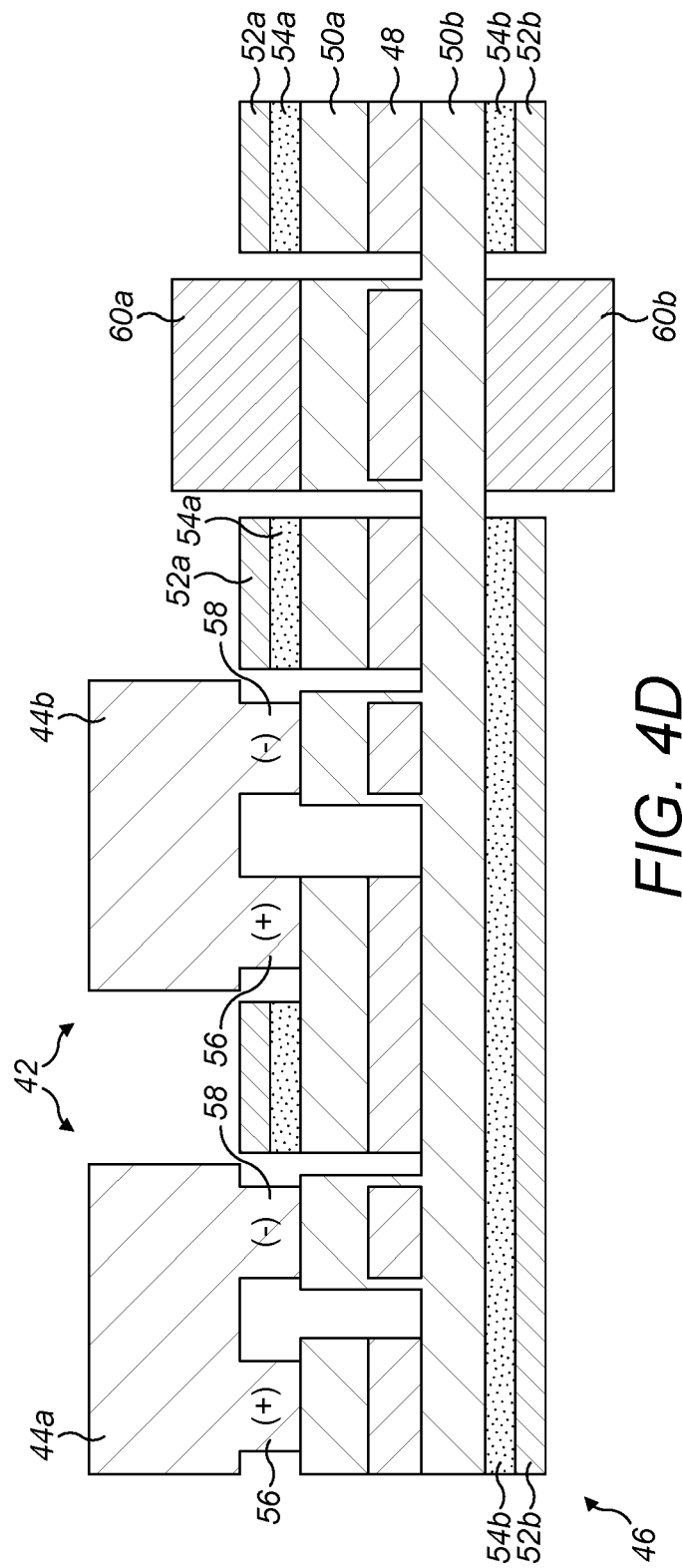


FIG. 4C



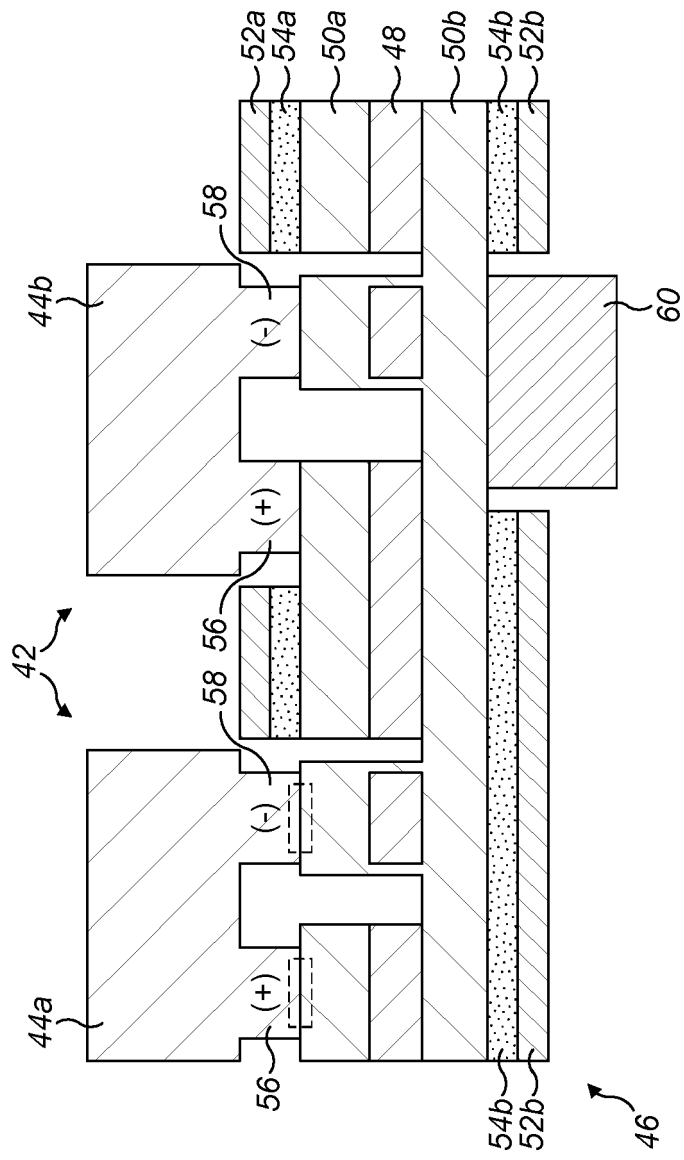


FIG. 4E

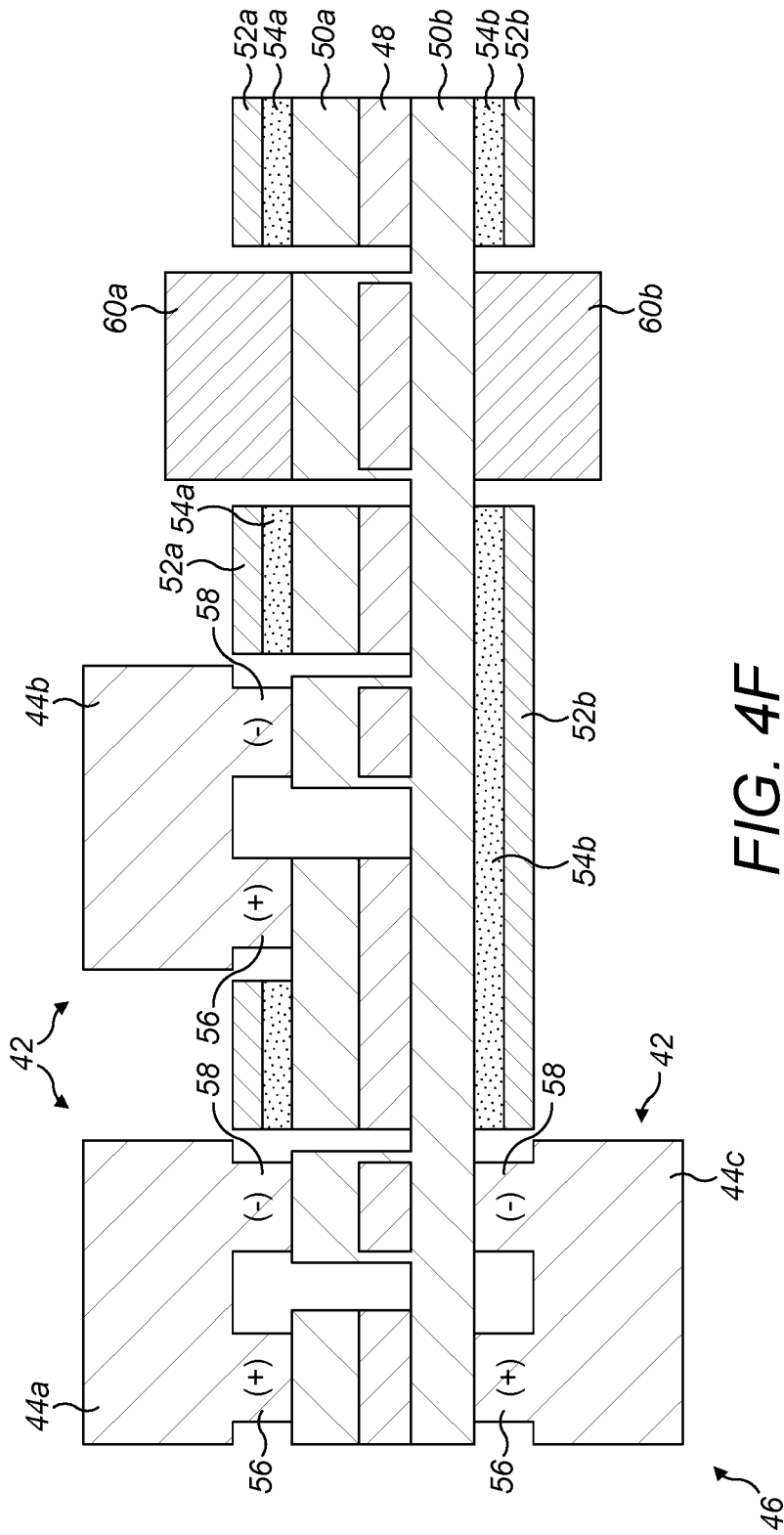


FIG. 4F



EUROPEAN SEARCH REPORT

Application Number

EP 23 21 3519

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 2023/301365 A1 (REGGIORI RICCARDO RIVA [CH] ET AL) 28 September 2023 (2023-09-28) * abstract; figures 1-4 * * paragraph [0007] * * paragraph [0052] * * paragraph [0057] * * paragraph [0062] * * paragraph [0067] - paragraph [0070] * -----	1-4,7,9, 10,12-14 5,6,8, 11,15	INV. A24F40/40 ADD. A24F40/20
A	Jens Anonymous: "The thin-film battery as a flexible, safe and alternative battery technology", , 15 May 2014 (2014-05-15), XP093163131, Retrieved from the Internet: URL:https://www.ifam.fraunhofer.de/en/magazine/thin-film-battery.html [retrieved on 2024-05-15] * the whole document * -----	1-15	
A	WO 2023/001925 A1 (PHILIP MORRIS PRODUCTS SA [CH]) 26 January 2023 (2023-01-26) * abstract; figure 1 * * page 30, line 34 - page 31, line 2 * -----	1-15	TECHNICAL FIELDS SEARCHED (IPC) A24F
A	EP 3 410 876 B1 (PHILIP MORRIS PRODUCTS SA [CH]) 1 April 2020 (2020-04-01) * abstract; figures 1, 2 * ----- - / - -	1-15	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 16 May 2024	Examiner Alaguero, Daniel
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	



EUROPEAN SEARCH REPORT

Application Number
EP 23 21 3519

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2020/060340 A1 (HEJAZI VAHID [US] ET AL) 27 February 2020 (2020-02-27) * abstract; figures 1-12 * * paragraph [0034] * * paragraph [0037] - paragraph [0038] * * paragraph [0091] * * paragraph [0096] * * paragraph [0135] * * paragraph [0137] * * paragraph [0140] *	1-15	
A	WO 2023/105773 A1 (JAPAN TOBACCO INC [JP]) 15 June 2023 (2023-06-15) * abstract; figures 1-17 *	1-15	
A	US 2021/169150 A1 (ZOMINY CLAUDE [FR]) 10 June 2021 (2021-06-10) * abstract; figures 1C, 4C * * paragraph [0031] - paragraph [0033] *	1-15	
A	US 11 533 953 B2 (PHILIP MORRIS PRODUCTS SA [CH]) 27 December 2022 (2022-12-27) * abstract; figures 1-6 *	1-15	TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 16 May 2024	Examiner Alaguero, Daniel
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 23 21 3519

16-05-2024

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
US 2023301365	A1	28-09-2023	CN	116134964	A	16-05-2023
			EP	4186337	A1	31-05-2023
			JP	2023535728	A	21-08-2023
			KR	20230042010	A	27-03-2023
			US	2023301365	A1	28-09-2023
			WO	2022018616	A1	27-01-2022

WO 2023001925	A1	26-01-2023	CN	117642090	A	01-03-2024
			CN	117677309	A	08-03-2024
			EP	4373321	A1	29-05-2024
			EP	4373324	A1	29-05-2024
			IL	310067	A	01-03-2024
			KR	20240036622	A	20-03-2024
			KR	20240036636	A	20-03-2024
			WO	2023001925	A1	26-01-2023
WO	2023001926	A1	26-01-2023			

EP 3410876	B1	01-04-2020	CA	3007764	A1	10-08-2017
			CN	108471810	A	31-08-2018
			EP	3410876	A1	12-12-2018
			IL	260111	A	31-07-2018
			JP	6959927	B2	05-11-2021
			JP	2019509022	A	04-04-2019
			KR	20180111799	A	11-10-2018
			RU	2018131349	A	04-03-2020
WO	2017133870	A1	10-08-2017			

US 2020060340	A1	27-02-2020	AU	2019323818	A1	08-04-2021
			BR	112021003130	A2	11-05-2021
			CA	3109788	A1	27-02-2020
			CL	2021000449	A1	13-08-2021
			CN	113194763	A	30-07-2021
			CO	2021002742	A2	19-03-2021
			EP	3840598	A1	30-06-2021
			IL	280894	A	29-04-2021
			JP	2021534760	A	16-12-2021
			KR	20210042987	A	20-04-2021
			US	2020060340	A1	27-02-2020
			US	2021153554	A1	27-05-2021
			US	2024148063	A1	09-05-2024
WO	2020039391	A1	27-02-2020			

WO 2023105773	A1	15-06-2023	NONE			

US 2021169150	A1	10-06-2021	CN	112752521	A	04-05-2021
			EA	202190571	A1	02-07-2021

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 23 21 3519

5

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The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

16-05-2024

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
		EP 3855951 A1	04-08-2021	
		JP 2022502022 A	11-01-2022	
		US 2021169150 A1	10-06-2021	
		WO 2020064347 A1	02-04-2020	

US 11533953	B2	27-12-2022	CA 3022233 A1	04-01-2018
			CN 109310153 A	05-02-2019
			EP 3478101 A1	08-05-2019
			JP 7069051 B2	17-05-2022
			JP 2019525737 A	12-09-2019
			KR 20190024880 A	08-03-2019
			RU 2019102193 A	29-07-2020
			US 2019320717 A1	24-10-2019
			WO 2018001746 A1	04-01-2018

30

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40

45

50

55

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82