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(54) **Title:** ONE-PIECE SHELL FOR VAPORIZER DEVICE

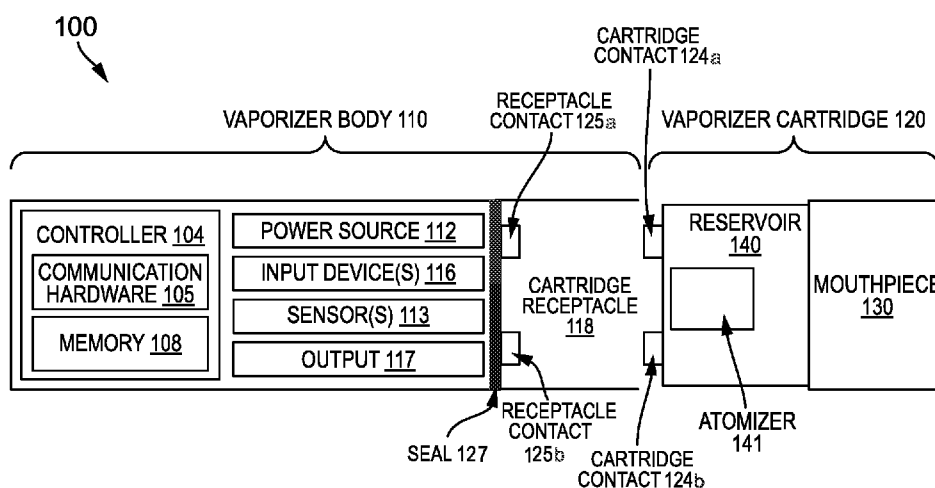


FIG. 1A

(57) **Abstract:** A vaporization device (100) includes a body (110) having first portion including a receptacle (118) configured to receive a vaporizer cartridge (120), and a second portion configured to contain a power source (112). Various embodiments of the vaporizer device are described that include one or more features for a one-piece metal body. In some embodiments, the aspect ratio of the one-piece metal body is 11:1 or 12:1.

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ONE-PIECE SHELL FOR VAPORIZER DEVICE

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 63/028,419, filed on May 21, 2020, which is incorporated herein by reference in entirety and for all purposes.

TECHNICAL FIELD

[0002] The subject matter described herein relates generally to vaporizer devices and more specifically to a shell for a vaporizer device.

BACKGROUND

[0003] Vaporizer devices, which can also be referred to as vaporizers, electronic vaporizer devices, or e-vaporizer devices, can be used for delivery of an aerosol (for example, a vapor-phase and/or condensed-phase material suspended in a stationary or moving mass of air or some other gas carrier) containing one or more active ingredients by inhalation of the aerosol by a user of the vaporizing device. For example, electronic nicotine delivery systems (ENDS) include a class of vaporizer devices that are battery powered and that can be used to simulate the experience of smoking, but without burning of tobacco or other substances. Vaporizers are gaining increasing popularity both for prescriptive medical use, in delivering medicaments, and for consumption of tobacco, nicotine, and other plant-based materials. Vaporizer devices can be portable, self-contained, and/or convenient for use.

[0004] In use of a vaporizer device, the user inhales an aerosol, colloquially referred to as “vapor,” which can be generated by a heating element that vaporizes (e.g., causes a liquid or solid to at least partially transition to the gas phase) a vaporizable material, which can be liquid, a solution, a solid, a paste, a wax, and/or any other form compatible for use with a specific vaporizer device. The vaporizable material used with a vaporizer can be provided within a cartridge for example, a separable part of the vaporizer device that contains vaporizable material) that includes an outlet (for example, a mouthpiece) for inhalation of the aerosol by a user.

[0005] To receive the inhalable aerosol generated by a vaporizer device, a user may, in certain examples, activate the vaporizer device by taking a puff, by pressing a button, and/or by some other approach. A puff as used herein can refer to inhalation by the user in a manner that causes a volume of air to be drawn into the vaporizer device such that the inhalable aerosol is generated by a combination of the vaporized vaporizable material with the volume of air.

[0006] An approach by which a vaporizer device generates an inhalable aerosol from a vaporizable material involves heating the vaporizable material in a vaporization chamber (e.g., a heater chamber) to cause the vaporizable material to be converted to the gas (or vapor) phase. A vaporization chamber can refer to an area or volume in the vaporizer device within which a heat source (for example, a conductive, convective, and/or radiative heat source) causes heating of a vaporizable material to produce a mixture of air and vaporized material to form a vapor for inhalation of the vaporizable material by a user of the vaporization device.

[0007] In some implementations, the vaporizable material can be drawn out of a reservoir and into the vaporization chamber via a wicking element (e.g., a wick). Drawing of the vaporizable material into the vaporization chamber can be at least partially due to capillary action provided by the wick as the wick pulls the vaporizable material along the wick in the direction of the vaporization chamber.

[0008] Vaporizer devices can be controlled by one or more controllers, electronic circuits (for example, sensors, heating elements), and/or the like on the vaporizer. Vaporizer devices can also wirelessly communicate with an external controller for example, a computing device such as a smartphone).

SUMMARY

[0009] In certain aspects of the current subject matter, challenges associated with designing the body of a vaporizer device, specifically the outer enclosure of the body, can be addressed by inclusion of one or more of the features described herein or comparable/equivalent approaches as would be understood by one of ordinary skill in the art. Aspects of the current subject matter relate to a one-piece outer enclosure for a body of a vaporizer device.

[0010] In some variations, one or more of the following features may optionally be included in any feasible combination.

[0011] In an aspect, a vaporizer device is provided. The vaporizer device includes a shell formed from a single continuous piece of a material, the shell having a first portion and a second portion, the first portion of the shell extending at least partially around a perimeter of a receptacle configured to receive a vaporizer cartridge containing a vaporizable material, and the second portion of the shell configured to receive at least a portion of a power source, and the second portion of the shell having a second thickness that is less than a first thickness of the first portion of the shell and/or a transition region between the first portion of the shell and the second portion of the shell.

[0012] In another, interrelated aspect, a shell for a vaporizer device is provided. The shell includes a single continuous piece of a material, wherein the shell has a first portion and a second portion, the first portion of the shell extending at least partially around a perimeter of a receptacle configured to receive a vaporizer cartridge containing a vaporizable material, and the second portion of the shell configured to receive at least a portion of a power source. The second portion of the shell has a second thickness that is less than a first thickness of the first portion of the shell and/or a thickness of a transition region between the first portion of the shell and the second portion of the shell.

[0013] In some variations, one or more of the following features may optionally be included in any feasible combination.

[0014] The second portion of the shell can have a larger inner cross-sectional dimension than the first portion of the shell. The material can include a metal or a metal alloy. The second thickness of the second portion of the shell can be reduced in order to increase an inner cross-sectional dimension of the second portion of the shell. A length of the shell can be greater than 8 times a width of the shell. A length of the shell can be 11-12 times a width of the shell. The shell can be formed by subjecting a slug or billet of the material to impact. The slug or billet may be either solid or hollow. The shell can include one or more apertures configured to allow visualization of one or more illuminating device indicators. The one or more illuminating device indicators can be light emitting diodes. The first portion of the shell can include a first air inlet configured to form a fluid coupling with a second air inlet in the vaporizer cartridge when the vaporizer cartridge is coupled with the vaporizer device, and the second air inlet in the vaporizer cartridge can be configured to allow air entering the first air inlet to further enter the vaporizer cartridge. The receptacle may include a cartridge interface configured to receive the vaporizer cartridge. At least one sidewall of the cartridge interface includes a notch where a material forming the cartridge interface is at least partially removed to accommodate the vaporizer cartridge.

[0015] The details of one or more variations of the subject matter described herein are set forth in the accompanying drawings and the description below. Other features and advantages of the subject matter described herein will be apparent from the description and drawings, and from the claims. The claims that follow this disclosure are intended to define the scope of the protected subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The accompanying drawings, which are incorporated into and constitute a part of this specification, show certain aspects of the subject matter disclosed herein and, together with the description, help explain some of the principles associated with the disclosed implementations. In the drawings:

[0017] FIG. 1A depicts a block diagram illustrating an example of a vaporizer device consistent with implementations of the current subject matter;

[0018] FIG. 1B depicts an example of a vaporizer cartridge consistent with implementations of the current subject matter;

[0019] FIG. 1C depicts a perspective view of an example of a vaporizer cartridge coupled to a vaporizer device consistent with implementations of the current subject matter;

[0020] FIG. 1D depicts a front plan view of the vaporizer cartridge and vaporizer device of FIG. 1C;

[0021] FIG. 1E depicts a back plan view of the vaporizer cartridge and vaporizer device of FIG. 1C;

[0022] FIG. 1F depicts a left side plan view of the vaporizer cartridge and vaporizer device of FIG. 1C;

[0023] FIG. 1G depicts a right side plan view of the vaporizer cartridge and vaporizer device of FIG. 1C;

[0024] FIG. 1H depicts a top plan view of the vaporizer cartridge of FIG. 1C;

[0025] FIG. 1I depicts a bottom plan view of the vaporizer device of FIG. 1C;

[0026] FIG. 2A depicts a schematic representation of an example of a shell for a body of a vaporizer device consistent with implementations of the current subject matter;

[0027] FIG. 2B depicts a schematic representation of a portion of an example of a shell for a body of a vaporizer device consistent with implementations of the current subject matter;

[0028] FIG. 3A depicts a cross-sectional view of an example of a shell for a body of a vaporizer device consistent with implementations of the current subject matter;

[0029] FIG. 3B depicts another cross-sectional view of an example of a shell for a body of a vaporizer device consistent with implementations of the current subject matter;

[0030] FIG. 4A depicts a top cross-sectional view of a vaporizer device consistent with implementations of the current subject matter;

[0031] FIG. 4B depicts a bottom cross-sectional view of the vaporizer device of FIG. 4A;

[0032] FIG. 4C depicts a front plan view of the vaporizer device of FIG. 4A;

[0033] FIG. 4D depicts a side cross-sectional view of the vaporizer device of FIG. 4A;

- [0034] FIG. 4E depicts another front plan view of the vaporizer device of FIG. 4A;
- [0035] FIG. 5A depicts a cross-sectional view of a body of an example of vaporizer device coupled to a vaporizer cartridge consistent with implementations of the current subject matter;
- [0036] FIG. 5B depicts a disassembled view of an example of a vaporizer body consistent with implementations of the current subject matter;
- [0037] FIG. 5C depicts a top perspective view of a vaporizer body including an example of a cartridge receptacle consistent with implementations of the current subject matter;
- [0038] FIG. 6 depicts a flowchart illustrating an example of a method for manufacturing a shell for a body of a vaporizer device consistent with implementations of the current subject matter;
- [0039] FIG. 7A depicts a front plan view of a vaporizer device consistent with implementations of the current subject matter after a step of the method for manufacturing of FIG. 6; and
- [0040] FIG. 7B depicts a front plan view of the vaporizer device of FIG. 7A after a subsequent step of the method for manufacturing of FIG. 6.
- [0041] When practical, similar reference numbers denote similar structures, features, or elements.

DETAILED DESCRIPTION

- [0042] Implementations of the current subject matter include methods, apparatuses, articles of manufacture, and systems relating to vaporization of one or more materials for inhalation by a user. Example implementations include vaporizer devices and systems including vaporizer devices. The vaporizable material used with a vaporizer device can be provided within a cartridge (for example, a part of the vaporizer that contains the vaporizable material in a reservoir or other container) which can be refillable when empty, or disposable such that a new cartridge containing additional vaporizable material of a same or different type can be used). A vaporizer device can be a cartridge-using vaporizer device, a cartridge-less vaporizer device, or a multi-use vaporizer device capable of use with or without a cartridge. For example, a vaporizer device can include a heating chamber (for example, an oven or other region in which material is heated by a heating element) configured to receive a vaporizable material directly into the heating chamber, and/or a reservoir or the like for containing the vaporizable material.
- [0043] In some implementations of the current subject matter, a vaporizer device can be configured for use with a liquid vaporizable material (for example, a carrier solution in which an active and/or inactive ingredient(s) are suspended or held in solution, or a liquid form of the

vaporizable material itself), a paste, a wax, and/or a solid vaporizable material. A solid vaporizable material can include a plant material that emits some part of the plant material as the vaporizable material (for example, some part of the plant material remains as waste after the material is vaporized for inhalation by a user) or optionally can be a solid form of the vaporizable material itself, such that all of the solid material can eventually be vaporized for inhalation. A liquid vaporizable material can likewise be capable of being completely vaporized, or can include some portion of the liquid material that remains after all of the material suitable for inhalation has been vaporized.

[0044] FIG. 1A depicts a block diagram illustrating an example of a vaporizer device 100 consistent with implementations of the current subject matter. Referring to FIG. 1A, the vaporizer device 100 can include a power source 112 (for example, a battery, which can be a rechargeable battery), and a controller 104 (for example, a processor, circuitry, etc. capable of executing logic) for controlling delivery of heat to an atomizer 141 to cause a vaporizable material 102 to be converted from a condensed form (such as a solid, a liquid, a solution, a suspension, a part of an at least partially unprocessed plant material, etc.) to the gas phase. The controller 104 can be part of one or more printed circuit boards (PCBs) consistent with certain implementations of the current subject matter. After conversion of the vaporizable material 102 to the gas phase, at least some of the vaporizable material 102 in the gas phase can condense to form particulate matter in at least a partial local equilibrium with the gas phase as part of an aerosol, which can form some or all of an inhalable dose provided by the vaporizer device 100 during a user's puff or draw on the vaporizer device 100. It should be appreciated that the interplay between gas and condensed phases in an aerosol generated by a vaporizer device 100 can be complex and dynamic, due to factors such as ambient temperature, relative humidity, chemistry, flow conditions in airflow paths (both inside the vaporizer and in the airways of a human or other animal), and/or mixing of the vaporizable material 102 in the gas phase or in the aerosol phase with other air streams, which can affect one or more physical parameters of an aerosol. In some vaporizer devices, and particularly for vaporizer devices configured for delivery of volatile vaporizable materials, the inhalable dose can exist predominantly in the gas phase (for example, formation of condensed phase particles can be very limited).

[0045] The atomizer 141 in the vaporizer device 100 can be configured to vaporize a vaporizable material 102. The vaporizable material 102 can be a liquid. Examples of the vaporizable material 102 include neat liquids, suspensions, solutions, mixtures, and/or the like. The atomizer 141 can include a wicking element (e.g., a wick) configured to convey an amount

of the vaporizable material 102 to a part of the atomizer 141 that includes a heating element (not shown in FIG. 1A).

[0046] For example, the wicking element can be configured to draw the vaporizable material 102 from a reservoir 140 configured to contain the vaporizable material 102, such that the vaporizable material 102 can be vaporized by heat delivered from a heating element. The wicking element can also optionally allow air to enter the reservoir 140 and replace the volume of vaporizable material 102 removed. In some implementations of the current subject matter, capillary action can pull vaporizable material 102 into the wick for vaporization by the heating element, and air can return to the reservoir 140 through the wick to at least partially equalize pressure in the reservoir 140. Other methods of allowing air back into the reservoir 140 to equalize pressure are also within the scope of the current subject matter.

[0047] As used herein, the terms “wick” or “wicking element” include any material capable of causing fluid motion via capillary pressure.

[0048] The heating element can include one or more of a conductive heater, a radiative heater, and/or a convective heater. One type of heating element is a resistive heating element, which can include a material (such as a metal or alloy, for example a nickel-chromium alloy, or a non-metallic resistor) configured to dissipate electrical power in the form of heat when electrical current is passed through one or more resistive segments of the heating element. In some implementations of the current subject matter, the atomizer 141 can include a heating element which includes a resistive coil or other heating element wrapped around, positioned within, integrated into a bulk shape of, pressed into thermal contact with, or otherwise arranged to deliver heat to a wicking element, to cause the vaporizable material 102 drawn from the reservoir 140 by the wicking element to be vaporized for subsequent inhalation by a user in a gas and/or a condensed (for example, aerosol particles or droplets) phase. Other wicking elements, heating elements, and/or atomizer configurations are also possible.

[0049] Certain vaporizer devices may, additionally or alternatively, be configured to create an inhalable dose of the vaporizable material 102 in the gas phase and/or aerosol phase via heating of the vaporizable material 102. The vaporizable material 102 can be a solid-phase material (such as a wax or the like) or plant material (for example, tobacco leaves and/or parts of tobacco leaves). In such vaporizer devices, a resistive heating element can be part of, or otherwise incorporated into or in thermal contact with, the walls of an oven or other heating chamber into which the vaporizable material 102 is placed. Alternatively, a resistive heating element or elements can be used to heat air passing through or past the vaporizable material 102, to cause convective heating of the vaporizable material 102. In still other examples, a

resistive heating element or elements can be disposed in intimate contact with plant material such that direct conductive heating of the plant material occurs from within a mass of the plant material, as opposed to only by conduction inward from walls of an oven.

[0050] The heating element can be activated in association with a user puffing (e.g., drawing, inhaling, etc.) on a mouthpiece 130 of the vaporizer device 100 to cause air to flow from an air inlet, along an airflow path that passes the atomizer 141 (e.g., wicking element and heating element). Optionally, air can flow from an air inlet through one or more condensation areas or chambers, to an air outlet in the mouthpiece 130. Incoming air moving along the airflow path moves over or through the atomizer 141, where vaporizable material 102 in the gas phase is entrained into the air. The heating element can be activated via the controller 104, which can optionally be a part of a vaporizer body 110 as discussed herein, causing current to pass from the power source 112 through a circuit including the resistive heating element, which is optionally part of a vaporizer cartridge 120 as discussed herein. As noted herein, the entrained vaporizable material 102 in the gas phase can condense as it passes through the remainder of the airflow path such that an inhalable dose of the vaporizable material 102 in an aerosol form can be delivered from the air outlet (for example, the mouthpiece 130) for inhalation by a user.

[0051] Activation of the heating element can be caused by automatic detection of a puff based on one or more signals generated by one or more sensor(s) 113. The sensor 113 and the signals generated by the sensor 113 can include one or more of: a pressure sensor or sensors disposed to detect pressure along the airflow path relative to ambient pressure (or optionally to measure changes in absolute pressure), a motion sensor or sensors (for example, an accelerometer) of the vaporizer device 100, a flow sensor or sensors of the vaporizer device 100, a capacitive lip sensor of the vaporizer device 100, detection of interaction of a user with the vaporizer device 100 via one or more input devices 116 (for example, buttons or other tactile control devices of the vaporizer device 100), receipt of signals from a computing device in communication with the vaporizer device 100, and/or via other approaches for determining that a puff is occurring or imminent.

[0052] As discussed herein, the vaporizer device 100 consistent with implementations of the current subject matter can be configured to connect (such as, for example, wirelessly or via a wired connection) to a computing device (or optionally two or more devices) in communication with the vaporizer device 100. To this end, the controller 104 can include communication hardware 105. The controller 104 can also include a memory 108. The

communication hardware 105 can include firmware and/or can be controlled by software for executing one or more cryptographic protocols for the communication.

[0053] A computing device can be a component of a vaporizer system that also includes the vaporizer device 100, and can include its own hardware for communication, which can establish a wireless communication channel with the communication hardware 105 of the vaporizer device 100. For example, a computing device used as part of a vaporizer system can include a general-purpose computing device (such as a smartphone, a tablet, a personal computer, some other portable device such as a smartwatch, or the like) that executes software to produce a user interface for enabling a user to interact with the vaporizer device 100. In other implementations of the current subject matter, such a device used as part of a vaporizer system can be a dedicated piece of hardware such as a remote control or other wireless or wired device having one or more physical or soft (e.g., configurable on a screen or other display device and selectable via user interaction with a touch-sensitive screen or some other input device like a mouse, pointer, trackball, cursor buttons, or the like) interface controls. The vaporizer device 100 can also include one or more outputs 117 or devices for providing information to the user. For example, the outputs 117 can include one or more illuminating indicators, such as light emitting diodes (LEDs) or other light sources, configured to provide feedback to a user based on a status and/or mode of operation of the vaporizer device 100. The illuminating indicators may flash, change colors, and/or brighten, or provide other indications relating to the status or use of the vaporizer device 100.

[0054] In the example in which a computing device provides signals related to activation of the resistive heating element, or in other examples of coupling of a computing device with the vaporizer device 100 for implementation of various control or other functions, the computing device executes one or more computer instruction sets to provide a user interface and underlying data handling. In one example, detection by the computing device of user interaction with one or more user interface elements can cause the computing device to signal the vaporizer device 100 to activate the heating element to reach an operating temperature for creation of an inhalable dose of vapor/aerosol. Other functions of the vaporizer device 100 can be controlled by interaction of a user with a user interface on a computing device in communication with the vaporizer device 100.

[0055] The temperature of a resistive heating element of the vaporizer device 100 can depend on a number of factors, including an amount of electrical power delivered to the resistive heating element and/or a duty cycle at which the electrical power is delivered, conductive heat transfer to other parts of the electronic vaporizer device 100 and/or to the

environment, latent heat losses due to vaporization of the vaporizable material 102 from the wicking element and/or the atomizer 141 as a whole, and convective heat losses due to airflow (e.g., air moving across the heating element or the atomizer 141 as a whole when a user inhales on the vaporizer device 100). As noted herein, to reliably activate the heating element or heat the heating element to a desired temperature, the vaporizer device 100 may, in some implementations of the current subject matter, make use of signals from the sensor 113 (for example, a pressure sensor) to determine when a user is inhaling. The sensor 113 can be positioned in the airflow path and/or can be connected (for example, by a passageway or other path) to an airflow path containing an inlet for air to enter the vaporizer device 100 and an outlet via which the user inhales the resulting vapor and/or aerosol such that the sensor 113 experiences changes (for example, pressure changes) concurrently with air passing through the vaporizer device 100 from the air inlet to the air outlet. In some implementations of the current subject matter, the heating element can be activated in association with a user's puff, for example by automatic detection of the puff, or by the sensor 113 detecting a change (such as a pressure change) in the airflow path.

[0056] The sensor 113 can be positioned on or coupled to (e.g., electrically or electronically connected, either physically or via a wireless connection) the controller 104 (for example, a printed circuit board or other type of circuit board). To take measurements accurately and maintain durability of the vaporizer device 100, it can be beneficial to provide a seal 127 resilient enough to separate an airflow path from other parts of the vaporizer device 100. The seal 127, which can be a gasket, can be configured to at least partially surround the sensor 113 such that connections of the sensor 113 to the internal circuitry of the vaporizer device 100 are separated from a part of the sensor 113 exposed to the airflow path. In an example of a cartridge-based vaporizer, the seal 127 can also separate parts of one or more electrical connections between the vaporizer body 110 and the vaporizer cartridge 120. Such arrangements of the seal 127 in the vaporizer device 100 can be helpful in mitigating against potentially disruptive impacts on vaporizer components resulting from interactions with environmental factors such as water in the vapor or liquid phases, other fluids such as the vaporizable material 102, etc., and/or to reduce the escape of air from the designated airflow path in the vaporizer device 100. Unwanted air, liquid or other fluid passing and/or contacting circuitry of the vaporizer device 100 can cause various unwanted effects, such as altered pressure readings, and/or can result in the buildup of unwanted material, such as moisture, excess vaporizable material 102, etc., in parts of the vaporizer device 100 where they can result in poor pressure signal, degradation of the sensor 113 or other components, and/or a shorter

life of the vaporizer device 100. Leaks in the seal 127 can also result in a user inhaling air that has passed over parts of the vaporizer device 100 containing, or constructed of, materials that may not be desirable to be inhaled.

[0057] In some implementations, the vaporizer body 110 includes the controller 104, the power source 112 (for example, a battery), one more of the sensor 113, charging contacts (such as those for charging the power source 112), the seal 127, and a cartridge receptacle 118 configured to receive the vaporizer cartridge 120 for coupling with the vaporizer body 110 through one or more of a variety of attachment structures. In some examples, the vaporizer cartridge 120 includes the reservoir 140 for containing the vaporizable material 102, and the mouthpiece 130 has an aerosol outlet for delivering an inhalable dose to a user. The vaporizer cartridge 120 can include the atomizer 141 having a wicking element and a heating element. Alternatively, one or both of the wicking element and the heating element can be part of the vaporizer body 110. In implementations in which any part of the atomizer 141 (e.g., heating element and/or wicking element) is part of the vaporizer body 110, the vaporizer device 100 can be configured to supply vaporizable material 102 from the reservoir 140 in the vaporizer cartridge 120 to the part(s) of the atomizer 141 included in the vaporizer body 110.

[0058] Cartridge-based configurations for the vaporizer device 100 that generate an inhalable dose of a vaporizable material 102 that is not a liquid, via heating of a non-liquid material, are also within the scope of the current subject matter. For example, the vaporizer cartridge 120 can include a mass of a plant material that is processed and formed to have direct contact with parts of one or more resistive heating elements, and the vaporizer cartridge 120 can be configured to be coupled mechanically and/or electrically to the vaporizer body 110 that includes the controller 104, the power source 112, and one or more receptacle contacts 125a and 125b configured to connect to one or more corresponding cartridge contacts 124a and 125b and complete a circuit with the one or more resistive heating elements.

[0059] In an embodiment of the vaporizer device 100 in which the power source 112 is part of the vaporizer body 110, and a heating element is disposed in the vaporizer cartridge 120 and configured to couple with the vaporizer body 110, the vaporizer device 100 can include electrical connection features (for example, means for completing a circuit) for completing a circuit that includes the controller 104 (for example, a printed circuit board, a microcontroller, or the like), the power source 112, and the heating element (for example, a heating element within the atomizer 141). These features can include one or more contacts (referred to herein as cartridge contacts 124a and 124b) on a bottom surface of the vaporizer cartridge 120 and at least two contacts (referred to herein as receptacle contacts 125a and 125b) disposed near a

base of the cartridge receptacle 118 of the vaporizer device 100 such that the cartridge contacts 124a and 124b and the receptacle contacts 125a and 125b make electrical connections when the vaporizer cartridge 120 is inserted into and coupled with the cartridge receptacle 118. The circuit completed by these electrical connections can allow delivery of electrical current to a heating element and can further be used for additional functions, such as measuring a resistance of the heating element for use in determining and/or controlling a temperature of the heating element based on a thermal coefficient of resistivity of the heating element.

[0060] In some implementations of the current subject matter, the cartridge contacts 124a and 124b and the receptacle contacts 125a and 125b can be configured to electrically connect in either of at least two orientations. In other words, one or more circuits necessary for operation of the vaporizer device 100 can be completed by insertion of the vaporizer cartridge 120 into the cartridge receptacle 118 in a first rotational orientation (around an axis along which the vaporizer cartridge 120 is inserted into the cartridge receptacle 118 of the vaporizer body 110) such that the cartridge contact 124a is electrically connected to the receptacle contact 125a and the cartridge contact 124b is electrically connected to the receptacle contact 125b. Furthermore, the one or more circuits necessary for operation of the vaporizer device 100 can be completed by insertion of the vaporizer cartridge 120 in the cartridge receptacle 118 in a second rotational orientation such cartridge contact 124a is electrically connected to the receptacle contact 125b and cartridge contact 124b is electrically connected to the receptacle contact 125a.

[0061] In one example of an attachment structure for coupling the vaporizer cartridge 120 to the vaporizer body 110, the vaporizer body 110 includes one or more detents (for example, dimples, protrusions, etc.) protruding inwardly from an inner surface of the cartridge receptacle 118, additional material (such as metal, plastic, etc.) formed to include a portion protruding into the cartridge receptacle 118, and/or the like. One or more exterior surfaces of the vaporizer cartridge 120 can include corresponding recesses (not shown in FIG. 1A) that can fit and/or otherwise snap over such detents or protruding portions when the vaporizer cartridge 120 is inserted into the cartridge receptacle 118 on the vaporizer body 110. When the vaporizer cartridge 120 and the vaporizer body 110 are coupled (e.g., by insertion of the vaporizer cartridge 120 into the cartridge receptacle 118 of the vaporizer body 110), the detents or protrusions of the vaporizer body 110 can fit within and/or otherwise be held within the recesses of the vaporizer cartridge 120, to hold the vaporizer cartridge 120 in place when assembled. Such an can provide enough support to hold the vaporizer cartridge 120 in place to ensure good contact between the cartridge contacts 124a and 124b and the receptacle

contacts 125a and 125b, while allowing release of the vaporizer cartridge 120 from the vaporizer body 110 when a user pulls with reasonable force on the vaporizer cartridge 120 to disengage the vaporizer cartridge 120 from the cartridge receptacle 118.

[0062] In some implementations, the vaporizer cartridge 120, or at least an insertable end 122 of the vaporizer cartridge 120 configured for insertion in the cartridge receptacle 118, can have a non-circular cross section transverse to the axis along which the vaporizer cartridge 120 is inserted into the cartridge receptacle 118. For example, the non-circular cross section can be approximately rectangular, approximately elliptical (e.g., have an approximately oval shape), non-rectangular but with two sets of parallel or approximately parallel opposing sides (e.g., having a parallelogram-like shape), or other shapes having rotational symmetry of at least order two. In this context, approximate shape indicates that a basic likeness to the described shape is apparent, but that sides of the shape in question need not be completely linear and vertices need not be completely sharp. Rounding of both or either of the edges or the vertices of the cross-sectional shape is contemplated in the description of any non-circular cross section referred to herein.

[0063] The cartridge contacts 124a and 124b and the receptacle contacts 125a and 125b can take various forms. For example, one or both sets of contacts can include conductive pins, tabs, posts, receiving holes for pins or posts, or the like. Some types of contacts can include springs or other features to facilitate better physical and electrical contact between the contacts on the vaporizer cartridge 120 and the vaporizer body 110. The electrical contacts can optionally be gold-plated, and/or include other materials.

[0064] FIG. 1B depicts an example of the vaporizer cartridge 120 consistent with implementations of the current subject matter. In some implementations of the current subject matter, the example of the vaporizer cartridge 120 shown in FIG. 1B may be configured to couple with the vaporizer body 110. Referring to FIG. 1B, the vaporizer cartridge 120 may include a housing 160, a collector 1313, a wicking element 1362, a heating element 1350, a wick housing 1315, and an identifier chip 174. For example, as shown in FIG. 1B, the collector 1313 may be coupled with an assembly including the wicking element 1362 and the heating element 1350 disposed at least partially inside the wick housing 1315. When the vaporizer cartridge 120 is assembled, the collector 1313 and the assembly including the wicking element 1362, the heating element 1350, and the wick housing 1315 may be disposed inside the housing 160 of the vaporizer cartridge 120 with the housing 160 extending around a perimeter of the collector 1313 and the wick housing 1315. Moreover, the housing 160 of the vaporizer cartridge 120 may extend at least partially below a top of the wick housing 1315. Accordingly,

when the vaporizer cartridge 120 is coupled with the vaporizer body 110, at least a portion of the vaporizer cartridge 120, for example, at least a portion of the wick housing 1315 may be disposed inside the cartridge receptacle 118 of the vaporizer body 110 and the housing 160 of the vaporizer cartridge 120 may extend at least partially around a perimeter of the cartridge receptacle 118 as well as at least partially below a top of the cartridge receptacle 118.

[0065] In some implementations of the current subject matter, the collector 1313 may be configured to control an exchange of air and a vaporizable material into and out of the reservoir 140 of the vaporizer cartridge 120. As shown in FIG. 1B, the reservoir 140 may include a storage chamber 1342 and an overflow volume 1344 including the collector 1313. The storage chamber 1342 may be configured to contain at least a portion of the vaporizable material included in the cartridge 120. Moreover, the cartridge 120 may be initially filled with the vaporizable material such that void space within the collector 1313 is at least partially filled with the vaporizable material as well. The overflow volume 1344 may be configured to collect and/or retain at least a portion of the vaporizable material displaced from the storage chamber 1342 to the overflow volume 1344 by one or more changes in a pressure state of the cartridge 120. Accordingly, the volumetric size of the overflow volume 1344 may be configured to be equal to, approximately equal to, or greater than the amount of increase in the volume of the content (e.g., vaporizable material and air) contained in the storage chamber 1342, when the volume of the content in the storage chamber 1342 expands due to a maximum expected change in pressure that the reservoir 140 may undergo relative to an ambient pressure.

[0066] Depending on changes in ambient pressure, temperature, and/or other factors, the cartridge 120 may experience a change from a first pressure state to a second pressure state (e.g., a first relative pressure differential between the interior of the reservoir and ambient pressure and a second relative pressure differential between the interior of the reservoir and ambient pressure). For example, in the first pressure state, the pressure inside the cartridge 120 may be less than an ambient pressure external to the cartridge 120. Contrastingly, in the second pressure state, the pressure inside the cartridge 120 may exceed the ambient pressure. When the cartridge 120 is in an equilibrium state, the pressure inside the cartridge 120 may be substantially equal to the ambient pressure external to the cartridge 120.

[0067] As used herein, a “pressure differential” may refer to a difference between a pressure within an internal part of the cartridge 120 and an ambient pressure external to the cartridge 120. Drawing the vaporizable material 1302 from the storage chamber 1342 to the atomizer for conversion to vapor or aerosol phases may reduce the volume of the vaporizable material 1302 remaining in the storage chamber 1342. Absent a mechanism for returning air

into the storage chamber 1342 (e.g., to increase the pressure inside the cartridge 120 to achieve a substantial equilibrium with ambient pressure), low pressure or even a vacuum may develop within the cartridge 120. The low pressure or vacuum may interfere with the capillary action of the wicking element 1362 to draw additional quantities of the vaporizable material 1302 to the heating element 1350.

[0068] Alternatively, the pressure inside of the cartridge 120 can also increase and exceed the ambient pressure external to the cartridge 120 due to various environmental factors such as, for example, a change in ambient temperature, altitude, and/or volume of the cartridge 120. This increase in internal pressure may occur, for example, after air is returned into the storage chamber 1342 to achieve an equilibrium between the pressure inside the cartridge 120 and the ambient pressure external to the cartridge 120. However, it should be appreciated that a sufficient change in one or more environmental factors may cause the pressure in the cartridge 120 to increase from below ambient pressure to above ambient pressure (e.g., transition from the first pressure state to the second pressure state) without any additional air entering the cartridge 120 to first achieve an equilibrium between the pressure inside the cartridge 120 and ambient pressure. The resulting negative pressure event in which the pressure inside the cartridge 120 undergoes a sufficient increase may displace at least a portion of the vaporizable material 1302 in the storage chamber 1342. Absent a mechanism for collecting and/or retaining the displaced vaporizable material 1302 within the cartridge 120, the displaced vaporizable material 1302 may leak from the cartridge 120.

[0069] In some implementations of the current subject matter, the overflow volume 1344 may have an opening to the exterior of cartridge 120 and may be in communication with the storage chamber 1342 such that the overflow volume 1344 may act as a venting channel to provide for the equalization of pressure in the cartridge 120, collect and at least temporarily retain the vaporizable material displaced from the storage chamber 1342 due to variations in a pressure differential between the storage chamber 1342 and ambient pressure, and/or optionally reversibly return at least a portion of the vaporizable material collected in the overflow volume 1344 back to into the storage chamber 1342.

[0070] For example, in the first pressure state, the vaporizable material may be stored in the storage chamber 1342 of the reservoir 140. As noted, the first pressure state may exist, for example, when the ambient pressure external to the cartridge 120 is approximately the same as or more than the pressure inside the cartridge 120. In this first pressure state, the structural and functional properties of the overflow channel 1104 are such that the vaporizable material may flow from the storage chamber 1342 toward the wicking element 1362 by way of one or more

wick feeds 1362 leading from the storage chamber 1342 to the wicking element 1362 through the collector 1313. For example, capillary action of the wicking element 1362 may draw the vaporizable material into proximity with the heating element 1350. Heat generated by the heating element 1350 may act on the vaporizable material to convert at least a portion of the vaporizable material to a gas phase.

[0071] In some implementations of the current subject matter, in the first pressure state, none or a limited quantity of the vaporizable material may flow into the collector 1313, for example, into the overflow channel 1104 of the collector 1313. Contrastingly, when the cartridge 120 transitions from the first pressure state to the second pressure state, the vaporizable material may flow from the storage chamber 1342 into the overflow volume 1344 of the reservoir 140. By collecting and at least temporarily retaining the vaporizable material 1302 displaced from the storage chamber 1342, the collector 1313 may prevent or limit an undesirable (e.g., excessive) flow of the vaporizable material out of the reservoir 140. As noted, the second pressure state may exist when the ambient pressure external to the cartridge 120 is less than the pressure inside the cartridge 120. This pressure differential may cause an expanding air bubble inside the storage chamber 1342, which may displace a portion of the vaporizable material inside the storage chamber 1342. The displaced portion of the vaporizable material may be collected and at least temporarily retained by the collector 1313 instead of exiting the cartridge 120 to cause undesirable leakage.

[0072] Advantageously, flow of the vaporizable material may be controlled by way of routing the vaporizable material displaced from the storage chamber 1342 to the overflow volume 1344 in the second pressure state. For example, as shown in FIG. 1D, the collector 1313 may include an overflow channel 1104 having one or more capillary structures configured to collect and at least temporarily retain that contain at least some (and advantageously all) of the excess liquid vaporizable material displaced from the storage chamber 1342 without allowing the liquid vaporizable material to exit the collector 1313 and cause undesirable leakage. The overflow channel 1104 may also include capillary structures that enable the vaporizable material pushed into the collector 1313 (e.g., by excess pressure in the storage chamber 1342 relative to ambient pressure) to be reversibly drawn back into the storage chamber 1342 when the pressure inside the storage chamber 1342 reduces and/or equalizes relative to ambient pressure. For instance, the overflow channel 1104 of the collector 1313 may include one or more flow reversal features and/or properties that prevent air and liquid from bypassing each other during filling and emptying of the collector 1313. As such, the overflow channel 1104 may include microfluidic features configured to control the flow of the

vaporizable material into as well as out of the collector 1313. In doing so, the collector 1313 including the overflow channel 1104 may prevent or reduce leakage of the vaporizable material as well as the entrapment of air bubbles in the storage chamber 1342 and/or the overflow volume 1344.

[0073] Depending on the implementation, the microfluidic features or properties noted above may be related to the size, shape, surface coating, structural features, and/or capillary properties of the wicking element 1362, the wick feeds 1368, and/or the overflow channel 1104. For example, the overflow channel 1104 in the collector 1313 may optionally have different capillary properties than the wick feeds 1368 leading to the wicking element 1362 such that a certain volume of the vaporizable material may be allowed to pass from the storage chamber 1342 into the overflow volume 1344 during the second pressure state in which at least a portion of the vaporizable material inside the storage chamber 1342 is displaced from the storage chamber 1342. In some implementations of the current subject matter, the overall resistance of the collector 1313 to allowing liquid to flow out of the collector 1313 may be larger than an overall resistance of the wicking element 1362, for example, to allow the vaporizable material 1302 to primarily flow through the wick feeds 1368 toward the wicking element 1362 during the first pressure state.

[0074] The wick feeds 1368 may provide a capillary pathway through or into the wicking element 1362 for the vaporizable material 1302 stored in reservoir 140. The capillary pathway may be large enough to permit a wicking action or capillary action to replace the vaporized vaporizable material in the wicking element 1362 but small enough to prevent leakage of the vaporizable material out of the cartridge 120 when excess pressure inside the cartridge 120 displaces at least a portion of the vaporizable material 1302 from the storage chamber 1342. The wicking element 1362 may be treated to prevent leakage, for example, by being coated after filling to prevent leakage or evaporation through the wicking element 1362. Any appropriate coating may be used, including, for example, a heat-vaporizable coating (e.g., a wax or other material) and/or the like.

[0075] In one embodiment, the generated heat may be transferred to at least a portion of the vaporizable material in the wicking element 1362 through conductive, convective, and/or radiative heat transfer such that at least a portion of the vaporizable material drawn into the wicking element 1362 is vaporized to generate an aerosol. Depending on implementation, air entering the cartridge 120 may flow over (or around, near, etc.) the wicking element 1362 and the heating element 1350 and may strip away the vaporized vaporizable material into the

airflow passageway 1338, where the vapor may optionally be condensed and delivered in aerosol form, for example, through the airflow passageway 1338.

[0076] Air, which may be admitted to the storage chamber 1342 when the pressure inside the vaporizer cartridge 120 is lower than ambient pressure, may increase the pressure inside the vaporizer cartridge 120 and may cause the vaporizer cartridge 120 to transition to the second pressure state in which the pressure inside the vaporizer cartridge 120 exceed the ambient pressure external to the vaporizer cartridge 120. Alternatively and/or additionally, the vaporizer cartridge 120 may transition to the second pressure state in response to a change in ambient temperature, a change in ambient pressure (e.g., due to a change in external conditions such as altitude, weather, and/or the like), and/or a change in the volume of the vaporizer cartridge 120 (e.g., when the vaporizer cartridge 120 is compacted by an external force such as squeezing). The increase in the pressure inside the storage chamber 1342, for example, in the case of a negative pressure event, may at least expand the air occupying the void space of the storage chamber 1342, thereby displacing at least a portion of the vaporizable material in the storage chamber 1342. The displaced portion of the vaporizable material may travel through at least some part of the overflow channel 1104 in the collector 1313. Microfluidic features of the overflow channel 1104 can cause the liquid vaporizable material 1302 to move along a length of the overflow channel 1104 in the collector 1313 only with a meniscus fully covering the cross-sectional area of the overflow channel 1104 transverse to the direction of flow along the length.

[0077] In some implementations of the current subject matter, the microfluidic features can include a cross-sectional area sufficiently small that for the material from which walls of the overflow channel 1104 are formed and the composition of the vaporizable material, the vaporizable material preferentially wets the overflow channel 1104 around an entire perimeter of the overflow channel 1104. For example, where the vaporizable material includes one or more of propylene glycol and vegetable glycerin, wetting properties of such a liquid are advantageously considered in combination with the geometry of the overflow channel 1104 and materials from which the walls of the overflow channel 1104 are formed. In this manner, as the pressure differential between the storage chamber 140 and ambient pressure varies, a meniscus is maintained between the vaporizable material present in the overflow channel 1104 and air entering from the ambient atmosphere to prevent the vaporizable material and the air from moving past one another. As pressure in the storage chamber 1342 drops sufficiently relative to ambient pressure and if there is sufficient void volume in the storage chamber 1342 to allow it, the vaporizable material present in the overflow channel 1104 of the collector 1313

may be drawn back into the storage chamber 1342 sufficiently to cause the leading liquid-air meniscus to reach a gate or port between the overflow channel 1104 of the collector 1313 and the storage chamber 1342. At such time, if the pressure differential in the storage chamber 1342 relative to ambient pressure is sufficiently negative to overcome surface tension maintaining the meniscus at the gate or port, the meniscus may be freed from the gate or port walls to form one or more air bubbles, which are then released into the storage chamber 1342 with sufficient volume to equalize the pressure inside the storage chamber 1342 relative to ambient pressure.

[0078] When air admitted into the storage chamber 1342 as discussed above (or otherwise becomes present therein) experiences an elevated pressure condition relative to ambient (e.g., due to a drop in ambient pressure or an elevation in internal pressure in the storage chamber 1342 such as might occur due to local heating, mechanical pressure that distorts a shape and thereby reduces a volume of the storage chamber 140, etc., or the like), the above-described process may be reversed. The vaporizable material may pass through the gate or port into the overflow channel 1104 of the collector 1313 and a meniscus may form at the leading edge of a column of the vaporizable material passing into the overflow channel 1104 to prevent air from bypassing and flowing counter to the progression of the vaporizable material.

[0079] Referring now to FIG. 1C, depicted is an example of the vaporizer device 100 and the vaporizer cartridge 120 consistent with implementations of the current subject matter. FIG. 1C depicts a perspective view of the vaporizer device 100 having the vaporizer cartridge 120 inserted (e.g., releasably) into the cartridge receptacle 118 (not shown in FIG. 1C) of the vaporizer body 110. The vaporizer cartridge 120 may include a transparent portion that remains visible when the vaporizer cartridge 120 is coupled to the vaporizer body 110. The transparent portion may allow a level of vaporizable material in the reservoir 140 to be viewed by a user.

[0080] FIGS. 1D-1G depict alternate views of the vaporizer device 100 of FIG. 1C. FIG. 1D and FIG. 1E show front and back views, respectively. FIG. 1F and FIG. 1G show left and right side views, respectively. The vaporizer cartridge 120 can be seen coupled (e.g. releasably) to the vaporizer body 110 in each of the views.

FIG. 1H depicts a top view of the vaporizer device 120, in which the airflow passageway 1338 is visible. When a user inhales from an airflow passageway 1338 of the cartridge 120, air may flow into the cartridge 120 through one or more air inlets in an operational relationship with the wicking element 1362. The heating element 1350 may be activated in response to a signal generated by the one or more sensors 113 (e.g., shown in FIG. 1A). As noted, the one or more sensors 113 may include at least one of pressure sensor, motion sensor, flow sensor, or other

mechanism capable of detecting a puff and/or an imminent puff including, for example, by detecting changes in the airflow passageway 1338. When the heating element 1350 is activated, the heating element 1350 may undergo a temperature increase as a result of a current flowing through one or more electrically resistive portion of the heating element 1350 where the electrical energy is converted to heat energy. It should be appreciated that the heating element 1350 may be activated by the controller 104 (e.g., shown in FIG. 1A) controlling the power source 112 to discharge an electric current from the power source 112 to the heating element 1350. FIG. 1I depicts a bottom view of the vaporizer body 110.

[0081] FIGS. 2A-2B depict schematic representations of an example of a shell 210 of the vaporizer body 110 consistent implementations of the current subject matter. As shown in FIGS. 2A-2B, the shell 210 may be formed from a single, continuous piece of material such as, for example, a metal, a metal alloy, and/or the like. In some implementations of the current subject matter, the shell 210 may exhibit an aspect ratio in which a length of the shell may be approximately 11-12 times a width of the shell 210. Moreover, the shell 210 may be formed by an impact extrusion process in which a slug (e.g., of metal, metal alloy, and/or the like) is pressed at a high velocity and with extreme force into a die or a mold. For example, the shell 210 can be formed from impact extrusion followed by machining of the first portion 201 and/or the second portion 202 and/or the transition region 203 of the shell 210. Typically, aspect ratios of similar objects created via conventional impact extrusion processes are limited to aspect ratios of approximately 8:1 or less. The shell 210 disclosed herein can have an aspect ratio higher than 8:1, such as 11:1 or 12:1 as previously disclosed. The design of the shell 210, including the thicknesses of the walls, allows for impact extrusion manufacturing of a stable and consistent shell 210 having an aspect ratio up to approximately 11:1 or 12:1.

[0082] A first portion 201 of the shell 210 may include the cartridge receptacle 118 configured to receive a vaporizer cartridge such as, for example, the examples of the vaporizer cartridge 120 shown in FIGS. 1A-D. Furthermore, a second portion 202 of the shell 210 may be configured to accommodate at least a portion of the power source 112 (e.g., a battery and/or the like). Forming the shell 210 from a single piece of metal can reduce manufacturing costs and complexity, for example, by eliminating a need for joining portions of the shell 210 by welding, adhesives, and/or the like. The structural integrity of the shell 210 can also be increased by using a one-piece design due to the absence of seams or joints (e.g., adhesives, welds, and/or the like) that may weaken and/or fail over time and use. The elimination of seams and joints may further improve the consistency of an external appearance of the shell 210.

[0083] FIG. 2B is a close-up view of the first portion 201 of the shell 210. The first portion 201 of the shell 210 may include a cartridge receptacle area 204. Referring to FIG. 1A, the cartridge receptacle 118 in the vaporizer body 110 may be disposed at least partially within the cartridge receptacle area 204 such that the first portion 201 of the shell 210 extends at least partially around a perimeter of the cartridge receptacle 118. The cartridge receptacle area 204 can also include one or more apertures 220. The apertures 220 can be configured to allow visualization of illuminating indicators (such as LEDs, or other light sources) through the shell 210. For example, the apertures 220 may allow a user to visualize flashing, color changes, brightness changes, and/or other patterns or changes in the illuminating indicators. The apertures 220 may be located at any position on the shell 210.

[0084] Referring now to FIGS. 3A-3B, cross-sectional views of the shell 210 are provided. FIG. 3A shows a cross-sectional view across an axis of the shell 210. The first portion 201, with cartridge receptacle area 204 and apertures 220, is shown. A transition region 203 can be seen between the first portion 201 and the second portion 202 of the shell 210 such that the walls of the second portion 202 of the shell 210 are thinner than the walls of the shell 210 in at least the transition region 203. The thickness of the walls of the second portion 202 of the shell 210 may be reduced, in order to increase the inner cross-sectional dimensions of the second portion 202 of the shell 210. Increasing the inner cross-sectional dimensions of the second portion 202 of the shell 210 may increase the capacity of the second portion 202 of the shell 210 such that the shell 210 is able to accommodate, for example, a larger battery serving as the power source 112. For example, the first portion 201 of the shell 210 can be approximately 14-16 mm wide and approximately 5-6 mm deep. The second portion 202 of the shell 210 can be approximately 16-17 mm wide and approximately 7-8 mm deep. In embodiments, the thickness of the walls of the first portion 201 of the shell can be approximately 0.4-0.5 mm, and the thickness of the walls of the second portion 202 of the shell 210 can be approximately 0.5-0.7 mm. For example, the inner cross-sectional dimensions of the second portion 202 of the shell 210 can be approximately 14.8 mm by approximately 5.8 mm, which is larger than the inner cross-sectional dimensions of the first portion 201 of the shell 210, which can be approximately 14.03 mm by approximately 4.81 mm.

[0085] In the example of the shell 210 shown in FIG. 3A, the walls of the shell 210 can have a first thickness at the first portion 201, a second thickness at the transition region 203, and a third thickness at the second portion 202. In embodiments, the first thickness of the shell 210 at the first portion 201 and the third thickness of the shell 210 at the second portion 202 may be less than the second thickness of the shell 210 at the transition region 203. Moreover,

in some embodiments, the first thickness of the shell 210 at the first portion 201 may be the same as, greater than, or less than the third thickness of the shell 210 at the second portion 202. These thicknesses may be achieved by forming the shell 210 via impact extrusion, followed by machining of the first portion 201 of the shell 210. Forming the shell 210 such that the thickness of the walls at the transition region 203 is greater than the thickness of the walls of the shell 210 at the first portion 201 and the second portion 202 offers the following advantages of allowing more space in the second portion 202 of the shell 210 to contain additional components and/or a larger battery.

[0086] FIG. 3B shows a cross-sectional view across an axis perpendicular to that shown in FIG. 3A. The first portion 201 of the shell 210 may include one or more air inlets 250. Air may flow through the shell 210 via one or more air inlets 250. The one or more air inlets 250, which may be in fluid communication with one or more air inlets in the vaporizer cartridge 120 when the vaporizer cartridge 120 is coupled with the vaporizer body 110 including the shell 210, may provide entry for air to travel through the vaporizer cartridge 120. The second portion 202 of the shell 210 may have larger inner cross sectional dimensions than the first portion 201 of the shell 210, with the second portion 202 of the shell 210 extending beyond the first portion 201 of the shell 210. When the vaporizer cartridge 120 (e.g., the example of the vaporizer cartridge 120 shown in FIG. 1D) is coupled with the vaporizer body 110, the housing 160 of the vaporizer cartridge 120 may extend at least partially below the top of the first portion 201 of the shell 210. The housing 160 of the vaporizer cartridge 120 may further extend at least partially around a perimeter of the first portion 201 of the shell 210 while remaining substantially flush with the second portion 202 of the shell 210.

[0087] Moreover, as shown in FIG. 3B, the thickness of the walls of the second portion 202 of the shell 210 may be reduced in order to increase the inner cross-sectional dimensions of the second portion 202 of the shell 210. For example, the second portion 202 of the shell 210 may have a larger inner cross-sectional dimension than that of the first portion 201 of the shell 210. In FIG. 3B, the one or more air inlets 250 can be seen in the cartridge receptacle area 204. The capacity of the second portion 202 of the shell 210 may be increased as a result of reducing the thickness of the walls of the second portion 202 of the shell 210. Increasing the capacity of the second portion 202 of the shell 210 may allow the shell 210 to accommodate a larger battery serving as the power source 112, thereby increasing the power of the power source 112 and/or extending the battery life associated with the vaporizer device 100. Alternatively and/or additionally, increasing the capacity of the second portion of the shell 210

may allow the shell 210 to accommodate additional components (e.g., controllers, sensors, and/or the like) that may lend additional functionalities to the vaporizer device 100.

[0088] FIGS. 4A-4E show embodiments of the cross-sectional dimensions of the shell 210. FIG. 4A shows the inner cross-sectional dimensions of the first portion 201 of the shell 210. As shown, the inner cross-sectional dimensions of the first portion 201 of the shell 210 can be approximately 14 mm by approximately 4.5-5.0 mm. FIG. 4B shows the inner cross-sectional dimensions of the second portion 202 of the shell 210. The inner cross-sectional dimensions of the second portion 202 of the shell 210 can be greater than the inner cross-sectional dimensions of the first portion 201 of the shell 210. For example, as shown in FIG. 4B, the inner cross-sectional dimensions of the second portion 202 of the shell 210 can be approximately 14.5-15.0 mm by approximately 5.5-6.0 mm. FIG. 4C shows a front view of the shell 210, indicating sections A and B. Section A is an outer view of the shell 210 corresponding with the cross-sectional view of section A-A of the second portion 202 of the shell 210, shown in FIG. 4B. Section B is an outer view of the shell 210 corresponding with the cross-sectional view of section B-B of the first portion 201 of the shell 210, shown in FIG. 4A. FIG. 4D shows a side cross-sectional view of the shell 210. The transition region 203 of the shell 210, as well as the one or more air inlets 250, can be seen. As shown in FIG. 4D, in some embodiments, the thickness of the walls of the first portion 201 of the shell 210 can be approximately 0.4-0.5 mm. In embodiments, the thickness of the walls of the second portion 202 of the shell can be approximately 0.60 mm. The thickness of the walls of the transition region 203 of the shell 210 can be thicker than one or both of the thicknesses of the first portion 201 and/or the second portion 202 of the shell 210. FIG. 4E is another front view of the shell 210, showing section C of the shell 210, which corresponds to the cross-sectional view of section C-C, shown in FIG. 4D. As shown in FIG. 4E, in some embodiments, the width of the first portion 201 of the shell 210 can be approximately 14.5-15.0 mm. In embodiments, the width of the second portion 202 of the shell 210 can be approximately 16.0 mm. It should be appreciated that the dimensions described and illustrated herein can vary without departing from the scope of the present disclosure.

[0089] FIG. 5A shows a close-up view of the vaporizer body 110 including the first portion 201, the second portion 202, and the transition region 203 of the shell 210. As shown in FIG. 5A, the vaporizer body 110 may be coupled with the vaporizer cartridge 120, which may include the collector 1313, wick feeds 1368, heating element 1350, and wicking element 1362. For example, FIG. 5A shows that the cartridge receptacle 118, which may be disposed at least partially within the cartridge receptacle area 204 formed by the first portion 201 of the shell

210, may receive the vaporizer cartridge 120. The wick housing 1315 including the wicking element 1362 and the heating element 1350 may be disposed at least partially within the cartridge receptacle 118 when the vaporizer cartridge 120 is coupled with the vaporizer body 110. The second portion 202 contains, at least partially, the power source 112, which provides power to the vaporizer cartridge 120 in order to vaporize the vaporizable material 102 (not shown in FIG. 5A). The second portion 202 may also include additional components such as controllers or sensors, which may add additional functionality.

[0090] FIG. 5B depicts a disassembled view of an example of the vaporizer body 110 consistent with implementations of the current subject matter. As shown in FIG. 5B, the vaporizer body 110 may include a shell 210, a sheath 1219, a battery 1212, a printed circuit board assembly (PCBA) 1203, an antenna 1217, a skeleton 1211, a charge badge 1213, a cartridge interface 1218, an endcap 1201, and an LED badge 1215. In some aspects, assembly of the vaporizer body 110 may include placing the battery 1212 within the skeleton 1211 at an inferior end of the skeleton 1211 (left-hand side of FIG. 5B). The antenna 1217 may be coupled to an inferior end of the battery 1212. The cartridge interface 1218, the PCBA 1203, and the battery 1212 may be mechanically coupled, for example, via one or more coupling means. For example, an inferior end of the PCBA 1203 may be coupled to a superior end of the battery 1212 and a superior end of the PCBA 1203 may be coupled to the cartridge interface 1218 using press fits, solder joints, and/or any other coupling means. To form the cartridge interface 1218, the sheath 1219 may be configured to at least partially surround the cartridge interface 1218 when the cartridge interface 1218 is disposed in the sheath 1219. When disposed in the shell 210, the skeleton 1211 (e.g., including the battery 1212, the antenna 1217, the cartridge interface 1218, and the PCBA 1203) may be secured to the shell 210 by friction fit, spring tension, and/or the like. For instance, as shown in FIG. 5B, the skeleton 1211 may include one or more snap features 1221 configured to engage the shell 210.

[0091] FIG. 5C depicts a top perspective view of the vaporizer body 110 including an example of the cartridge receptacle 118 consistent with implementations of the current subject matter. As shown in FIG. 5C, the cartridge receptacle 118 may be disposed at least partially within the sheath 1219. For example, in the example shown in FIG. 5C, the top rim of the cartridge receptacle 118 and the sheath 1219 may be substantially flush. The interior of the cartridge receptacle 118 may include one or more pod identifier contacts (e.g., the pod identifier contacts 307A, 307B, and 307C) and one or more receptacle contacts (e.g., the receptacle contacts 125A and 125B). Moreover, the vaporizer body 110 may also include one or more pod retention features 415, which may be disposed on an interior of the cartridge receptacle

118 and/or an exterior of the sheath 1219. Examples of the pod retention features 415 may include pins, clips, protrusions, detents, and/or the like. The pod retention features 415 may be configured to secure the vaporizer cartridge 120 within the cartridge receptacle 118 including by applying, against the vaporizer cartridge 120, a magnetic force, an adhesive force, a compressive force, a friction force, and/or the like.

[0092] In implementations where the pod retention features 415 are disposed inside the cartridge receptacle 118, the pod retention features 415 may be configured to form a mechanical coupling with, for example, at least a portion of the heating element 1350 and/or a portion of the wick housing 1315 (e.g., the recesses in the wick housing 1315). Alternatively and/or additionally, in example implementations where the pod retention features 415 are disposed on an exterior of the sheath 1219, the pod retention features 415 may be configured to form a mechanical coupling with the housing of the vaporizer cartridge 120. It should be appreciated that the pod retention features 415 may include various means of securing the vaporizer cartridge 120 within the cartridge receptacle 118. Moreover, the pod retention features 415 may be disposed at any suitable location in the vaporizer body 110.

[0093] Referring again to FIG. 5C, the cartridge interface 1218 may include a notch 510 in at least one sidewall of the cartridge interface 1218. According to some implementations of the current subject matter, the thickness of the walls of the shell 210, particularly in the areas around the sheath 1219, may be thickened to increase the strength of the material forming the shell 210 (e.g., aluminum (Al) and/or the like). Thus, in the example shown in FIG. 5C, the notch 510 may include a region in the sidewall of the cartridge interface 1218 where the thickness of the material forming the cartridge interface 1218 is reduced (e.g., thinned or tapered) or where the material forming the cartridge interface 1218 is eliminated altogether. The resulting notch 510 may provide space for accommodating the wick housing 1315 of the vaporizer cartridge 120 when the vaporizer cartridge 120 is coupled with the vaporizer body 110. For example, the example of the notch 510 shown in FIG. 5C may be U-shaped cutout conforming at least partially to the contours of the wick housing 1315. The shape, size, and thickness of the material at the notch 510 may correspond to the shape and size of the wick housing 1315 as well as the thickness of the shell 210 (e.g., at the sheath 1219).

[0094] Implementing the notch 510 as a cutout instead of thinning (or tapering) the material may improve the dissipation of heat from the heating element 1350 disposed in the wick housing 1315. For example, excess heat generated by the heating element 1350 may be absorbed and dissipated by the shell 210, instead of the excess heat potentially softening or damaging one or more portions of the cartridge interface 1218 or other structures that are

proximate to the heating element 1350 when the cartridge 160 is inserted into the cartridge receptacle 118. Forming the notch 510 by thinning (or tapering) the material may reduce the structural integrity of the cartridge interface 1218, rendering the cartridge interface 1218 more susceptible to breakage during manufacturing and use. Thus, in some implementations of the current subject matter, the notch 510 may be implemented as a cutout to increase the robustness the cartridge interface 1218 and the durability of the vaporizer device 100 incorporating the cartridge interface 1218. Manufacturing complexity and cost may also be reduced by implementing the notch 510 as a cutout at least because the cartridge interface 1218 may be less fragile and prone to breakage during manufacturing and assembly.

[0095] FIG. 6 is a flow chart showing an exemplary processing method 600, which may be used to form an example of the shell 210 consistent with implementations of the current subject matter. As shown, a material can be provided, such as a slug, billet, or other material (601). The slug or billet may be hollow or solid. Impact extrusion can then be performed on the material (602). For example, impact extrusion may be performed to form the shell 210. Machining may be employed to form various features of the shell 210 (603). For example, the first portion 201 of the shell 210 may be machined. Additionally and/or alternatively, the neck features, cartridge receptacle area 204, and/or transition region 203 may be machined. Optionally, the machining step can be followed by additional processing, such as heat treatment, sandblasting, polishing, anodizing, or the like.

[0096] FIGS. 7A-7B show the shell 210 manufactured via the processing method 600 of FIG. 6. FIG. 7A is a front plan view of the shell 210 after impact extrusion of a material 700 was used to form the shape of the shell 210 (602). As shown in FIG. 7A, some material 700 remains around the exterior of the shell 210, including additional material 703 around the transition region 203 (not shown in FIG. 7A) of the shell 210. FIG. 7B is a front plan view of the shell 210 after machining of features of the shell (603). As shown in FIG. 7B, the cartridge receptacle area 204, apertures 220, and the first portion 201 and second portion 202, have been machined onto the shell 210.

Terminology

[0097] When a feature or element is herein referred to as being “on” another feature or element, it can be directly on the other feature or element or intervening features and/or elements can also be present. In contrast, when a feature or element is referred to as being “directly on” another feature or element, there are no intervening features or elements present. It will also be understood that, when a feature or element is referred to as being “connected”,

“attached” or “coupled” to another feature or element, it can be directly connected, attached or coupled to the other feature or element or intervening features or elements can be present. In contrast, when a feature or element is referred to as being “directly connected”, “directly attached” or “directly coupled” to another feature or element, there are no intervening features or elements present.

[0098] Although described or shown with respect to one embodiment, the features and elements so described or shown can apply to other embodiments. It will also be appreciated by those of skill in the art that references to a structure or feature that is disposed “adjacent” another feature can have portions that overlap or underlie the adjacent feature.

[0099] Terminology used herein is for the purpose of describing particular embodiments and implementations only and is not intended to be limiting. For example, as used herein, the singular forms “a,” “an,” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise.

[0100] In the descriptions above and in the claims, phrases such as “at least one of” or “one or more of” may occur followed by a conjunctive list of elements or features. The term “and/or” may also occur in a list of two or more elements or features. Unless otherwise implicitly or explicitly contradicted by the context in which it used, such a phrase is intended to mean any of the listed elements or features individually or any of the recited elements or features in combination with any of the other recited elements or features. For example, the phrases “at least one of A and B;” “one or more of A and B;” and “A and/or B” are each intended to mean “A alone, B alone, or A and B together.” A similar interpretation is also intended for lists including three or more items. For example, the phrases “at least one of A, B, and C;” “one or more of A, B, and C;” and “A, B, and/or C” are each intended to mean “A alone, B alone, C alone, A and B together, A and C together, B and C together, or A and B and C together.” Use of the term “based on,” above and in the claims is intended to mean, “based at least in part on,” such that an unrecited feature or element is also permissible.

[0101] Spatially relative terms, such as “forward”, “rearward”, “under”, “below”, “lower”, “over”, “upper” and the like, may be used herein for ease of description to describe one element or feature’s relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if a device in the figures is inverted, elements described as “under” or “beneath” other elements or features would then be oriented “over” the other elements or features. Thus, the exemplary term “under” can encompass both an orientation of over and under. The device can

be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly. Similarly, the terms “upwardly”, “downwardly”, “vertical”, “horizontal” and the like are used herein for the purpose of explanation only unless specifically indicated otherwise.

[0102] Although the terms “first” and “second” may be used herein to describe various features/elements (including steps), these features/elements should not be limited by these terms, unless the context indicates otherwise. These terms may be used to distinguish one feature/element from another feature/element. Thus, a first feature/element discussed below could be termed a second feature/element, and similarly, a second feature/element discussed below could be termed a first feature/element without departing from the teachings provided herein.

[0103] As used herein in the specification and claims, including as used in the examples and unless otherwise expressly specified, all numbers can be read as if prefaced by the word “about” or “approximately,” even if the term does not expressly appear. The phrase “about” or “approximately” may be used when describing magnitude and/or position to indicate that the value and/or position described is within a reasonable expected range of values and/or positions. For example, a numeric value can have a value that is +/- 0.1% of the stated value (or range of values), +/- 1% of the stated value (or range of values), +/- 2% of the stated value (or range of values), +/- 5% of the stated value (or range of values), +/- 10% of the stated value (or range of values), etc. Any numerical values given herein should also be understood to include about or approximately that value, unless the context indicates otherwise. For example, if the value “10” is disclosed, then “about 10” is also disclosed. Any numerical range recited herein is intended to include all sub-ranges subsumed therein. It is also understood that when a value is disclosed that “less than or equal to” the value, “greater than or equal to the value” and possible ranges between values are also disclosed, as appropriately understood by the skilled artisan. For example, if the value “X” is disclosed the “less than or equal to X” as well as “greater than or equal to X” (e.g., where X is a numerical value) is also disclosed. It is also understood that the throughout the application, data is provided in a number of different formats, and that this data, represents endpoints and starting points, and ranges for any combination of the data points. For example, if a particular data point “10” and a particular data point “15” are disclosed, it is understood that greater than, greater than or equal to, less than, less than or equal to, and equal to 10 and 15 are considered disclosed as well as between 10 and 15. It is also understood that each unit between two particular units are also disclosed. For example, if 10 and 15 are disclosed, then 11, 12, 13, and 14 are also disclosed.

[0104] Although various illustrative embodiments are described above, any of a number of changes can be made to various embodiments without departing from the teachings herein. For example, the order in which various described method steps are performed may often be changed in alternative embodiments, and in other alternative embodiments, one or more method steps may be skipped altogether. Optional features of various device and system embodiments may be included in some embodiments and not in others. Therefore, the foregoing description is provided primarily for exemplary purposes and should not be interpreted to limit the scope of the claims.

[0105] One or more aspects or features of the subject matter described herein can be realized in digital electronic circuitry, integrated circuitry, specially designed application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs) computer hardware, firmware, software, and/or combinations thereof. These various aspects or features can include implementation in one or more computer programs that are executable and/or interpretable on a programmable system including at least one programmable processor, which can be special or general purpose, coupled to receive data and instructions from, and to transmit data and instructions to, a storage system, at least one input device, and at least one output device. The programmable system or computing system can include clients and servers. A client and server are generally remote from each other and typically interact through a communication network. The relationship of client and server arises by virtue of computer programs running on the respective computers and having a client-server relationship to each other.

[0106] These computer programs, which can also be referred to programs, software, software applications, applications, components, or code, include machine instructions for a programmable processor, and can be implemented in a high-level procedural language, an object-oriented programming language, a functional programming language, a logical programming language, and/or in assembly/machine language. As used herein, the term “machine-readable medium” refers to any computer program product, apparatus and/or device, such as for example magnetic discs, optical disks, memory, and Programmable Logic Devices (PLDs), used to provide machine instructions and/or data to a programmable processor, including a machine-readable medium that receives machine instructions as a machine-readable signal. The term “machine-readable signal” refers to any signal used to provide machine instructions and/or data to a programmable processor. The machine-readable medium can store such machine instructions non-transitorily, such as for example as would a non-transient solid-state memory or a magnetic hard drive or any equivalent storage medium. The

machine-readable medium can alternatively or additionally store such machine instructions in a transient manner, such as for example, as would a processor cache or other random access memory associated with one or more physical processor cores.

[0107] The examples and illustrations included herein show, by way of illustration and not of limitation, specific embodiments in which the subject matter may be practiced. As mentioned, other embodiments may be utilized and derived there from, such that structural and logical substitutions and changes may be made without departing from the scope of this disclosure. Such embodiments of the inventive subject matter may be referred to herein individually or collectively by the term “invention” merely for convenience and without intending to voluntarily limit the scope of this application to any single invention or inventive concept, if more than one is, in fact, disclosed. Thus, although specific embodiments have been illustrated and described herein, any arrangement calculated to achieve the same purpose may be substituted for the specific embodiments shown. This disclosure is intended to cover any and all adaptations or variations of various embodiments. Combinations of the above embodiments, and other embodiments not specifically described herein, will be apparent to those of skill in the art upon reviewing the above description. Use of the term “based on,” herein and in the claims is intended to mean, “based at least in part on,” such that an unrecited feature or element is also permissible.

[0108] The subject matter described herein can be embodied in systems, apparatus, methods, and/or articles depending on the desired configuration. The implementations set forth in the foregoing description do not represent all implementations consistent with the subject matter described herein. Instead, they are merely some examples consistent with aspects related to the described subject matter. Although a few variations have been described in detail herein, other modifications or additions are possible. In particular, further features and/or variations can be provided in addition to those set forth herein. For example, the implementations described herein can be directed to various combinations and subcombinations of the disclosed features and/or combinations and subcombinations of several further features disclosed herein. In addition, the logic flows depicted in the accompanying figures and/or described herein do not necessarily require the particular order shown, or sequential order, to achieve desirable results. Other implementations may be within the scope of the following claims.

CLAIMS

What is claimed is:

1. A vaporizer device comprising:
a shell formed from a single continuous piece of a material, the shell having a first portion and a second portion, the first portion of the shell extending at least partially around a perimeter of a receptacle configured to receive a vaporizer cartridge containing a vaporizable material, and the second portion of the shell configured to receive at least a portion of a power source, and the second portion of the shell having a second thickness that is less than a first thickness of the first portion of the shell and/or a transition region between the first portion of the shell and the second portion of the shell.
2. The vaporizer device of claim 1, wherein the second portion of the shell has a larger inner cross-sectional dimension than the first portion of the shell.
3. The vaporizer device of any of claims 1 to 2, wherein the material comprises a metal or a metal alloy.
4. The vaporizer device of any of claims 1 to 3, wherein the second thickness of the second portion of the shell is reduced in order to increase an inner cross-sectional dimension of the second portion of the shell.
5. The vaporizer device of any of claims 1 to 4, wherein a length of the shell is greater than 8 times a width of the shell.
6. The vaporizer device of any of claims 1 to 5, wherein a length of the shell is 11-12 times a width of the shell.
7. The vaporizer device of any of claims 1 to 6, wherein the shell is formed by subjecting a hollow slug of the material to impact.

8. The vaporizer device of any of claims 1 to 7, wherein the shell is formed by subjecting a solid slug of the material to impact.

9. The vaporizer device of any of claims 1 to 8, wherein the shell includes one or more apertures configured to allow visualization of one or more illuminating device indicators.

10. The vaporizer device of claim 9, wherein the one or more illuminating device indicators are light emitting diodes.

11. The vaporizer device of any of claims 1 to 10, wherein the first portion of the shell includes a first air inlet configured to form a fluid coupling with a second air inlet in the vaporizer cartridge when the vaporizer cartridge is coupled with the vaporizer device, and wherein the second air inlet in the vaporizer cartridge is configured to allow air entering the first air inlet to further enter the vaporizer cartridge.

12. The vaporizer device of any of claims 1 to 11, wherein the receptacle includes a cartridge interface configured to receive the vaporizer cartridge, and wherein at least one sidewall of the cartridge interface includes a notch where a material forming the cartridge interface is at least partially removed to accommodate the vaporizer cartridge.

13. A shell for a vaporizer device comprising:

a single continuous piece of a material;

wherein the shell has a first portion and a second portion, the first portion of the shell extending at least partially around a perimeter of a receptacle configured to receive a vaporizer cartridge containing a vaporizable material, and the second portion of the shell configured to receive at least a portion of a power source; and

wherein the second portion of the shell has a second thickness that is less than a first thickness of the first portion of the shell and/or a thickness of a transition region between the first portion of the shell and the second portion of the shell.

14. The shell of claim 13, wherein the second portion of the shell has a larger inner cross-sectional dimension than the first portion of the shell.

15. The shell of any of claims 13 to 14, wherein the material comprises a metal or a metal alloy.

16. The shell of any of claims 13 to 15, wherein the second thickness of the second portion of the shell is reduced in order to increase an inner cross-sectional dimension of the second portion of the shell.

17. The shell of any of claims 13 to 16, wherein a length of the shell is greater than 8 times a width of the shell.

18. The shell of any of claims 13 to 17, wherein a length of the shell is 11-12 times a width of the shell.

19. The shell of any of claims 13 to 18, wherein the shell is formed by subjecting a hollow slug of the material to impact.

20. The shell of any of claims 13 to 19, wherein the shell is formed by subjecting a solid slug of the material to impact.

21. The shell of any of claims 13 to 20, further including one or more apertures configured to allow visualization of one or more illuminating device indicators.

22. The shell of claim 21, wherein the one or more illuminating device indicators are light emitting diodes.

23. The shell of any of claims 13 to 22, wherein the first portion of the shell includes a first air inlet configured to form a fluid coupling with a second air inlet in a vaporizer cartridge when the vaporizer cartridge is coupled with the shell, and wherein the second air inlet in the vaporizer cartridge is configured to allow air entering the first air inlet to further enter the vaporizer cartridge.

24. The shell of any of claims 13-23, wherein the receptacle includes a cartridge interface configured to receive the vaporizer cartridge, and wherein at least one sidewall of the cartridge interface includes a notch where a material forming the cartridge interface is at least partially removed to accommodate the vaporizer cartridge.

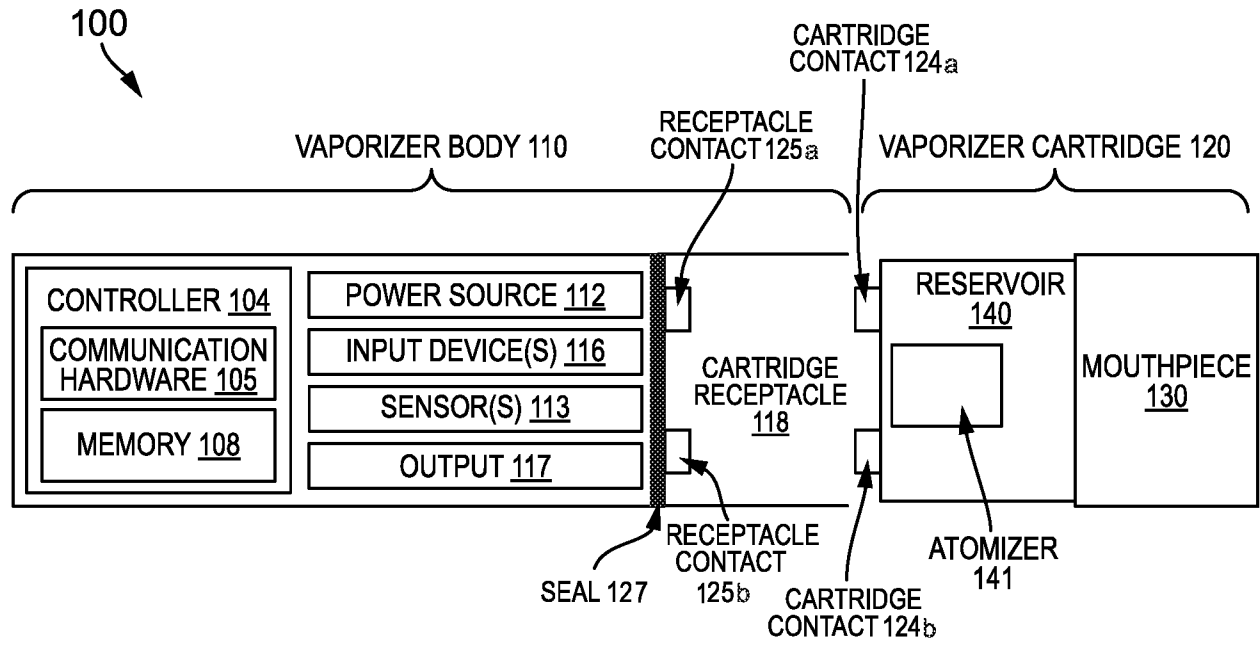


FIG. 1A

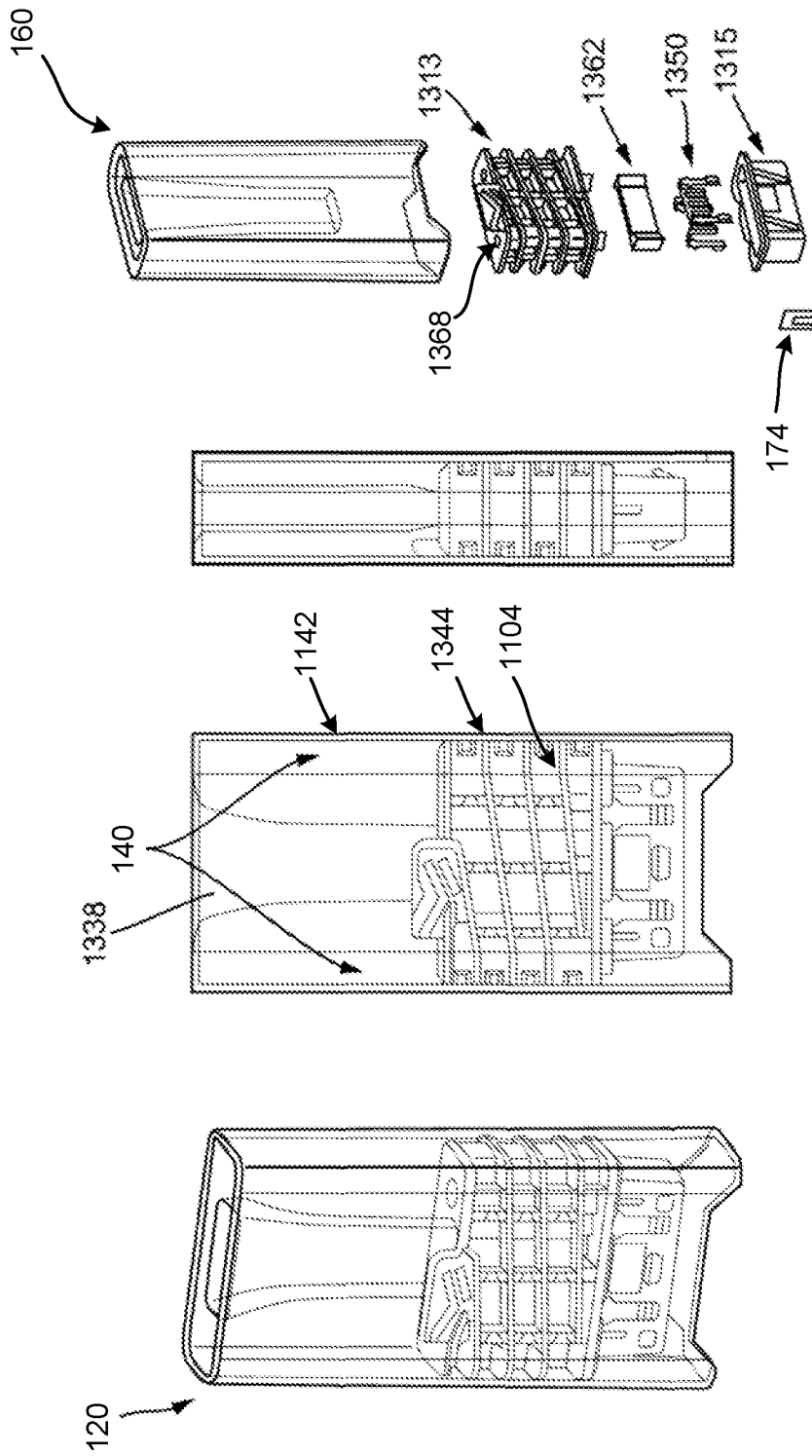


FIG. 1B

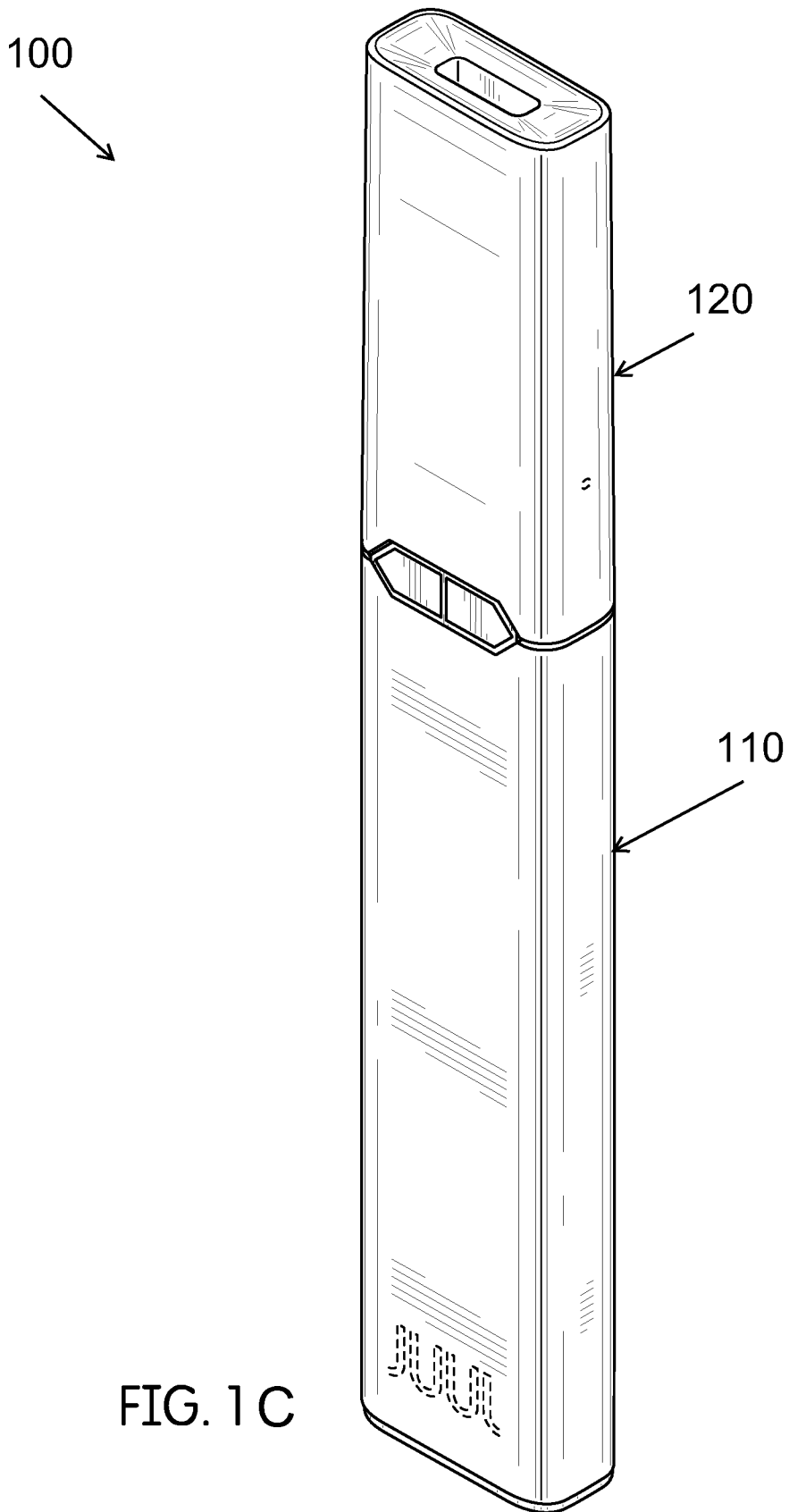


FIG. 1 C

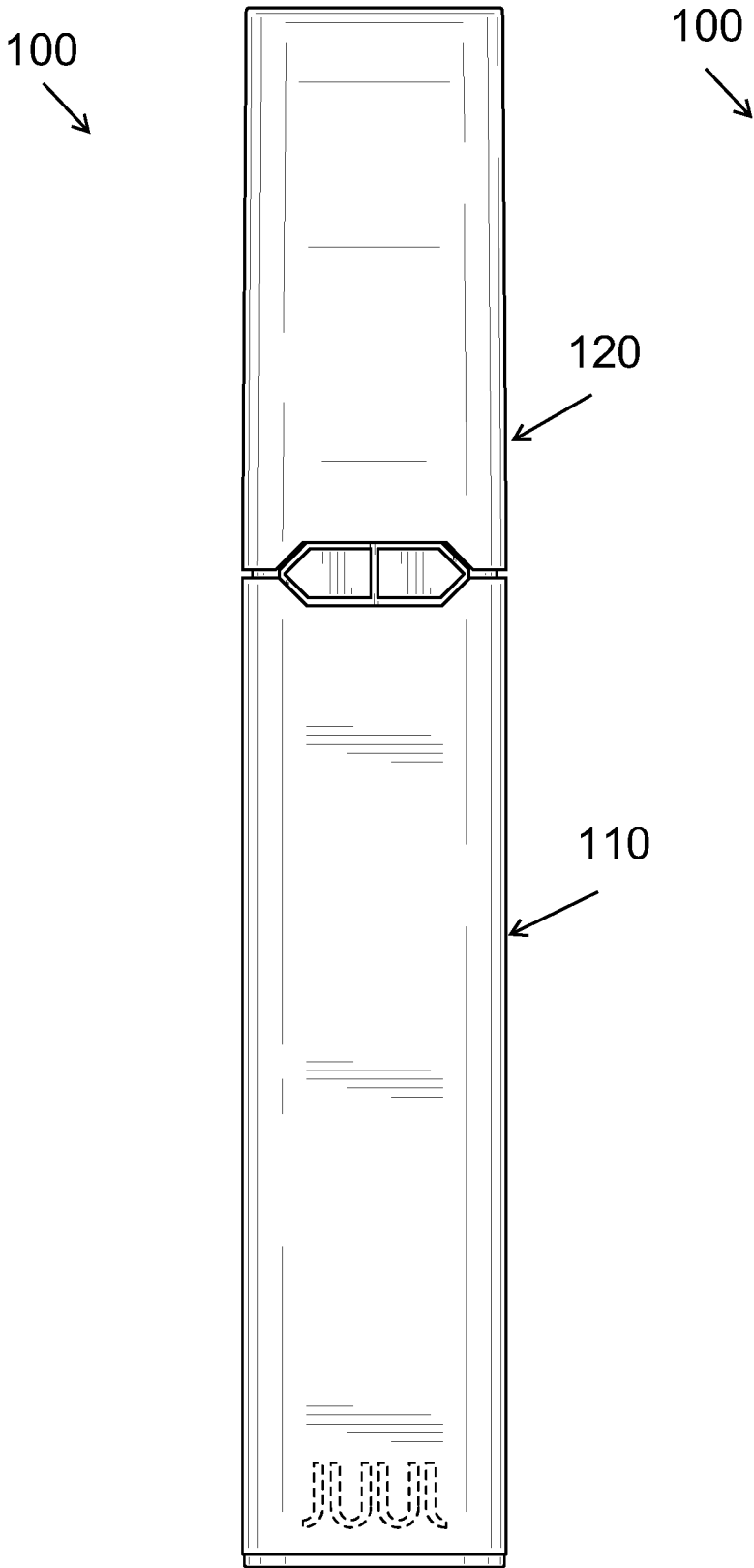


FIG. 1D

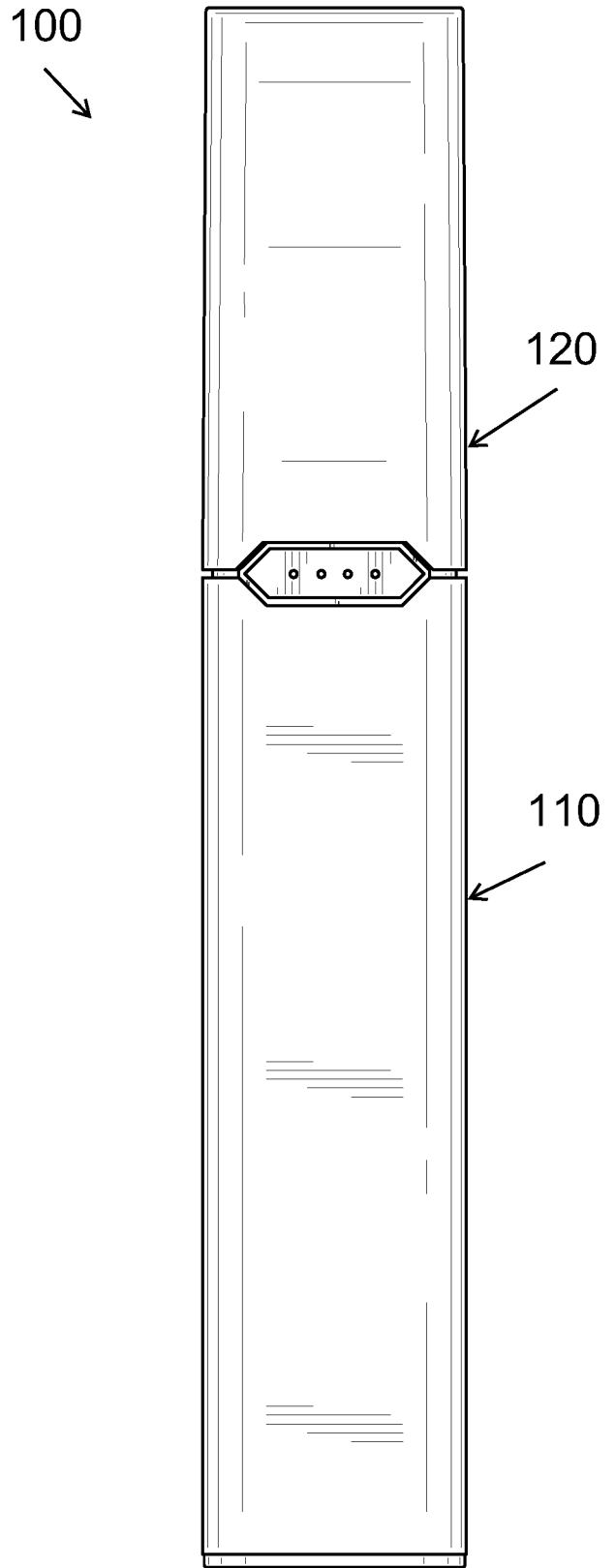


FIG. 1E

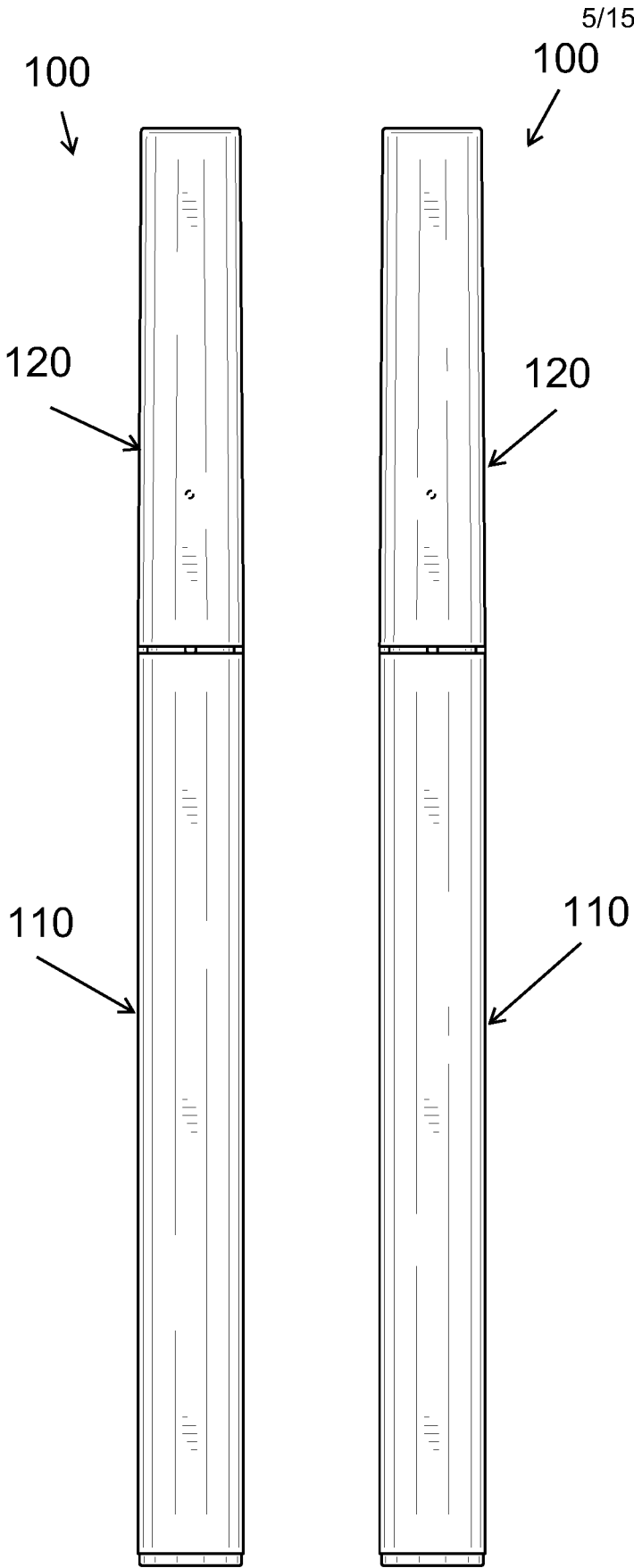


FIG. 1F

FIG. 1G

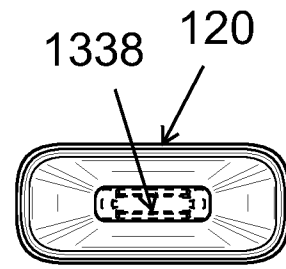


FIG. 1H

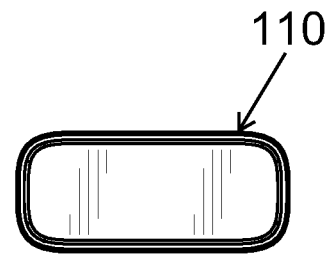


FIG. 1I

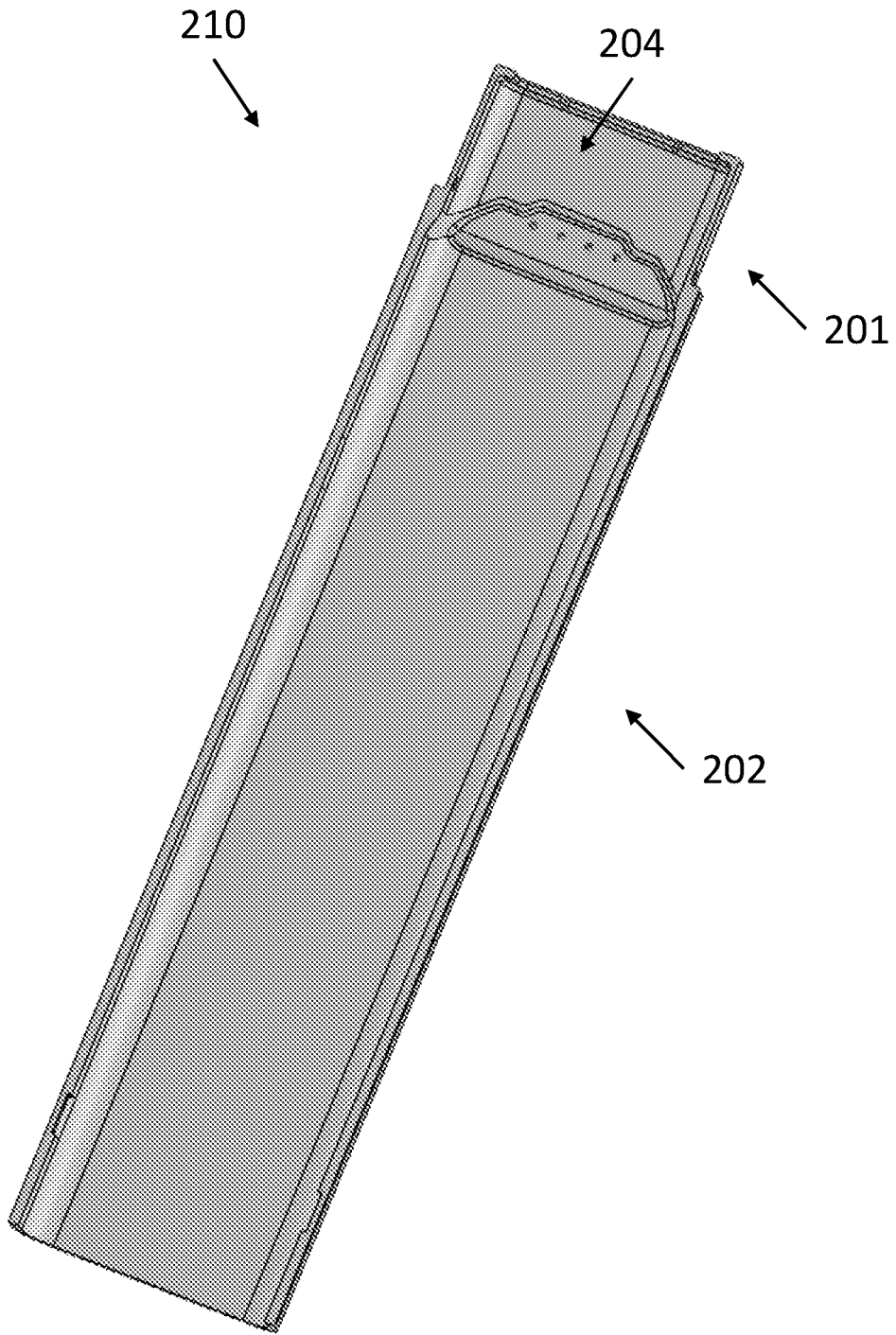


FIG. 2A

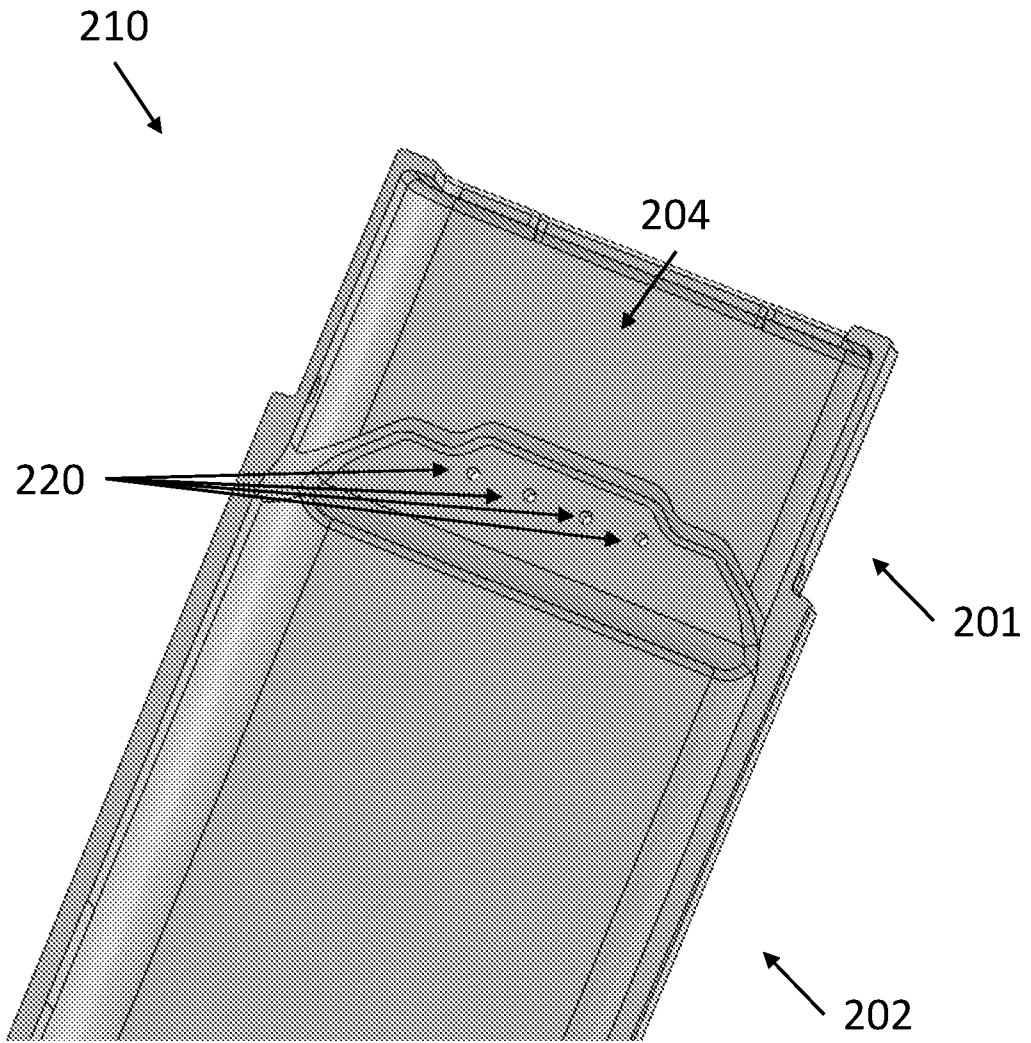


FIG. 2B

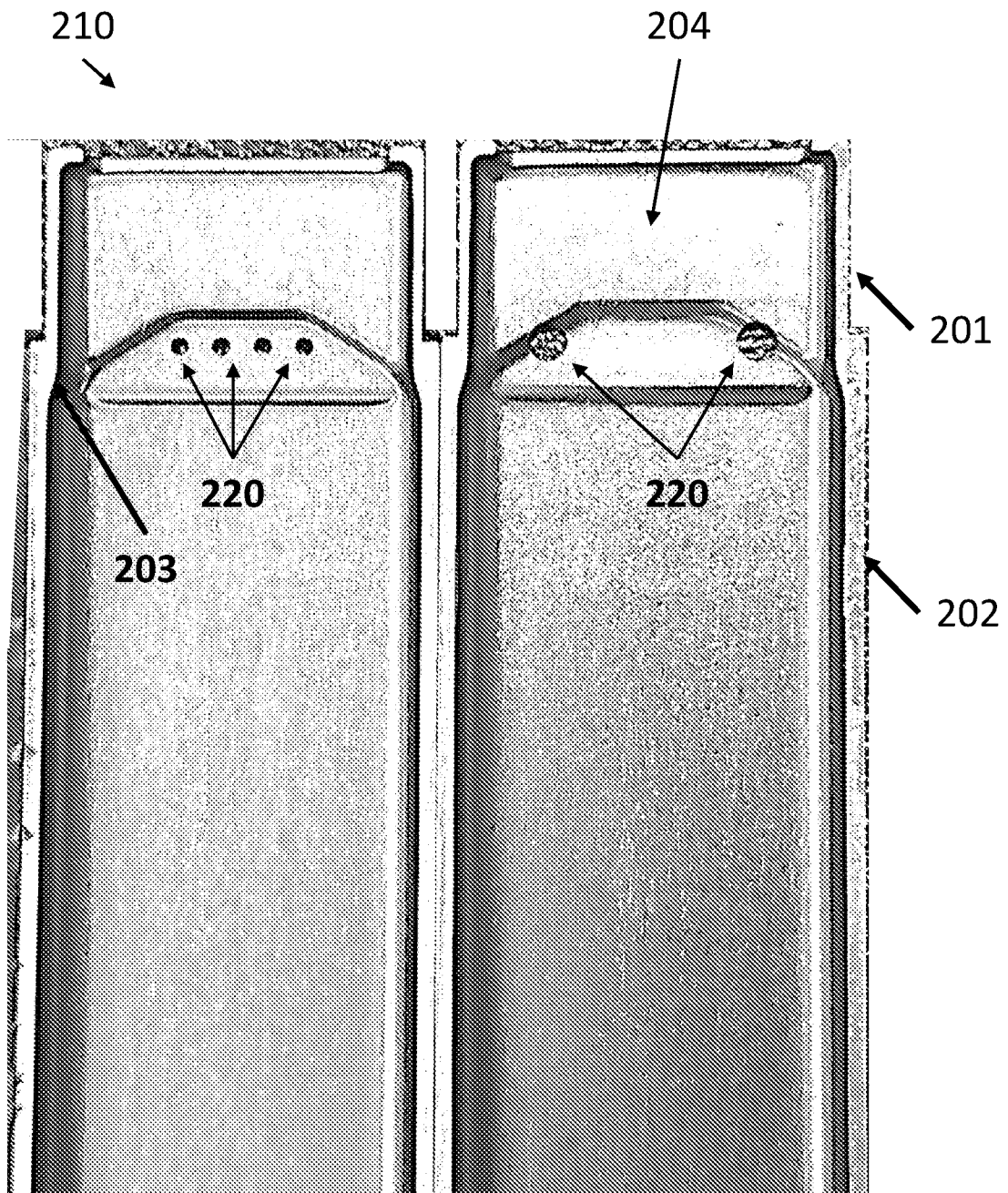


FIG. 3A

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210
↙

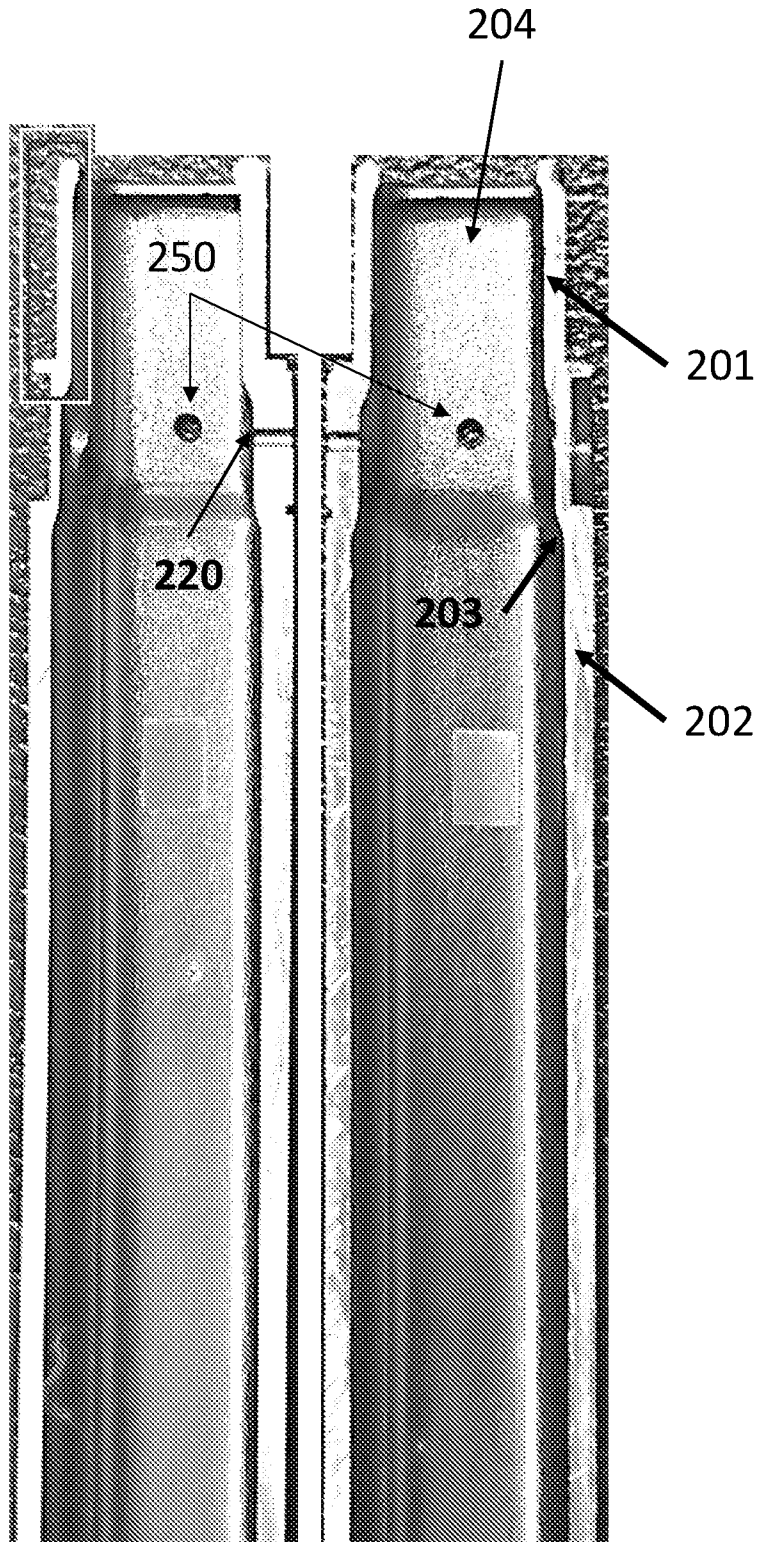


FIG. 3B

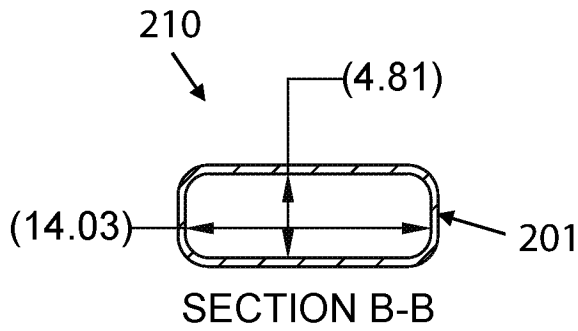


FIG. 4A

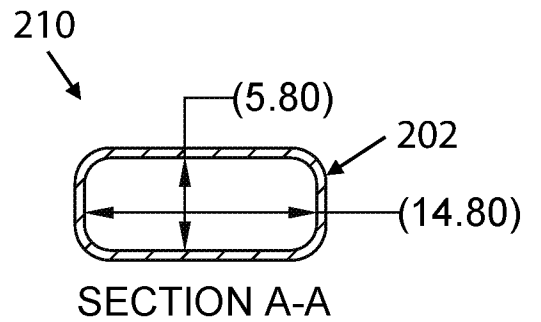


FIG. 4B

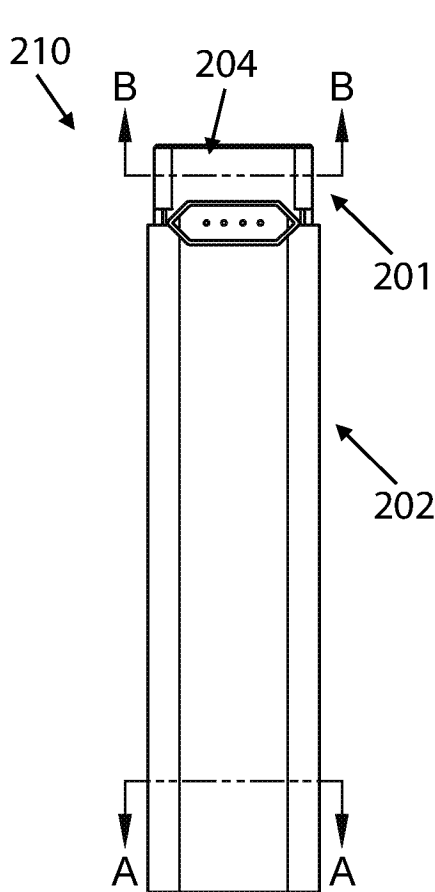
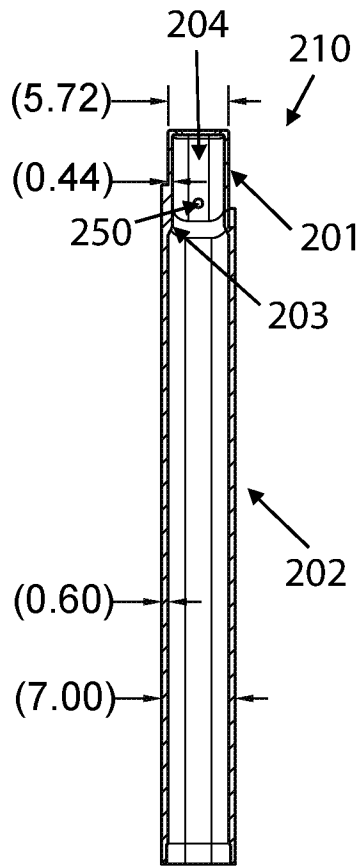


FIG. 4C



SECTION C-C
FIG. 4D

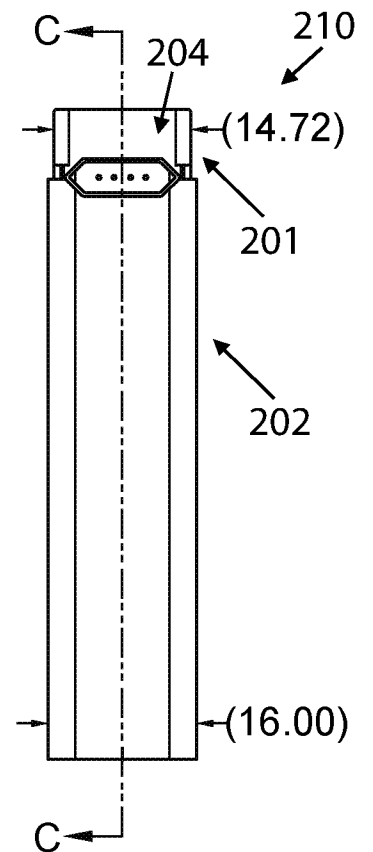


FIG. 4E

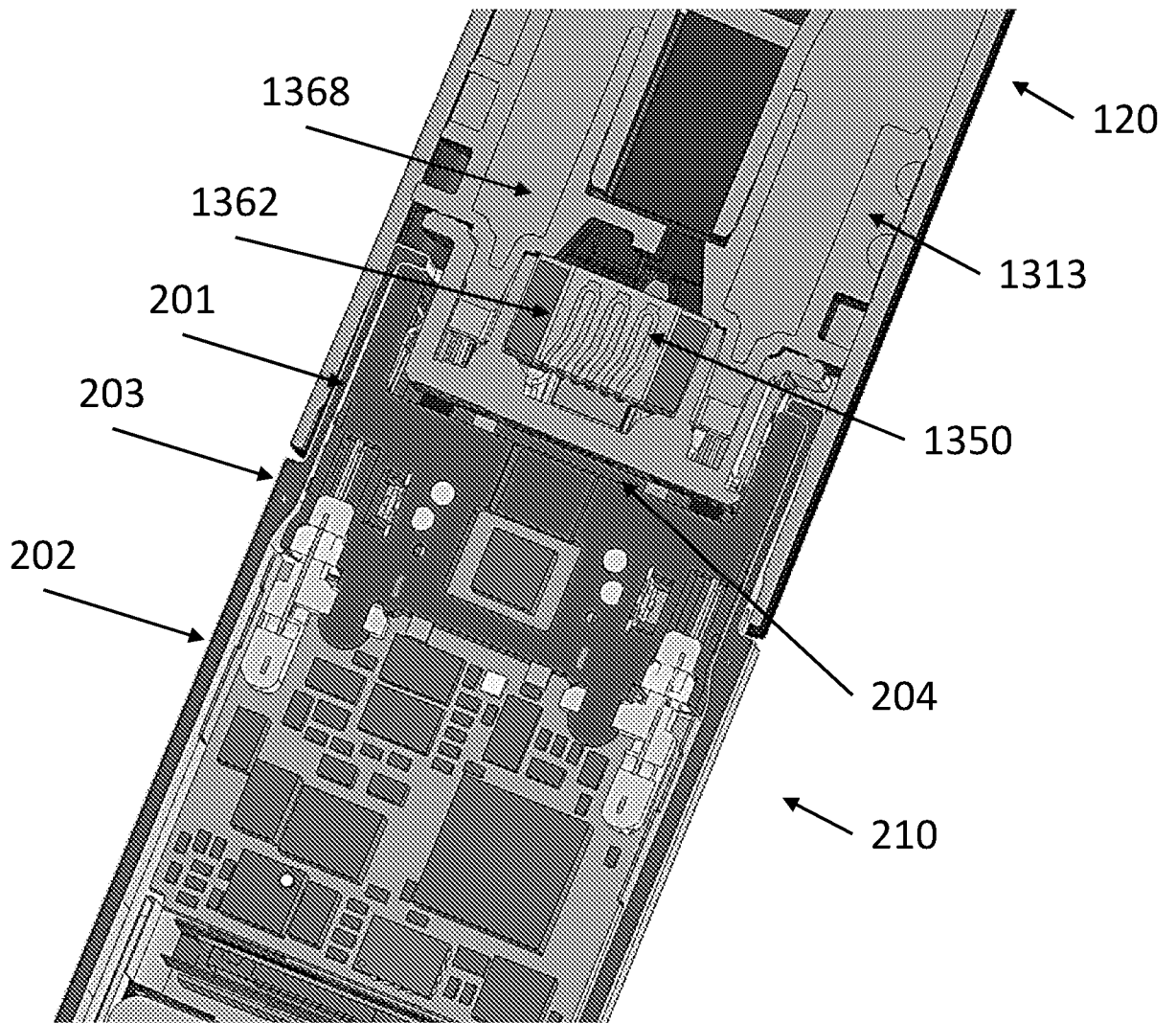


FIG. 5A

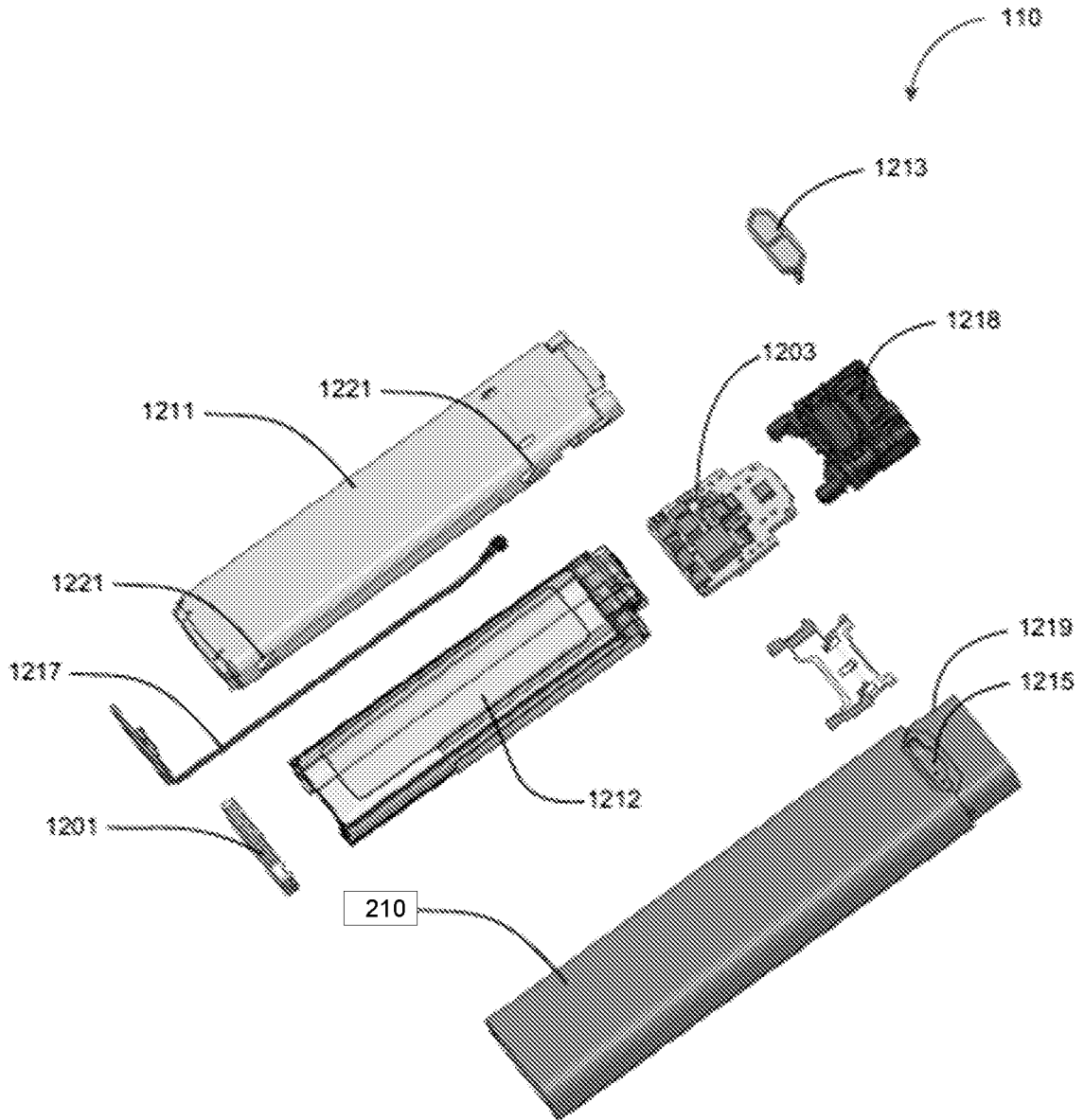


FIG. 5B

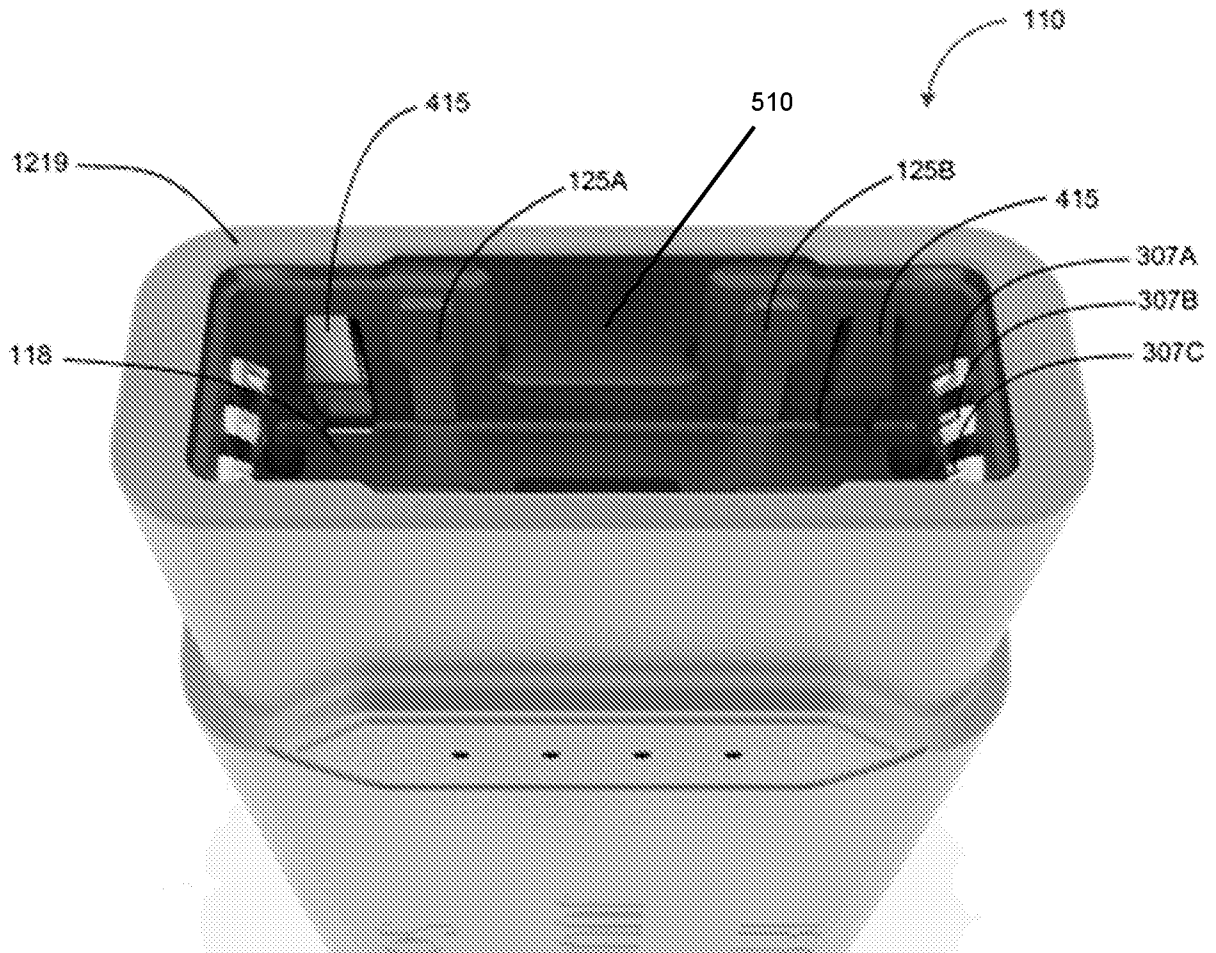


FIG. 5C

14/15

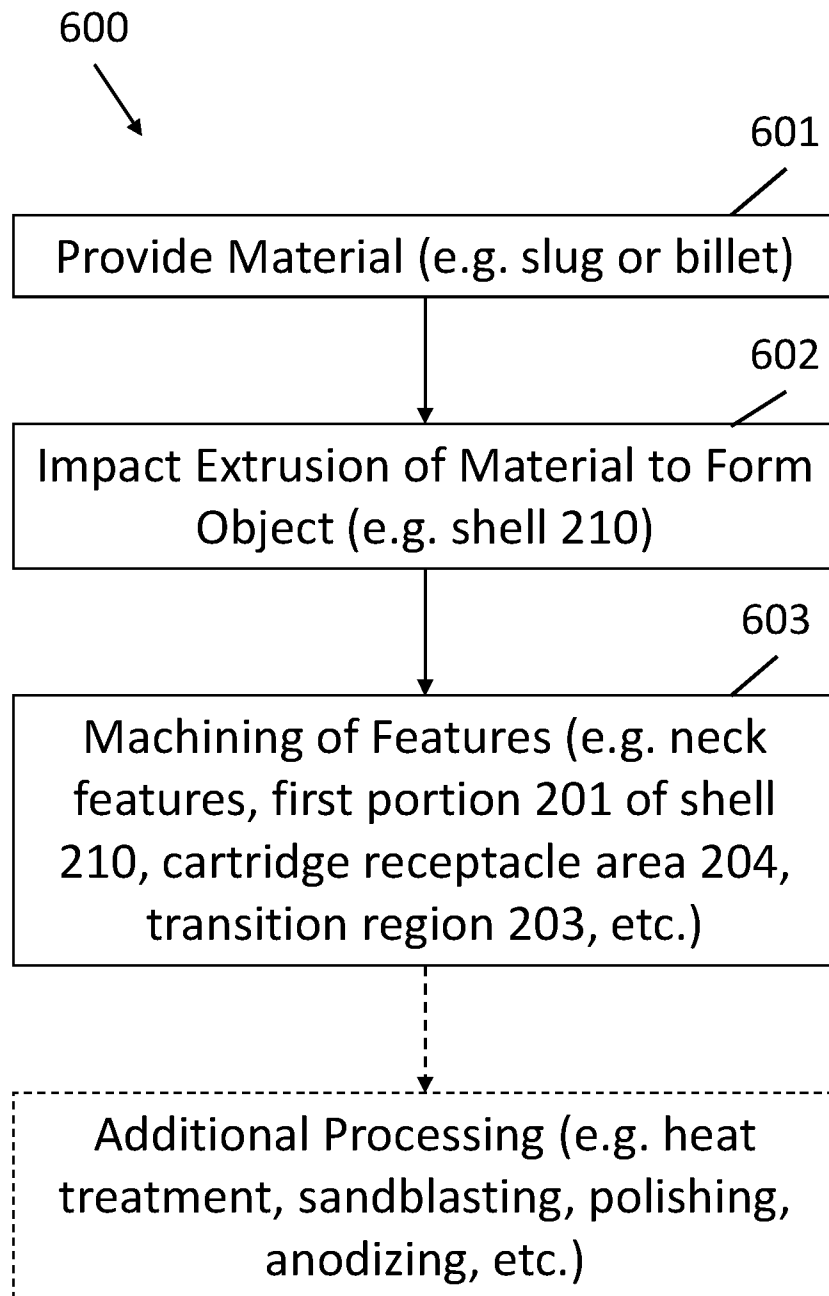


FIG. 6

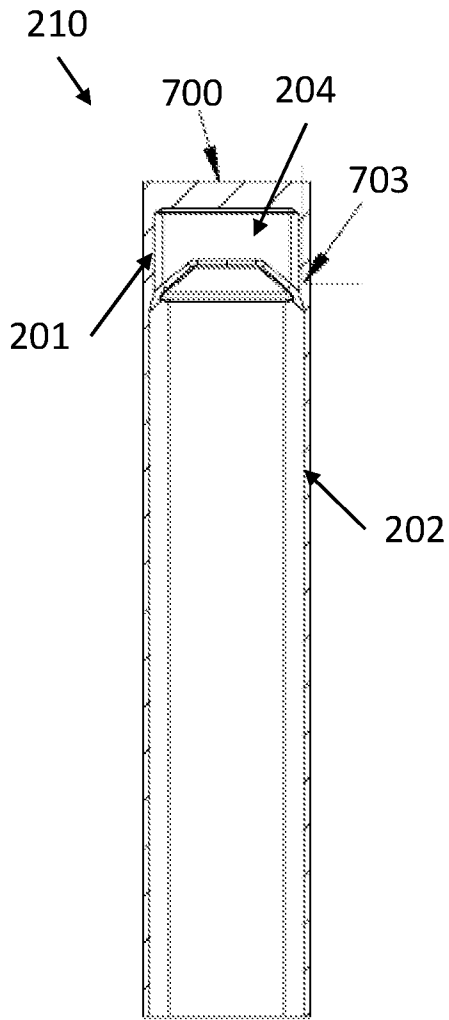


FIG. 7A

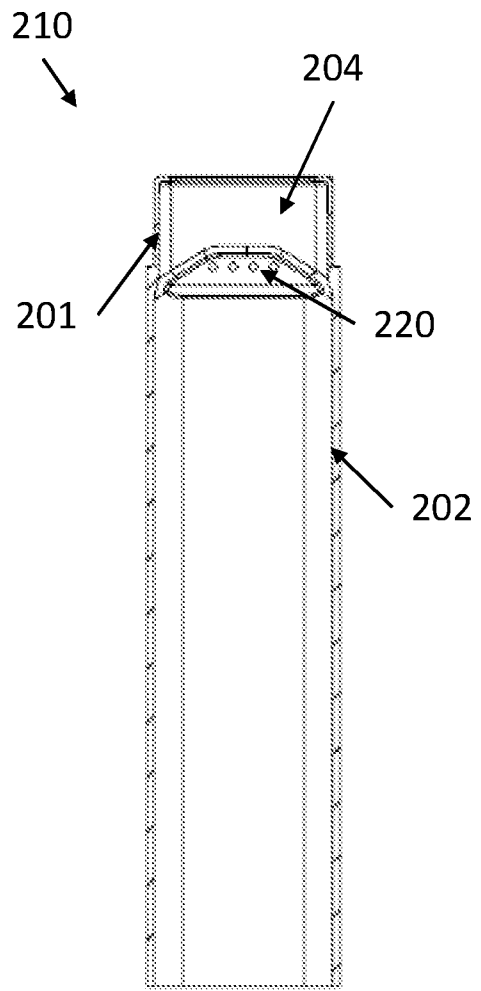


FIG. 7B

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2021/033757

A. CLASSIFICATION OF SUBJECT MATTER
 INV. A24F40/40
 ADD. A24F40/10 A24F40/70

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

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, 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	EP 3 440 950 A1 (BRITISH AMERICAN TOBACCO INVESTMENTS LTD [GB]) 13 February 2019 (2019-02-13) paragraph [0035] - paragraph [0062]; figures 1-5	1-24
X	----- CN 204 907 924 U (SHENZHEN FIRST UNION TECH CO) 30 December 2015 (2015-12-30) paragraph [0022] - paragraph [0030]; figures 1-6	1-24
X	----- CN 107 890 142 A (SHENZHEN IVPS TECH CO LTD) 10 April 2018 (2018-04-10) paragraph [0034] - paragraph [0057]; figures 1-10	1-24
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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 27 August 2021	Date of mailing of the international search report 15/09/2021
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