Innovation, Sciences et Développement économique Canada
Office de la Propriété Intellectuelle du Canada

Innovation, Science and Economic Development Canada
Canadian Intellectual Property Office

CA 3068712 A1 2020/07/18

(21) 3 068 712

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2020/01/17

(41) Mise à la disp. pub./Open to Public Insp.: 2020/07/18

(30) Priorités/Priorities: 2019/01/18 (US62/794411); 2019/02/13 (US62/805,160)

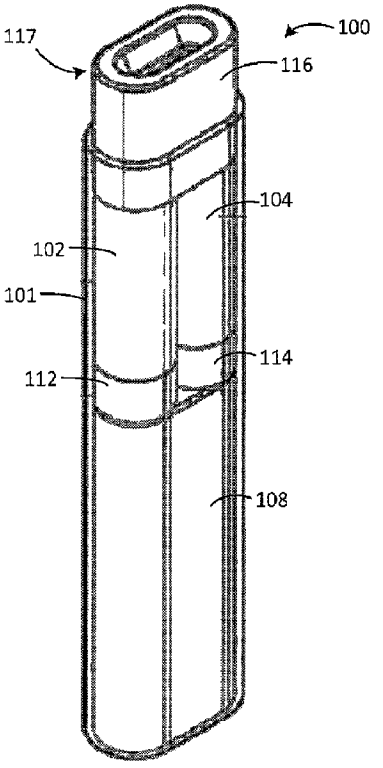
(51) Cl.Int./Int.Cl. *A24F 40/30* (2020.01), *A24F 40/00* (2020.01), *A24F 40/42* (2020.01), *A61M 15/06* (2006.01)

(71) Demandeur/Applicant:
LOOP LABORATORIES, LLC, US

(72) Inventeurs/Inventors:
WILSON, SCOTT H., US;
ETTENSON, GREG, US;
PUHALLA, DENNIS M., US;
IAVICOLI, MATTEO, US;
PAULSEN, GARY HARLAN, US;
ALSBERG, KEITH, US

(74) Agent: MLT AIKINS LLP

(54) Titre : VAPORISATEUR A CARTOUCHES MULTIPLES
(54) Title: MULTI-CARTRIDGE VAPORIZER



(57) Abrégé/Abstract:
Embodiments include a personal vaporizer with two cartridges disposed side-by- side and coupled between a removable mouthpiece and a housing comprising a power source for powering both cartridges. The vaporizer may include a selection device

(21) 3 068 712

(13) A1

(57) Abrégé(suite)/Abstract(continued):
configured to enable selection of an individual cartridge for vaping, or of both cartridges for blended vaping. The vaporizer may also include an electronics module for controlling delivery of power to the cartridges based on a selected operating mode. Certain embodiments can include a locating system to identify a current location of the device, a dosing system to indicate when the device is in use and/or to provide accurate dosing, and/or an indication system to signify a current operating mode or status of the device.

Abstract

Embodiments include a personal vaporizer with two cartridges disposed side-by-side and coupled between a removable mouthpiece and a housing comprising a power source for powering both cartridges. The vaporizer may include a selection device configured to enable selection of an individual cartridge for vaping, or of both cartridges for blended vaping. The vaporizer may also include an electronics module for controlling delivery of power to the cartridges based on a selected operating mode. Certain embodiments can include a locating system to identify a current location of the device, a dosing system to indicate when the device is in use and/or to provide accurate dosing, and/or an indication system to signify a current operating mode or status of the device.

MULTI-CARTRIDGE VAPORIZER

[001]

Technical Field

[002] The present invention relates to personal, portable vaporizers or other apparatus for vaporized delivery of a substance.

Background

[003] Various types of personal vaporizers can be used to deliver a substance to the lungs. Generally speaking, vaporizing devices are configured to electrically heat a liquid substance into a vapor and provide the vapor for inhalation. A typical vaporizer may include (1) a cartridge that holds a liquid solution to be vaporized, (2) an atomizer or heating element for vaporizing the liquid, (3) a power source, such as, for example, a rechargeable lithium-ion battery, for powering the atomizer and/or delivery system, and (4) a mouthpiece to enable inhalation of the vapor. When a button is pressed, the heating element fires to atomize the liquid as it is drawn across the heating element. Suction pressure is simultaneously supplied by the user at the mouthpiece, pulling the vaporized liquid through a barrel or delivery tube and through the mouthpiece.

[004] With the recent growth in vaping and legalization of certain cannabis-based products, the demand for personal vaporizers that can deliver various strains of cannabis and other products has risen dramatically. Such vaporizers are typically portable, self-contained devices

CA 3068712 2020-01-17

that come in varying sizes and/or forms, including, for example, cylindrical "vape pens," slim rectangular housings designed to fit comfortably within a hand, as well as others. In addition, personal vaporizers may be disposable or reusable, as a whole. In the case of reusable devices, the vaporizer may include replaceable and/or refillable components. For example, once the liquid within the cartridge has been depleted, the user may choose to refill the cartridge with more liquid or replace the empty cartridge with one that is pre-filled with liquid, depending on the type of vaporizer. Reusable vaporizers have the added advantage of allowing the user to change the makeup or composition of the substance or liquid being vaporized and inhaled. For example, cannabis-based products may come in different blends or strains, and a user may want different products or strains at different times or for different needs. At the same time, reusable vaporizers are relatively more expensive and therefore, are more costly to replace if lost.

Summary of the Invention

[005] Embodiments include a dual cartridge, or multi-cartridge, vaporizer comprising a plurality of containers for separately storing different contents and a delivery system configured to simultaneously or alternatively deliver the contents of each cartridge based on a user selection. The vaporizer, or vaporizing device, may be implemented using one or more embodiments, or a combination thereof. Certain embodiments can include a locating system to identify a current location of the device, a dosing system to indicate when the device is in use and control the delivery and/or provide accurate dosing, and/or a selection system that enables toggling between, or blending of, the contents of the different cartridges (e.g., different substances or strains).

[006] One exemplary embodiment includes a vaporizer with adjacent, or side-by-side, cartridges coupled between a removable mouthpiece and an electronics compartment comprising a power source and other electronic components. The vaporizer also includes a selection device

configured to enable selection of a single cartridge or both cartridges for delivery of vaporized content through the mouthpiece.

[007] Another exemplary embodiment includes a vaporizer with an extendible main body comprising a movable sleeve surrounding two cartridges and an electronics compartment coupled thereto. The sleeve is configured to slide up or down between opposing ends of the main body. In some embodiments, the vaporizer also includes a mouthpiece disposed on each of two opposing ends of the main body and coupled to a respective one of the cartridges. In such embodiments, the user can select which of the two cartridges to use by extending out, from the sleeve, the mouthpiece that is coupled to the selected cartridge. In other embodiments, the sleeve is slidable to provide access to one or more components or features of the vaporizer, such as, for example, a charging port for coupling to a charging cable. In such cases, the charging port can be electronically coupled to a rechargeable battery included in the electronics compartment of the vaporize, and can be configured for receiving power from a power source electronically coupled to the charging cable.

[008] In another exemplary embodiment, a vaporizer with two retractable and/or extendible cartridges coupled atop a main body is provided. The two cartridges are positioned side-by-side, and each cartridge includes a mouthpiece on its top end. A lower portion of each cartridge is housed within the main body when the cartridge is not in use. A selection device is configured to lengthen a selected cartridge, so that the lower portion of the selected cartridge extends out from the main body and the mouthpiece of the selected cartridge stands taller than the other mouthpiece. The main body also includes an electronics compartment comprising a power source and other electronic components.

[009] Yet another exemplary embodiment provides a vaporizer with two cartridges located on opposing ends of a main body, each cartridge having its own mouthpiece facing away from the main body. The main body includes an electronics compartment comprising a power source and other electronic components.

[0010] While certain features and embodiments are referenced above, these and other features and embodiments of the present invention will be, or will become, apparent to one having ordinary skill in the art upon examination of the following figures and detailed description. It is intended that all such additional embodiments and features included within this description, be within the scope of the present invention, and be protected by the accompanying claims.

Brief Description of the Drawings

[0011] The present invention can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present invention. In the drawings, like reference numerals designate corresponding parts throughout the several views.

[0012] FIG. 1 is a top perspective view of an example multi-cartridge vaporizer in accordance with certain embodiments.

[0013] FIG. 2 is a bottom perspective view of the multi-cartridge vaporizer shown in FIG. 1 coupled to a base, in accordance with certain embodiments.

[0014] FIG. 3 is a block diagram of an exemplary electronics system of the multi-cartridge vaporizer shown in FIG. 1, in accordance with certain embodiments.

[0015] FIG. 4A is a perspective view of a mouthpiece of the multi-cartridge vaporizer shown in FIG. 1, in accordance with certain embodiments.

[0016] FIG. 4B is an exploded view of the mouthpiece of FIG. 3A, in accordance with certain embodiments.

[0017] FIG. 5 is a front view of another exemplary multi-cartridge vaporizer, in accordance with certain embodiments.

[0018] FIG. 6 is a perspective view of another exemplary multi-cartridge vaporizer, in accordance with certain embodiments.

[0019] FIG. 7 is a perspective view of the vaporizer shown in FIG. 6 in a first use mode, in accordance with certain embodiments.

[0020] FIG. 8 is a perspective view of another exemplary multi-cartridge vaporizer, in accordance with certain embodiments.

[0021] FIG. 9 is another perspective view of the multi-cartridge vaporizer shown in FIG. 9 with transparent top and bottom surfaces, in accordance with certain embodiments.

[0022] FIG. 10 is a bottom perspective view of another exemplary multi-cartridge vaporizer, in accordance with certain embodiments.

[0023] FIG. 11 is a side perspective view of the multi-cartridge vaporizer shown in FIG. 10 with an outer sleeve of the vaporizer moved to an open position, in accordance with certain embodiments.

[0024] FIGS. 12A, 12B, and 12C are exploded views of various portions of the multi-cartridge vaporizer shown in FIG. 10, in accordance with certain embodiments.

[0025] FIGS. 13A, 13B, and 13C are cross-sectional views illustrating assembly of a first cartridge and attachment of the first cartridge to a mouthpiece of an exemplary multi-cartridge vaporizer, in accordance with certain embodiments.

[0026] FIG. 14A is a bottom end view of an exemplary multi-cartridge vaporizer illustrating user selection of a first operational state, in accordance with certain embodiments.

[0027] FIG. 14B is a cross-sectional view of the multi-cartridge vaporizer of FIG. 14A illustrating cartridge operation during the first operational state, in accordance with certain embodiments.

[0028] FIG. 15A is a bottom end view of the multi-cartridge vaporizer of FIG. 14B illustrating user selection of a blended operational state, in accordance with certain embodiments.

[0029] FIG. 15B is a cross-sectional view of the multi-cartridge vaporizer of FIG. 15A illustrating cartridge operation during the blended operational state, in accordance with certain embodiments.

[0030] FIG. 16A is a bottom end view of the multi-cartridge vaporizer of FIG. 14B illustrating user selection of a second operational state, in accordance with certain embodiments.

[0031] FIG. 16B is a cross-sectional view of the multi-cartridge vaporizer of FIG. 16A illustrating cartridge operation during the second operational state, in accordance with certain embodiments.

[0032] FIG. 17 is a flowchart depicting an exemplary method for operating a multi-cartridge vaporizer comprising first and second cartridges, in accordance with certain embodiments.

[0033] FIG. 18A is a front view of an exemplary multi-cartridge vaporizer with a slidable, outer sleeve placed in a lowered position, in accordance with certain embodiments.

[0034] FIG. 18B is a front view of the multi-cartridge vaporizer of FIG. 18A with the slidable, outer sleeve placed in an elevated position, in accordance with certain embodiments.

[0035] FIG. 18C is a back view of the multi-cartridge vaporizer shown in FIG. 18A, in accordance with certain embodiments.

[0036] FIG. 18D is a back view of the multi-cartridge vaporizer of FIG. 18B, in accordance with certain embodiments.

[0037] FIG. 19 is a front view of another exemplary multi-cartridge vaporizer, in accordance with certain embodiments.

Detailed Description

[0038] The description that follows describes, illustrates and exemplifies one or more particular embodiments of the present invention in accordance with its principles. This description is not provided to limit the invention to the embodiments described herein, but rather to explain and teach the principles of the invention in such a way to enable one of ordinary skill in the art to understand these principles and, with that understanding, be able to apply them to practice not only the embodiments described herein, but also other embodiments that may come to mind in accordance with these principles. The scope of the present invention is intended to cover all such embodiments that may fall within the scope of the appended claims, either literally or under the doctrine of equivalents.

[0039] FIG. 1 illustrates an exemplary vaporizer 100 configured to provide multiple vaping options within a single device, in accordance with embodiments. As shown, the vaporizer 100 has a flattened or substantially rectangular body 101 with two cartridges 102 and 104 positioned side-by-side, or in parallel to each other, within a top half of the body 101. In the illustrated embodiment, the cartridges 102 and 104 (also referred to herein as "barrels") have a generally cylindrical shape, though other shapes are also contemplated. While the embodiments shown and described herein include two cartridges, other embodiments may include more than two cartridges to accommodate a greater variety of contents. Also, while the vaporizer 100 is shown as having a tall and slim profile that is akin to a "vape pen," other embodiments may have

different overall shapes or configurations to accommodate, for example, more than two cartridges or cartridges having a different shape or profile.

[0040] Each of the cartridges 102 and 104 comprises a storage compartment configured to store a substance (e.g., liquid solution or dry materials) to be vaporized. In some embodiments, each cartridge 102, 104 may be entirely or partially transparent, across all or a portion of an outer surface of the cartridge 102, 104, to reveal the contents of its storage compartment (e.g., as shown in FIG. 10). In other embodiments, the cartridges 102 and 104 may have a solid or opaque outer surface that fully or partially hides the contents of the storage compartments (e.g., as shown in FIG. 19).

[0041] In embodiments, the cartridges 102, 104 may be removable, replaceable, and/or refillable. The cartridges 102, 104 may be configured to store one or more of the following: cannabis extracts, terpenes, nutraceuticals, essential oils, cannabinoids, or the like. In some embodiments, the vaporizer 100 can be configured to vaporize the contents of the one or more cartridges 102, 104 using an atomizer that includes a ceramic heating element or coil (not shown). In such cases, the cartridges 102, 104 may be implemented using CCELL® cartridges or other suitable ceramic-compatible cartridge. The cartridges 102 and 104 can be individually removable from the vaporizer 100 for refilling and/or replacing (e.g., as shown in FIGS. 13A-C). For example, in some cases, each cartridge 102, 104 can be refilled with a desired solution or substance. In other cases, the entire cartridge 102 or 104 may be replaced with another cartridge.

[0042] The cartridges 102 and 104 can be coupled to the vaporizer 100 using a magnetic connector, a threaded fastener, any other suitable fastening device, or a combination thereof. In some embodiments, instead of requiring a separate coupling device, the bottom end of each cartridge 102, 104 may present threads (e.g., a 510 thread) that can be screwed into a mating

housing (not shown) permanently attached to the main body 101 of the vaporizer 100. In other embodiments, the threaded ends of each cartridge 102, 104 may be coupled to an adapter having an internal threaded surface configured for coupling to a given threaded end and an external body configured for coupling with the main body 101 of the vaporizer 100 (e.g., as shown in FIG. 12B).

[0043] Each cartridge 102, 104 may store or contain a different substance or solution, a different blend of materials, a different strain or flavor of the same substance, or any combination thereof, and a user of the vaporizer 100 can choose to individually use one of the cartridge(s) 102, 104 for vaping, or blend the contents of the two cartridges 102 and 104 to create a mixed output or pull (e.g., as shown in FIGS. 14B, 15B, and 16B). For example, the vaporizer 100 may be configured to selectively operate in one of a plurality of modes, including (1) a first mode for enabling vaporization of the contents of the first cartridge 102, (2) a second mode for enabling vaporization of the contents of the second cartridge 104, and (3) a third or blended mode for enabling simultaneous vaporization of the contents of both cartridges 102 and 104. To enable multi-mode operation, the vaporizer 100 can include a selection device 106 (also referred to herein as a "user input device") capable of activating either one of the cartridges 102 and 104 or both simultaneously, in response to a user selection or input. As an example, the user selection can cause activation of the selected cartridge(s) by powering the heating element therein, which can heat the substance within the cartridge until a vapor forms.

[0044] In embodiments, the selection device 106 may be configured for switching or toggling between a first position corresponding to selection of the first operating mode, a second position corresponding to selection of the second operating mode, and a third position corresponding to activation of the third operating mode (e.g., as shown in FIGS. 14A-16B). FIG.

2 depicts the selection device 106 as a slider configured to move horizontally, or more specifically, along a first axis parallel to a bottom end 107 of the vaporizer 100. In the illustrated example, the first operating mode may be selected when the slider 106 is aligned with the first cartridge 102, the second operating mode may be selected when the slider 106 is aligned with the second cartridge 104, and the third operating mode may be selected when the slider 106 is held in a middle position between the first and second cartridges 102 and 104.

[0045] Though a specific implementation is shown in the FIG. 2, in other embodiments, the selection device 106 may be positioned in a different location (e.g., along a side of the vaporizer as shown in FIG. 5) and/or may have a different shape or functionality (e.g., as shown in FIGS. 6 and 7). For example, the selection device 106 may comprise one or more buttons, switches, or any other type of device capable of changing or toggling between different operating modes based on user input. In some embodiments, the selection device 106 may be an electronic device configured to receive user inputs, such as a touch screen, a control panel, or the like. In some embodiments, the selection device may present in a format that allows a user to select any combination of mixture from the two cartridges. For example, the selection device could present in the form of a twist knob that controls a baffle (mechanically or electrically) that dictates which cartridge is open to allow the contents to pass across the heating element. When twisted fully in a first direction, only cartridge 102 would be open. As the knob is turned in a second, opposing direction, cartridge 104 begins to open as cartridge 102 begins to close. A full turn in the second direction would seal cartridge 102 and allow discharge only from cartridge 104.

[0046] The vaporizer 100 further comprises an electronics compartment 108 disposed within the main body 101 for providing power to and/or controlling one or more electronic components of the vaporizer 100 (e.g., as shown in FIG. 13A). In particular, the electronics compartment 108

includes a power source for powering various components of the vaporizer 100. In some embodiments, the power source may be used to power both of the cartridges 102 and 104, as well as other components. The power source may be a rechargeable battery or other type of battery. The main body 101 and/or the electronics compartment 108 may include one or more receiving ports (see, e.g., ports 780 and 782 in FIG. 14B) configured to receive the cartridges 102 and 104 and electrically couple each cartridge 102, 104 to the electronics compartment 108 for receiving power and/or control signals therefrom.

[0047] FIG. 2 shows the vaporizer 100 coupled to a base 110 that may be used to recharge the battery. The base 110 may include an induction charging device or any other charging device suitable for recharging the power source of the vaporizer 100. In other embodiments, instead of a charging base, the electronics compartment 108 includes a charging port for receiving a charging cable coupled to an external power source for recharging the battery (e.g., as shown in FIG. 11). In some embodiments, the electronics compartment 108 may also include one or more internal components (not shown) for coupling the selection device 106 to the cartridges 102 and 104 and for enabling activation of the appropriate cartridge(s) 102, 104 in response to a user input received through the selection device 106 (e.g., as shown in FIG. 14B).

[0048] FIG. 3 illustrates an exemplary electronics system 200 that may be included in the electronics compartment 108, in accordance with embodiments. The electronics system 200 may be implemented, at least in part, on one or more printed circuit boards (PCBs) (e.g., as shown in FIG. 14B) that are electronically coupled (e.g., using wires or cables) to one or more other components of the vaporizer 100, including, for example, the selection device 106 and the cartridges 102 and 104. In some embodiments, the electronics system 200 is electrically coupled

to a rechargeable battery of the vaporizer 100. In other embodiments, the electronics system 200 includes the rechargeable battery.

[0049] As shown in FIG. 3, the electronics system 200 includes a processor 202 and a memory element 204 for storing software that may be executed by the processor 202 to implement one or more functions of the vaporizer 100. The processor 202 may use or instruct one or more other electronic devices or systems of the electronics system 200 in order to implement these functions, as described below. The processor 202 may communicate with the memory element 204 and any other components of the electronics system 200 using a data bus (not shown) or other appropriate medium. The electronics system 200 also includes a battery 206 for powering the electronics system 200. In some cases, the battery 206 also supplies power to the cartridges 102 and 104 of the vaporizer 100. In other cases, the battery 206 is separate from the power source for powering the cartridges 102 and 104.

[0050] In embodiments, the processor 202 (e.g., data processor) can comprise one or more of a microprocessor, a microcontroller, a programmable logic array, an application-specific integrated circuit, a logic device, or other electronic device for processing, inputting, outputting, manipulating, storing, or retrieving data. The memory element 204 (e.g , data storage device) can comprise one or more of electronic memory, nonvolatile random access memory (e.g., RAM), flip-flops, a computer-writable or computer-readable storage medium, a magnetic or optical data storage device, a magnetic or optical disc drive, a hard disk drive, or other electronic device for storing, retrieving, reading, or writing data. The memory element 204 may store one or more software program modules or software instructions for execution by the processor 202, including, for example, a program module or software instructions corresponding to method 800 shown in FIG. 17.

[0051] In embodiments, the electronics system 200 includes a communications module 208 configured to facilitate wireless communications between the vaporizer 100 and an external or remote device, such as, e.g., a mobile device (e.g., smartphone, tablet, laptop, etc.) or other computing device of the user. The communications module 208 may comprise one or more transceivers, ports, modems, or other communications devices for facilitating communications using Bluetooth, NFC, Wi-Fi, or other wireless communications technology.

[0052] According to embodiments, the electronics system 200 also includes an indicating system 210 configured to convey various types of information related to the vaporizer 100, such as indicating a currently selected operating mode of the vaporizer 100, providing information about the cartridges 102 and 104, and/or notifying the user in response to other functionalities of the vaporizer 100. For example, the indicating system 210 may be configured to indicate or convey which cartridge(s) are currently selected, in use, and/or are available for use; whether a dose has been completed for the cartridge that is in use; error messages related to operation of the cartridges 102 and 104, the battery 206, and/or other aspects of the vaporizer 100; low or depleted contents for a given cartridge; and/or various other detectable condition(s). The indicating system 210 can include one or more lights (e.g., light-emitting diodes (LEDs)), haptic devices (e.g., a vibrating motor or actuator), audio devices (e.g., a speaker or tweeter), and/or display devices (e.g., a touchscreen or LCD). In some embodiments, the indicating system 210 includes a haptic device configured to provide dynamic feedback to the user during a vaping session. For example, the haptic device may be configured to vibrate once a single dose is complete and/or each time the user has completed a dose, where a dose comprises a pre-determined amount or content of vaporized liquid and/or corresponds to a pull or inhale lasting a predetermined length of time (e.g., two seconds).

[0053] FIG. 1 illustrates an exemplary embodiment in which the indicating system 210 includes light indicators 112 and 114 respectively coupled to the cartridges 102 and 104 and adjacent to a top end of the electronics compartment 108, so that the light indicators 112 and 114 are visible outside of the electronics compartment 108. In one embodiment, using software stored in the memory 204 and executed by the processor 202, the light indicators 112 and 114 can be configured to light up when the corresponding cartridge 102, 104 is in use and to blink on and off when a first condition is met, such as, e.g., completion of a dose. When both cartridges 102 and 104 are in use (e.g., during the blended mode), both indicators 112 and 114 may be turned on or activated. In some cases, each of the light indicators 112 and 114 may include a different colored LED to help differentiate between the two cartridges 102 and 104. In other cases, each indicator 112, 114 may include multiple LEDs of different colors, and each color may represent a different message (e.g., red meaning depleted contents or error message, green meaning ready to use, blue meaning dosing complete, etc.).

[0054] In embodiments, the electronics system 200 can include a locating system 212 configured to help the user locate or track the vaporizer 100 if misplaced. The locating system 212 may be in communication with the processor 202, and the memory 204 may store computer program modules or software instructions that, when executed by the processor 202, implement a locating mode of the vaporizer 100. In some embodiments, the locating mode causes the vaporizer 100 to play an audible alert (e.g., beeping sound) to help guide the user to the vaporizer 100. In other embodiments, the locating mode causes the vaporizer 100 to broadcast its location to enable real-time tracking of the vaporizer 100 on another device, such as, e.g., the user's mobile phone.

[0055] In some embodiments, the locating system 212 can be configured to operate as a standalone system that comprises, for example, a beacon, a sensor, an antenna, a wireless receiver and/or transmitter, an audio device, a light device, and/or other electronic device(s) required to implement the locating mode. In other cases, the locating system 212 can be configured to operate in combination with one or more other components of the electronics system 200. For example, the locating system 212 may utilize the communications module 208 to broadcast a current location of the misplaced vaporizer 100 or otherwise communicate with a remote device being used to locate the vaporizer 100. As another example, the locating system 212 may utilize the indicating system 210 to provide audible alerts or other notifications designed to help the user locate the misplaced vaporizer 100.

[0056] In one exemplary embodiment, when location services are required, the user may use a software application (e.g., mobile app) stored on a remote device (e.g., a smartphone, tablet, laptop, or other computing device) to transmit a wireless signal (e.g., using Bluetooth or Wi-Fi technology) to the vaporizer 100. The locating system 212 can be configured to scan for the wireless signal, either continuously or periodically, using one or more wireless receivers of the communications module 208 or the locating system 212. Once the wireless signal is received or detected, the locating system 212 may provide the received signal to the processor 202 for processing, or otherwise cause the processor 202 to initiate a locating mode of the vaporizer 100

[0057] In some embodiments, in response to receiving the wireless signal, the processor 202 may send an instruction to an audio device of the indicating system 210 or locating system 212 to play an audible alert. The audio device can be configured to generate and play a predetermined sound or audible waveform for a set period of time and/or continuously, until the locating mode is turned off. The user may follow the sound to locate the vaporizer 100.

[0058] In other embodiments, in response to receiving the wireless signal (e.g., ping), the processor 202 may send an instruction to a wireless transmitter of the communications module 208 or the locating system 212 to broadcast a real-time or current location of the vaporizer 100. The wireless transmitter may receive location information (e.g., geographic coordinates) from another component, such as, e.g., a location determining receiver (e.g., GPS receiver), included in either the locating system 212 or the communications module 208. The user's remote device may receive the transmitted location information and provide the same to the software application for locating the vaporizer 100. The software application may be configured to display a real-time location of the vaporizer 100 on a map or other graphical user interface configured to guide the user to the vaporizer 100.

[0059] As shown in FIG. 3, the electronics system 200 may also include one or more sensors 214 configured to facilitate operation of the vaporizer 100. In embodiments, the sensor(s) 214 can include one or more accelerometers or other motion sensors, temperature sensors, air-flow sensors to facilitate vaping operation (e.g., as shown in FIG. 14B), touch sensors configured to "wake up" the electronics system 200 once a human touch is detected on a surface of the vaporizer 100, and/or other appropriate sensing devices.

[0060] Referring back to FIG. 1 and additionally to FIGS. 4A and 4B, the vaporizer 100 includes a mouthpiece 116 positioned at a top end 117 of the vaporizer 100, opposite the bottom end 107, for delivering vapor to a user. In embodiments, the mouthpiece 116 may be removably coupled to the top ends (also referred to herein as "cartridge tips") of the cartridges 102 and 104 using a magnetic connector (not shown), a press-fit mechanism, or any other suitable connection mechanism. As shown in FIG. 4B, the mouthpiece 116 may have a removable and/or replaceable

filter 118 (e.g., a micro filter) coupled to an open end of the mouthpiece 116 for easy cleaning. The mouthpiece 116 may be made of silicone, plastic, or any other suitable material.

[0061] During operation, the user may place the mouthpiece 116 (or "tip") at least partially in their mouth in order to pull the vapor produced by the vaporizer 100. The vapor may travel out from the tips of the selected cartridge(s) 102, 104, into an airway within the mouthpiece 116, and out through the filter 118 at the open end of the mouthpiece 116 (e.g., as shown in FIG. 14B). The mouthpiece 116 may be configured to seal the cartridges 102 and 104 in order to optimize airflow during operation. In some embodiments, each of the cartridges 102 and 104 may include an opening (not shown) that remains sealed, by the mouthpiece 116 or the cartridge itself, until the respective cartridge is activated or selected for vaping. For example, each cartridge's opening may be individually sealed to prevent mixing when single cartridge operation is selected. Upon activation of a given cartridge 102, 104 via the selection device 106, the opening of the selected cartridge(s) 102, 104 may be unsealed and placed in communication with the airway within the mouthpiece 116 for delivery of the resulting vapor. In some embodiments, the mouthpiece 116 may include a one-way seal, that allows the vapor to escape but does not allow liquid or debris to enter into the vaporizer 100 through the mouthpiece 116.

[0062] In some embodiments, the mouthpiece 116 includes two airways that are respectively coupled to the cartridges 102 and 104 and are completely or substantially isolated from each other (e.g., as shown in FIG. 14B). Each airway may be dedicated to, or in communication with, a respective one of the cartridges 102 and 104, and may be individually opened, or partially opened, depending on the selected operating mode. For example, if a first or second operating mode is selected, the selection device 106 of the vaporizer 100 may be configured to cause the appropriate airway to fully open, so that the selected cartridge 102, 104 can be connected to the

mouthpiece 116 for vaping. If the third operating mode is selected, the selection device 106 may be configured to cause both airways to at least partially open, so that a blended vapor may be delivered through the mouthpiece 116. In some cases, the mouthpiece 116 may be configured to keep the airway that is not in use sealed or closed, to optimize airflow and prevent undesired mixing. In some embodiments, the selection device 106 may be configured to allow the user to control the exact makeup of the blended vapor by varying the extent to which each airway is opened. For example, if the user wants a blended vapor that includes a greater percentage of the first substance, a larger portion of the corresponding first airway may be opened, while a smaller portion of the second airway may be left open.

[0063] FIG. 5 illustrates another exemplary vaporizer 300 that is at least somewhat similar to the vaporizer 100, in accordance with embodiments. In particular, like the vaporizer 100, the vaporizer 300 has a generally flattened body 301 comprising two side-by-side barrels 302 and 304 for storing two different contents (e.g., strains, blends, substances, solutions, etc.), a selection device 306 for selecting either one or both of the barrels 302, 304, and a mouthpiece 316 at a top end 317 of the vaporizer 300 for delivering vapor to the user. Moreover, like the selection device 106 shown in FIG. 2, the selection device 306 includes a slider capable of moving horizontally between a first position corresponding to selection of the first barrel 302, a second position corresponding to selection of the second barrel 304, and a third or intermediate position between the first and second positions for blending the contents of the two barrels 302, 304. However, unlike the slider 106, the slider 306 is positioned on a side surface 309 of the vaporizer 300 adjacent to the barrels 302 and 304.

[0064] In some embodiments, the vaporizer 300 is configured to include two mouthpieces 316 and 319 at opposing ends of the main body 301 and a movable sleeve or component 320

coupled to a mid-section of the main body 301. Each mouthpiece 316, 319 may be in communication with a respective one of the cartridges 302, 304 through an appropriate airway (not shown). The sleeve 320 may be configured to move laterally or across the main body 301 between a top end 317 adjacent the first mouthpiece 316 and a bottom end 307 adjacent the second mouthpiece 319. In such cases, the sleeve 320 may be configured to operate as a selection device for selecting different operating modes for the vaporizer 300. For example, sliding the sleeve 320 towards the first mouthpiece 316 may activate the first operating mode (i.e. selection of the first cartridge 302), while sliding the sleeve 320 towards the second mouthpiece 319 may activate the second operating mode (i.e. selection of the second cartridge 304). In some embodiments, the sleeve 320 may be configured to open the airway between the selected mouthpiece and cartridge and/or activate the atomizer of the selected cartridge in response to movement of the sleeve 320. In some embodiments, the cartridges 302 and 304 may be individually activated based on airflow through the corresponding mouthpiece 303, 305. In some cases, the slider 306 may be omitted or modified to enable unobstructed movement of the sleeve 320, as will be appreciated. In one exemplary case, the slider 306 may be modified to enable activation of the third operating mode, or selection of both cartridges 302 and 304 for a blended vapor.

[0065] FIG. 6 illustrates another exemplary vaporizer 400 having a flattened main body 401 and two cylindrical cartridges 402 and 404, in accordance with embodiments. The main body 401 may include a power source and one or more electronic components for controlling operation of the vaporizer 400. As shown, the cartridges 402 and 404 are coupled to the main body 401 such that a first or lower portion of each cartridge 402, 404 is embedded within the body 401 and a second or upper portion of each cartridge 402, 404 extends above a top end 417

of the main body 401. The upper portion of each cartridge 402, 404 may serve as a mouthpiece 416, 419, respectively, for emitting or delivering vapor produced by the corresponding cartridge 402, 404. The lower portion of each cartridge 402, 404 may include an airway (not shown) that connects the corresponding mouthpiece 416, 419 to a storage compartment (not shown) within the cartridge 402, 404 for storing the substance to be vaporized.

[0066] In some embodiments, the cartridges 402 and 404 are configured to be individually or separately activated based on airflow through the corresponding mouthpiece 416, 419. For example, to use one of the cartridges 402 and 404, the user can simply draw on the mouthpiece 416, 419 that is coupled to the desired cartridge 402, 404. If the user wants a blend of the two cartridges 402 and 404, the user can draw on both of the mouthpieces 416 and 419 simultaneously. In other embodiments, the cartridges 402 and 404 (or the heating elements therein) may need to be activated before the user draws on the mouthpieces 416 and 419, in order to produce a vapor.

[0067] The vaporizer 400 includes at least one selection device 406 to enable selection and/or activation of either one or both of the cartridges 402 and 404. In embodiments, the selection device 406 is configured to lengthen one or both of the cartridges 402 and 404 to make it easier for the user to access the mouthpiece of the selected cartridge. In some embodiments, the selection device 406 may also be configured to activate or deactivate the selected cartridge 402, 404, like the selection device 106 described herein.

[0068] In the illustrated example, the selection device 406 includes a slider coupled to a side wall 421 of the vaporizer 400 and moveable in a vertical direction, or along a longitudinal axis of the vaporizer 400. As shown in FIG. 7, pushing the slider 406 upwards may cause the lower portion of the cartridge 402 to extend or pop out from within the main body 101 and move into a

use position. This extended position makes the mouthpiece 416 of the selected cartridge 402 more accessible and may place the mouthpiece 416 into communication with a strain of liquid associated with the first cartridge. Pulling or sliding the slider 406 down can cause the first cartridge 402 to move downwards, or drop the lower portion back into the main body 401. Both cartridges 402 and 404 may be aligned in height when they are in their resting positions or side-by-side, as shown in FIG. 6. As will be appreciated, though a slider is shown, other embodiments may include other types of selection devices, such as, e.g., a button, switch, touch screen, control panel, etc.

[0069] In some embodiments, the slider 406 may be configured to also enable extension or selection of the second cartridge 404 and/or simultaneous extension of both cartridges 402 and 404 for a blended mode. In other embodiments, the vaporizer 400 may include a second selection device or slider (not shown) positioned on an opposing side wall 422 adjacent the second cartridge 404 for selecting and/or deselecting the second cartridge 404. In such cases, the blended mode may be selected by using both sliders to extend both cartridges 402 and 404 simultaneously.

[0070] FIG. 8 illustrates another exemplary vaporizer 500 having an elongated body 501 comprised of two cartridges 502 and 504 located at opposite ends of the body 501, in accordance with embodiments. As shown, the cartridges 502 and 504 are coupled to opposing ends of an electronics compartment 508 situated in or near a center of the body 501. The electronic compartment 508 may include a power source, such as, e.g., a rechargeable battery, and one or more electronic components for controlling the vaporizer 500. Though the illustrated embodiment shows the vaporizer 500 having a generally cylindrical shape, other embodiments may have different shapes, including, for example, a flattened or more rectangular shape.

[0071] The cartridges 502 and 504 may be configured to store different blends, strains, or substances, like the cartridges 102 and 104 shown in FIG. 1. In some cases, the cartridges 502 and 504 may have external indicators to indicate its contents, such as, for example, different colors, lights, or symbols. As shown in FIG. 9, in some embodiments, the cartridges 502 and 504 may have at least partially transparent surfaces, so that the contents of the cartridges 502 and 504 can be visible to the user. Each end of the vaporizer 500 includes a mouthpiece 516, 519 for accessing the contents of the cartridge 502, 504 coupled thereto. The cartridges 502 and 504 may be individually or separately activated based on airflow through the corresponding mouthpieces 516 and 519. For example, to initiate vaping of the contents in the first cartridge 502, the user may simply draw on the mouthpiece 516. Or to initiate vaping of the contents in the second cartridge 504, the user can draw on the mouthpiece 519.

[0072] FIGS. 10 and 11 illustrate another exemplary multi-cartridge vaporizer 600 (also referred to herein as a "vaping system") configured to deliver, either individually or simultaneously, different substances, solutions, strains, blends, or any combination thereof, in accordance with embodiments. The vaporizer 600 is substantially similar to the vaporizer 100 shown in FIGS. 1 and 2. For example, the vaporizer 600 comprises a mouthpiece 616 at a top end 617 of the vaporizer 600, similar to the mouthpiece 116 of the vaporizer 100. The vaporizer 600 also includes first and second cartridges 602 and 604 coupled to the mouthpiece 616 and extending vertically into a main body or housing 601 of the vaporizer 600, similar to the cartridges 102 and 104 and main body 101 of the vaporizer 100. In addition, the vaporizer 600 includes a selection device 606 located at a bottom end 607 of the main body 601 for toggling between the cartridges 602 and 604, similar to the selection device 106 of the vaporizer 100. The vaporizer 600 further comprises an electronics compartment or housing 608 within the main

body 601 that comprises a rechargeable battery 624, similar to the electronics compartment 108 included in the vaporizer 100. In embodiments, the electronics compartment 608 also includes an electronics system for controlling operation of the vaporizer 600, similar to the electronics system 200 shown in FIG. 2.

[0073] In embodiments, the multi-cartridge vaporizer 600 further comprises a charging port 626 operatively coupled to the battery 624 and located adjacent to the bottom end 607 of the vaporizer 600, as shown in FIG. 11. The charging port 626 may be a Universal Serial Bus (USB) port (e.g., USB-A, USB-C, mini-USB, micro-USB, etc.), a lightning port, or any other type of port suitable for electrically coupling to a charging cable connected to an external power supply. As will be appreciated, the charging port 624 may be coupled to internal circuitry (not shown) for transferring the received power to the battery 624.

[0074] Also in embodiments, the vaporizer 600 comprises a movable sleeve or component 620 configured to move laterally across the vaporizer 600 between the top and bottom ends 617, 607 of the vaporizer 600, similar to the sleeve 320 of the vaporizer 300 shown in FIG. 5. During use, the movable sleeve 620 may be slid down or positioned adjacent to the bottom end 607, so that the mouthpiece 616 at the top end 617 of the vaporizer 600 is exposed and accessible for use, as shown in FIG. 10. This use position causes the sleeve 620 to cover the charging port 626, as a bottom edge 628 of the sleeve 620 is aligned with, or adjacent to, the bottom end 607 of the vaporizer 600. To access the charging port 626, the movable sleeve 620 may be slid up towards the top end 617 of the vaporizer 600 into a charging position, or until the charging port 626 is exposed and/or a top edge 630 of the sleeve 620 is aligned with, or adjacent to, a top end of the mouthpiece 616, as shown in FIG. 11. Thus, the charging port 626 remains hidden and protected from debris during vaping operation and can be uncovered or revealed for charging operation.

[0075] FIGS. 12A-C are partially exploded views of various components of the multi-cartridge vaporizer 600, including the mouthpiece 616, the cartridges 602 and 604, the electronics compartment 608, and the movable sleeve 620, in accordance with embodiments. In particular, FIG. 12A shows the mouthpiece 616 disconnected from the cartridges 602 and 604. In embodiments, the mouthpiece 616 may be configured for easy removal from the cartridges 602 and 604 for cleaning purposes, for example, as also shown in FIGS. 4A and 4B. The mouthpiece 616 may be configured to receive and seal, or cap, both of the cartridges 602, 604 at once. In the illustrated embodiment, the mouthpiece 616 includes two apertures 632 and 634 configured to individually receive the cartridges 602 and 604. For example, each cartridge 602, 604 may include a respective top end 636, 638 (also referred to herein as a "tip") that is configured for insertion into one of the apertures 632 and 634. In embodiments, the cartridges 602 and 604 may have identical top ends 636 and 638 and the mouthpiece 616 may have identical apertures 632 and 634 to allow for interchangeable placement of the cartridges 602 and 604, or any other similar cartridge, within the mouthpiece 616. Each of the apertures 632, 634 may be configured to form an airway that is isolated from the other, in order to individually deliver vapor from the cartridge 602, 604 coupled thereto. In embodiments, the mouthpiece 616 may be made of silicone, plastic, or other suitable material and may be configured to form a snug fit on top of the cartridges 602 and 604, so as to avoid extra airflow into or through the vaporizer 600.

[0076] FIG. 12B shows base connectors 640 and 642 disconnected from the cartridges 602 and 604, respectively. In embodiments, the base connectors 640 and 642 may be coupled to threaded ends 644 and 646 of the cartridges 602 and 604 using, for example, magnetic, threaded, or press-fit mechanisms. In one example embodiment, the base connectors 640 and 642 include internal threading configured for coupling to the respective threaded ends 644 and 646 of the

cartridges 602 and 604 (e.g., as shown in FIG. 13A). As an example, the threaded ends 644 and 646 may be a standard 510 thread that can be screwed into the base connectors 640 and 642. The base connectors 640 and 642 may be identical in shape and size to allow coupling with either of the ends 644, 646. In some embodiments, the base connectors 640 and 642 may be configured for attachment to mating receptacles (not shown) in a top end of the electronics component 608, and the mating receptacles may be configured to operatively couple the cartridges 602 and 604 to the electronics components 608. In one example embodiment, the base connectors 640 and 642 are magnetically coupled to the mating receptacles of the electronics compartment 608.

[0077] In some cases, the base connectors 640 and 642 may operate as adapters configured to convert the threaded ends 644 and 646 of the cartridges 602 and 604 into compatible connectors for coupling with the electronics compartment 608. In such cases, the threaded ends 644 and 646 may be used for coupling to other embodiments in which the mating receptacles of the electronics compartment contain threaded surfaces configured for attachment to the threaded ends 644 and 646. In other embodiments, the base connectors 640 and 642 may be permanently coupled to the cartridges 602 and 604.

[0078] FIG. 12C shows the electronics compartment 608, which comprises the battery 624, disassembled from the sleeve 620. The sleeve 620 may have a hollow body with two opposing, open ends forming top and bottom edges 630 and 628, thus allowing the sleeve 620 to move laterally across the vaporizer 600, for example, as shown in FIG. 11. During assembly, a bottom end of the electronics compartment 608 may be inserted into the top, open end of the sleeve 620 and slid down until the electronics compartment 608 is fully covered by the sleeve 620. In some embodiments, once the electronics compartment 608 is coupled to the sleeve 620, the two pieces become permanently, but slidably, attached. In other embodiments, the electronics compartment

608 may be removably attached to the sleeve 620, for example, to troubleshoot a component of the electronics compartment 608. In the illustrated embodiment, the electronics compartment 608 includes a metal clip 648 coupled to a mechanical stop 649 and configured to enable slidable attachment to the sleeve 620, as shown in FIGS. 18A-D and described below.

[0079] FIGS. 13A-13C are cross-sectional views of an exemplary cartridge 702 being coupled to an exemplary mouthpiece 716, prior to attachment to a vaporizer, in accordance with embodiments. FIGS. 14A-B, 15A-B, and 16A-B are various views of an exemplary multi-cartridge vaporizer 700 with the mouthpiece 716 and two cartridges 702 and 704 installed therein, during first, second, and third operational modes, in accordance with embodiments. As shown, the first cartridge 702 and a second cartridge 704 are both coupled to the same mouthpiece 716 (also referred to as a "dual tip"). The vaporizer 700 may be substantially similar to the vaporizer 100 shown in FIGS. 1-4 and/or the multi-cartridge vaporizer 600 shown in FIGS. 10-12. In particular, the cartridges 702 and 704 may be substantially similar to either of the cartridges 102 and 104 shown in FIG. 1 and/or either of the cartridges 602 and 604 shown in FIG. 12A. Likewise, the mouthpiece 716 may be substantially similar to the mouthpiece 116 shown in FIGS. 4A and 4B and/or the mouthpiece 616 shown in FIG. 12A. Also, the vaporizer 700 includes an electronics compartment 708 that is substantially similar to the electronics compartment 108 shown in FIGS. 1 and 3 and/or the electronics compartment 608 shown in FIG. 12C.

[0080] As shown in FIG. 13A, a base connector or adapter 740 may be removably coupled to a bottom end 744 of the cartridge 702. The base connector 740 may be configured for attachment to the bottom end 744 using techniques similar to the base connector 640 shown in FIG. 12B. For example, in the illustrated embodiment, the base connector 740 comprises a threaded

interface surface that may be configured for attachment to a threaded outer surface of the bottom end 744, e.g., similar to the threaded bottom 644 shown in FIG. 12B. In other embodiments, the base connector 740 may be magnetically coupled to the bottom end 744, or using any other suitable attachment mechanism. Also like the base connector 640, the base connector 740 may be configured for attachment to a mating receptacle, or receiving port, disposed in a top end of the electronics compartment 708 of the vaporizer 700, such as, for example, one of the receiving ports 780 and 782 shown in FIG. 14B. In embodiments, power and/or control signals may be provided to the cartridge 702 through electrical connections formed between the bottom end 744 and the base connector 740, and between the base connector 740 and the corresponding receiving port 780, 782.

[0081] As also shown in FIG. 13A, the cartridge 702 comprises a top end or tip 736, a storage compartment 750 for storing a substance 752 to be vaporized, and a central air passage 754 (also referred to as a "chimney") for delivering vapor through the top end 736. The cartridge 702 further comprises a heating chamber 756 operatively coupled to the air passage 754 and the storage compartment 750. In some embodiments, the heating chamber 756, which may include a ceramic heating coil, can be located within the storage compartment 750, and the air passage 754 may be a thin tube or cannula that extends from the heating chamber 756 through the storage compartment 750 and is communicatively coupled to an opening 758 in the top end 736 of the cartridge 702. During operation, the heating chamber 756 heats, or vaporizes, the substance 752, and the resulting vapor travels up the air passage 754, out through the opening 758 of the top end 736, and ultimately exits through the mouthpiece 716 coupled thereto, as shown in FIG. 14B, for example. It should be appreciated that the second cartridge 704 operates in substantially the same way as the first cartridge 702, except a storage compartment 751 of the second cartridge 704

contains a second substance 753 different form the first substance 752 stored in the first cartridge 702, such as, e.g., a different flavor, strain, blend, solution, and/or other variation of a given product.

[0082] As shown in FIG. 13B, the mouthpiece 716 includes two apertures or openings 732 and 734 configured for receiving the cartridges 702 and 704, similar to the apertures 632 and 634 shown in FIG. 12A. As shown in FIG. 13C, the mouthpiece 716 may be configured to hold the two cartridges 702 and 704 adjacent to each other and in parallel, with top ends 736 and 738 substantially hidden within the mouthpiece 716. The apertures 732 and 734 may be formed by internal walls of the mouthpiece 716, including opposing sidewalls 760 and 762 and a central wall 764 for bisecting an internal chamber 766 formed between the sidewalls 760 and 762. Internal top surfaces formed from the sidewalls 760 and 762 and the central wall 764 create a top wall 768 against which the top ends 736 and 738 of the cartridges 702 and 704 abut, once installed as shown in FIG. 13C.

[0083] In embodiments, the apertures 732 and 734 may be configured to form a snug fit around the cartridge tips 736 and 738, so that the mouthpiece 716 remains firmly in place and airflow is optimized. For example, in FIGS. 13B and 13C, the top end 738 of the second cartridge 704 has already been fully inserted into the second aperture 734 and fits securely within the internal walls that form the second aperture 734. The first cartridge 702 can be secured to the first aperture 732 by first inserting a tip of the top end 736 at an angle into an open end of the aperture 732, as shown in FIG. 13B, and then straightening the cartridge 702 as the remainder of the top end 736 is slid into the aperture 732 until the tip is flush with internal top wall 768 of the mouthpiece 716. In some embodiments, each of the mouthpiece 716 and the top ends 736 and 738 may be configured (e.g., sized and shaped) to create the secure connection shown in FIG.

13C. For example, the top ends 736 and 738 and/or the internal walls of the mouthpiece 716 may be specifically molded to create an interference or press fit between the cartridges 702 and 704 and the mouthpiece 716. In other embodiments, a magnetic attachment or other suitable fastening mechanism may be used to securely couple the cartridges 702 and 704 to the mouthpiece 716.

[0084] As shown in FIG. 13C, the internal walls of the mouthpiece 716 are configured to form two airways 770 and 772 that are in communication with the apertures 732 and 734, respectively. As shown in FIGS. 14B, 15B, and 16B, either one or both of the airways 770 and 772 may be used for vapor delivery depending on whether the cartridge 702, 704 coupled to the corresponding aperture 732, 734 has been activated. This selection process using the vaporizer 700 will be described below in conjunction with FIG. 17. In some embodiments, the airways 770 and 772 may be individually sealed when not in use, or partially sealed in order to blend the vapors produced by both cartridges 702 and 704.

[0085] In some embodiments, the airways 770 and 772 may be configured to be either uniformly (e.g., 50/50) or non-uniformly (e.g., 75/25) opened during a blended operation in order to allow the user to control the exact makeup of the blended vapor. For example, if the user wants a blended vapor that includes a greater percentage of a first substance 752 stored in the first cartridge 702 than a second substance 753 stored in the second cartridge 704, a larger surface area of the first airway 770 may be opened and/or a larger surface area of the second airway 772 may be left closed. In such cases, a selection device 706 of the vaporizer 700 can be configured to enable the user to select a specific mixing ratio for the blended vapor, in addition to selecting between individual or blended operation. For example, where the selection device 706 is a slider, moving the selection device 706 to a middle position (i.e. halfway between a first

position and a second position) may cause the airways 770 and 772 to uniformly open, thus creating a blended vapor with equal portions of the two substances 752 and 753. And sliding the selection device 706 half way between the first position and the middle position may open the first airway 770 more than the second airway 772, thus creating a blended vapor that contains more of the first substance 752 (e.g., 75%) and less of the second substance 753 (e.g., 25%). In embodiments, the selection device 706 may be movable to any point between the first and second positions in order to allow the user to fine tune the mixing ratio and create a customized blend of vapors using the vaporizer 700.

[0086] Referring additionally to FIG. 17, shown is a method 800 of delivering one or more vaporized substances using a personal vaporizer comprising at least two cartridges coupled between a single mouthpiece and a single power source, in accordance with embodiments. As an example, the method 800 may be carried out by the vaporizer 700 shown in FIGS. 14B, 15B, and 16B, with mouthpiece 716 coupled to cartridges 702 and 704, each of which comprises a different substance 752, 753, respectively.

[0087] In some embodiments, the method 800 may be carried out by an electronics compartment of the vaporizer (e.g., electronics compartment 708 shown in FIG. 14B, 15B, and 16B), or more specifically, using software stored on a memory (e.g., memory 204) and executing on one or more processors (e.g., processor 202) of an electronics module or system (e.g., electronics system 200 shown in FIG. 3) included therein. For example, the vaporizer 700 include an electronics compartment 708 within a main body or housing 701 of the vaporizer 700 (e.g., similar to electronics compartment 608 shown in FIG. 12C). The electronics compartment 708 comprises a rechargeable battery 724 (e.g., similar to battery 624 shown in FIG. 11) and other components that form an electronics system similar to the electronics system 200 shown in

FIG. 3. In particular, the electronics compartment 708 comprises a printed circuit board (PCB) 774 that houses various components of the electronics system, such as, e.g., at least one processor, at least one memory element, a communications module, etc. The electronics compartment 708 further comprises sensors 776 and 778, which may be operatively coupled to the PCB 774 and to a respective one of the cartridges 702 and 704, as shown in FIGS. 14B, 15B, and 16B. In some embodiments, the electronics compartment 708, and/or the main body 701, further comprises receiving ports 780 and 782 configured to receive the bottom ends of the cartridges 702 and 704 and electrically couple the cartridges 702 and 704 to the sensors 776 and 778, respectively, and/or other components of the electronics system. The electronics compartment 708 may further include circuitry and/or other components (not shown) that operatively couple a selection device 706 of the vaporizer 700 to the PCB 774.

[0088] In embodiments, the method 800 comprises receiving, via a user input device, user selection of one of a plurality of operating modes, and activating one or more of the cartridges based on the selected operating mode. The operating modes can include a first operating mode for enabling operation of the first cartridge only, a second operating mode for enabling operation of the second cartridge only, and a third operating mode for enabling simultaneous operation of both cartridges. These operating modes are illustrated as separate steps in FIG. 17 for ease of explanation.

[0089] More specifically, the method 800 may include, at step 802, receiving a first user input through a selection device of the vaporizer. In embodiments, the first user input may correspond to the user moving the selection device to a first selector position. For example, FIGS. 14A and 14B show the vaporizer 700 as having selection device 706 on a bottom end 707 of the vaporizer 700, similar to the selection device 106 shown in FIG. 2 and/or selection device

606 shown in FIG. 10. The illustrated selection device 706 is a slider capable of moving between a far left selector position, as shown in FIGS. 14A-B, a far right selector position, as shown in FIGS. 16A-B, and a middle selector position, as shown in FIGS. 15A-B. In an exemplary embodiment, step 802 may be completed once the user moves the selection device 706 to the first position. It should be appreciated that other types of selection devices may be used, such as, for example, a touchscreen or other suitable digital input device, or other types of manual input devices (e.g., knobs, levers, buttons, etc.).

[0090] At step 804, a first cartridge is individually activated in response to receiving the first user input. For example, the selection device 706 shown in FIGS. 14A, 15A, and 16A may be operatively coupled to the electronics components 708 of the vaporizer 700, and receipt of the first user input, upon the user moving the selection device 706 to the first selector position, may cause the PCB 774 to activate one or more of the cartridges 702 and 704. In some embodiments, each of the selector positions corresponds to, and/or causes activation of, either a select one of the cartridges 702 and 704 or both of the cartridges 702 and 704. For example, in FIGS. 14B, 15B, and 16B, the far left selector position (also referred to herein as "first position") is configured to cause activation of the first cartridge 702, the far right selector position (also referred to herein as "second position") is configured to cause activation of the second cartridge 704, and the middle selector position (also referred to herein as "third position") is configured to cause activation of both cartridges 702 and 704 simultaneously.

[0091] In the illustrated embodiment, each of the cartridges 702 and 704 is operatively coupled to a respective one of the sensors 776 and 778, for example, via the receiving ports 780 and 782. In response to the user input, the corresponding cartridge(s) 702, 704 may be activated, individually or simultaneously, by turning on the respective sensor(s) 776, 778. In certain

embodiments, the sensors 776 and 778 may be airflow sensors that are configured to activate the corresponding cartridge 702, 704 upon detecting airflow through said cartridge, e.g., as a result of the user pulling air through the mouthpiece 716. The airflow sensors 776 and 778 may be electrically coupled to the processor 702, as well as to heating chambers 756 and 757 included in cartridges 702 and 704, respectively. For example, the airflow sensors 776 and 778 may be electrically connected to the receiving ports 780 and 782, respectively, and each port 780, 782 may be electrically coupled to the cartridge 702, 704 disposed within that port via the corresponding bottom end 744 and/or base connector 740 of the cartridge. During operation, the processor 702 may send a signal to the corresponding sensor(s) 776, 778 upon detecting a new selector position at the selection device 706. In response to receiving this signal, the airflow sensor(s) 776, 778 may activate, or turn on, and, upon detecting airflow through the corresponding cartridge 702, 704, may cause the heating chamber 756, 757 coupled thereto to turn on and heat the substance 752, 753 stored in the corresponding cartridge 702, 704. In some cases, this process may include the sensor(s) 776, 778 sending a control signal to the corresponding cartridge 702, 704 directing the cartridge to turn on its heating chamber. In other cases, the process may include the processor 702 directing the battery 724 to deliver power to the corresponding cartridge 702, 704 in response to receiving a signal or other indication from the sensor(s) 776, 778 that airflow has been detected. The heating chamber 756, 757 may continue to heat the substance 752, 753 until a vapor forms, or for a preset amount of time, and the resulting vapor can be delivered to the user through the corresponding airway 770, 772 of the mouthpiece 716. It is contemplated that other techniques may be used to activate a given cartridge in response to receiving a user input indicating selection of that cartridge and such implementations are intended to be within the scope of this disclosure.

[0092] Referring back to FIG. 14B, shown is an exemplary use case for selection of the first cartridge 702, or a first operational state, for example, in accordance with steps 802 and 804 of the method 800. As shown, the first airflow sensor 776 has been activated by the processor 702 in response to the selection device 706 being moved to the first, or far left, position. In turn, the first sensor 776 has activated the first heating chamber 756, which has heated, and vaporized, the first substance 752 within the first cartridge 702. The resulting vapors exit the mouthpiece 716 through the first airway 770 coupled to the first cartridge 702.

[0093] Continuing with the method 800 shown in FIG. 17, at step 806, a second user input is received through the selection device of the vaporizer. The second user input may correspond to the user moving the selection device to a second selector position. At step 808, a second cartridge is individually activated in response to receiving the second user input. As an example, FIGS. 16A and 16B illustrate an exemplary use case for selection of the second cartridge 704, or a second operational state. As shown, the second airflow sensor 778 has been activated by the processor 702 in response to the selection device 706 being moved to the second, or far right, position. In turn, the second sensor 778 has activated the second heating chamber 757, which has heated the second substance 753 within the second cartridge 704 into a vapor. The resulting vapors can exit the mouthpiece 716 through the second airway 772 coupled to the second cartridge 704.

[0094] The method 800 also includes step 810, wherein a third user input is received through the selection device of the vaporizer. The third user input may correspond to the user moving the selection device to a third selection position. At step 812, the first and second cartridges are simultaneously activated in response to receiving the third user input. As an example, FIGS. 15A and 15B illustrate an exemplary use case for selection of both cartridges 702 and 704, also

known as a third or blended operational state. As shown, both airflow sensors 776 and 778 have been activated by the processor 702 in response to the selection device 706 being moved to the third, or middle, position. In turn, the two sensors 776 and 778 have respectively activated the two heating chambers 756 and 757, causing both of the substances 752 and 753 to be heated into a vapor. The resulting vapors simultaneously exit the mouthpiece 716 through the airways 770 and 772, respectively, thus delivering a blended output comprising both substances 752 and 753 to the user.

[0095] While the steps of method 800 are shown in FIG. 17 and described herein using a particular order, it should be understood that the steps 802-812 are not necessarily chronological. For example, in some cases, user selection of the second cartridge 704 in accordance with steps 806 and 808 (e.g., the second operational state) may occur before user selection of the first cartridge 702 in accordance with steps 802 and 804 (e.g., the first operational state) and/or user selection of both cartridges 702 and 704 in accordance with steps 810 and 812 (e.g., the third or blended operational state). Likewise, user selection of both cartridges 702 and 704 may occur at any time relative to user selection of an individual cartridge 702, 704. In other cases, the user may choose to use one of the cartridges repeatedly and only use the other cartridge for blended operation. Also, while the method 800 and the FIGS. 14A-B, 15A-B, and 16A-B refer to a double or two cartridge vaporizer 700, other implementations comprising three or more cartridges are also contemplated in accordance with the techniques described herein and are intended to be within the scope of this disclosure.

[0096] FIGS. 18A-18D illustrate an exemplary multi-cartridge vaporizer 900 that is substantially similar to the vaporizer 600 shown in FIGS. 10 and 11 and/or the vaporizer 700 shown in FIGS. 14B, 15B, and 16B, in accordance with embodiments. For example, like the

vaporizer 600, the vaporizer 900 includes removable and/or refillable first and second cartridges 902 and 904, each comprising or storing a different substance to be vaporized. The cartridges 902 and 904 are operatively coupled to a mouthpiece 916 configured to deliver vapors to the user from either or both of the cartridges 902, 904 (e.g., similar to mouthpiece 716 shown in FIG. 15B). The vaporizer 900 also includes an electronics compartment or housing 908 (also referred to herein as a "core body") comprising a battery and an electronics system for controlling the vaporizer 900, similar to the electronics compartment 608 shown in FIG. 12C.

[0097] As illustrated in FIGS. 18A-D, the vaporizer 900 further includes an outer sleeve 920 that is slidable or movable between a top end 917 and a bottom end 907 of the vaporizer 900, similar to the outer sleeve 620 shown in FIGS. 10 and 11. In embodiments, the top end 917 of the vaporizer 900 may correspond to a top of the mouthpiece 916 and the bottom end 907 of the vaporizer 900 may correspond to the bottom of the electronics compartment 908, as illustrated. The sleeve 920 can be configured to move laterally between a lowered position wherein a bottom edge 928 of the sleeve 920 is adjacent to the bottom end 907 of the vaporizer, as shown in FIGS. 18A and BC and an elevated position wherein a top edge 930 of the sleeve 920 is adjacent to the top end 917 of the vaporizer, as shown in FIGS. 18B and D.

[0098] In embodiments, the sleeve 920 is configured so that, while in the lowered position, the sleeve 920 is substantially clear of the mouthpiece 916 to allow vaping through the mouthpiece 916, and while in the elevated position, the sleeve 920 reveals a bottom portion of the electronics compartment 908 for battery charging purposes. For example, though not shown in FIGS. 18B and D, the electronics compartment 908 may include a charging port on one side of the bottom portion of the compartment 908, similar to the charging port 626 shown in FIG. 11. The outer sleeve 920 may cover the charging port when in the lowered or use position, to protect

the port from debris, water damage, etc., and may uncover, or provide access to, the charging port when in the elevated or charging position (e.g., as shown in FIGS. 10 and 11). In the illustrated embodiment, the length of the outer sleeve 920 is configured such that the top edge 930 is adjacent to the top of the mouthpiece 916 when in the elevated position, thus preventing use of the vaporizer 900. In other embodiments, the outer sleeve 920 may be configured (e.g., sized and/or shaped) to allow access to the mouthpiece 916 while the charging port is revealed, so that the user can use the vaporizer 900 for vaping while also charging the battery of the vaporizer 900.

[0099] In FIGS. 18A-D, the outer sleeve 920 is drawn as being fully transparent to illustrate exemplary internal mechanisms configured to slidably couple the sleeve 920 to the core body 908 of the vaporizer 900, in accordance with embodiments. In particular, the vaporizer 900 may include a spring mechanism 948, a catch mechanism 949, and a magnetic mechanism 979 that work in conjunction to create a slidable attachment between the sleeve 920 and the core body 908. In embodiments, an inner surface of the sleeve 920 may be configured to engage the spring mechanism 948 and move up and down along the core body 908 as the spring mechanism 948 travels within the catch mechanism 949. Moreover, the magnetic mechanism 979 may be configured to urge the spring mechanism 948, and the sleeve 920 coupled thereto, to jump to a first mechanical stop 949a of the catch mechanism 949, which corresponds to the elevated position of the sleeve 920 (e.g., as shown in FIGS. 18B and D) and/or jump to a second mechanical stop 949b of the catch mechanism 949, which corresponds to the lowered position of the sleeve 920 (e.g., as shown in FIGS. A and C).

[00100] For example, in the illustrated embodiment, the spring mechanism 948 includes a spring steel clip fastened to, or wrapped around, a side wall 980 of the core body 908, similar to

the metal clip 648 shown in FIG. 12C. The spring steel clip 948 may have a "U" shape with a first or front end 948a attached to a front surface 982 of the core body 908, as shown in FIGS. 18A-B, and a second or back end 948b attached to a back surface 984 of the core body 908, as shown in FIGS. 18C-D. The spring steel clip 948 may exert a spring force on the core body 908 that must be overcome in order to slide the sleeve 920 up or down.

[00101] As shown, the catch mechanism 949 includes first and second mechanical stops 949a and 949b provided by recesses embedded or formed into the front surface 982 of the core body 908. The stops 949a and 949b are configured to engage the front end 982 of the spring steel clip as the spring mechanism 948 moves up and down, respectively, similar to the mechanical stop 649 shown in FIG. 12C. The mechanical stops 949a and 949b are also configured to prevent the sleeve 920 from sliding off of, or being removed from, the core body 908 altogether. As shown in FIGS. 18A and 18B, the catch mechanism 949 has a generally elongated shape that extends lengthwise along the core body 908, with the first mechanical stop 949a forming a top end of the catch mechanism 949 and the second mechanical stop 949b forming a bottom end of the catch mechanism 949. The catch mechanism 949 may also include a central portion or recess 949c connecting the first and second mechanical stops 949a and 949b.

[00102] In embodiments, each of the mechanical stops 949a and 949b may be configured for receiving the front end 948a of the spring clip 948. For example, the stops 949a and 949b may be sized and shaped to match a size and shape of the front end 948a of the spring clip 948, so that the spring clip 948 can slide into the first mechanical stop 949a as the sleeve 920 moves up, as shown in FIG. 18B, and slide into the second mechanical stop 949b as the sleeve moves down, as shown in FIG. 18A. The central portion 949c has a greater width than the stops 949a and 949b and corresponds to, or is aligned with a recess or slot 986 formed into the core body 908 (e.g., as

also shown in FIG. 12C). The recess 986 forms a "U" shape like the spring clip 948, extending across a portion of the front surface 982, around the side 980, and across a portion of the back surface 984 of the core body 908. The recess 986 may be configured to catch or hold the spring clip 948 in a neutral state that places the sleeve 920 between the lowered position and the elevated position. The spring force exerted by the metal clip may bias the spring mechanism 948 towards this neutral state. During operation, the user may need to exert a force greater than the spring force in order to slide the sleeve 920 upwards or downwards.

[00103] In embodiments, the force required to move the sleeve 920 may also need to counteract, or accommodate for, a magnetic force exerted by the magnetic mechanism 979 on the spring mechanism 948. For example, in the illustrated embodiment, the magnetic mechanism 979 includes an upper magnet 979a coupled to the back surface 984 and positioned opposite the first mechanical stop 949a on the front surface 982 of the core body 908. The magnetic mechanism 979 also includes a lower magnet 979b coupled to the back surface 984 and positioned opposite the second mechanical stop 949b on the front surface 982 of the core body 908. As the spring mechanism 948 is moved up or down, the magnetic mechanism 979 may operate to pull the spring clip 948 towards the nearest magnet 979a, 979b, for example, once the spring clip 948 enters a magnetic field of that magnet.

[00104] In one example, when the sleeve 920 is slid upwards from the lowered position shown in FIG. 18C to the elevated position shown in FIG. 18D, a magnetic force exerted by the upper magnet 979a may cause the spring clip 948 to be pulled towards, or jump onto, the upper magnet 979a. Initially, in order to pull the spring clip 948 away from the lower magnet 979b, the force exerted by the user on the sleeve 920 may need to be greater than a magnetic force exerted by the lower magnet 979b on the spring clip 948. As the spring clip 948 nears the upper magnet

979a, the amount of force required to keep moving the sleeve 920 upwards may decrease as the magnetic force exerted by the upper magnet 979a takes over, or begins pulling the spring clip 948 to the magnet 979a. It should be understood that a similar process occurs as the sleeve 920 is slid down from the elevated position to the lowered position, ultimately causing the spring clip 948 to jump into place on top of the lower magnet 979b, as shown in FIG. 18C.

[00105] Other techniques for slidably coupling the outer sleeve 920 to the core body 908 are also contemplated, and such implementations are intended to be within the scope of the present disclosure. For example, in other embodiments, the internal mechanisms may include sliding structures that are included on both the sleeve 920 and the core body 908 and are configured to cooperatively engage to enable movement of the sleeve 920 relative to the core body 908.

[00106] Many of the embodiments described herein are shown with a fully or partially transparent outer sleeve that reveals all or portions of the cartridges included in the vaporizer, such as, e.g., vaporizer 600 shown in FIGS. 10 and 11, vaporizer 300 shown in FIG. 5, and vaporizer 100 shown in FIGS. 1 and 2. FIG. 19 illustrates an exemplary multi-cartridge vaporizer 1000 that has a solid outer sleeve 1020 and a solid mouthpiece 1016 that completely conceal the other components of the vaporizer 1000, including multiple cartridges and the different substances contained in each.

[00107] In certain embodiments, the process descriptions or blocks in the figures, such as FIG. 17, can represent modules, segments, or portions of code which include one or more executable instructions for implementing specific logical functions or steps in the process. Any alternate implementations are included within the scope of the embodiments described herein, in which functions may be executed out of order from that shown or discussed, including substantially

concurrently or in reverse order, depending on the functionality involved, as would be understood by those having ordinary skill in the art.

[00108] It will be understood by those skilled in the art that various changes may be made and equivalents may be substituted without departing from the scope of the novel and non-obvious techniques disclosed in this application. Therefore, it is intended that the novel teachings of the present invention not be limited to the particular embodiment disclosed, but that they will include all embodiments falling within the scope of the appended claims.

Claims

1. A personal vaporizer, comprising:

a housing with a first receiving port configured to receive a first cartridge and a second receiving port configured to receive a second cartridge, each cartridge comprising a substance to be vaporized; and

a power source disposed within the housing and electrically coupled to the first and second receiving ports for selectively delivering power to the first and second cartridges.

2. The personal vaporizer of claim 1, wherein the housing further comprises a user input device configured to selectively enable operation of one or more of the cartridges based on a user input.

3. The personal vaporizer of claim 2, wherein the user input device is configured to enable user selection of one of the following: (1) a first operating mode for activating only the first cartridge, (2) a second operating mode for activating only the second cartridge, and (3) a third operating mode for simultaneously activating both cartridges.

4. The personal vaporizer of claim 3, wherein the user input device includes a slider configured to move between a first position corresponding to selection of the first operating mode, a second position corresponding to selection of the second operating mode, and a third position corresponding to selection of the third operating mode.

5. The personal vaporizer of claim 3, wherein the housing further comprises an electronics system configured to control the delivery of power from the power source to one or more of the receiving ports based on a selected operating mode, the electronics system comprising first and

second airflow sensors configured to detect airflow through the first and second cartridges, respectively.

6. The personal vaporizer of claim 5, wherein the electronics system selectively activates the airflow sensors based on the selected operating mode.

7. The personal vaporizer of claim 1, further comprising a mouthpiece configured to receive a top end of each of the first and second cartridges, wherein a bottom end of each cartridge is disposed within the housing.

8. The personal vaporizer of claim 7, wherein the mouthpiece comprises a first airway for delivering a vapor produced by the first cartridge and a second airway for delivering a vapor produced by the second cartridge.

9. The personal vaporizer of claim 1, wherein the first and second receiving ports are located substantially side by side at a top end of the housing.

10. The personal vaporizer of claim 1, further comprising a charging port and a movable component coupled to the housing and configured to move between a first position configured to cover the charging port and a second position configured to expose the charging port.

11. A method of delivering one or more vaporized substances using a personal vaporizer comprising a power source coupled to a first cartridge and a second cartridge, the method comprising:

receiving, via a user input device, user selection of one of a plurality of operating modes, the operating modes comprising a first operating mode for enabling operation of the first

cartridge only, a second operating mode for enabling operation of the second cartridge only, and a third operating mode for enabling simultaneous operation of both cartridges; and

activating one or more of the cartridges based on the selected operating mode.

12. The method of claim 11, wherein activating one or more of the cartridges comprises:

activating each airflow sensor coupled to said one or more cartridges, and

upon detecting airflow at said sensors, delivering power from the power source to the one or more cartridges.

13. The method of claim 12, wherein delivering power to the one or more cartridges causes activation of a heating element included in each of the one or more cartridges, the heating element being configured to heat a substance disposed in the cartridge into a vapor.

14. A vaping system, comprising:

a first cartridge comprising a first substance to be vaporized;

a second cartridge comprising a second substance to be vaporized, the second substance being different from the first substance;

a housing configured to receive the first and second cartridges; and

a power source disposed within the housing and configured to selectively deliver power to the first and second cartridges.

15. The vaping system of claim 14, further comprising an electronics module disposed within the housing and electrically coupled to the power source and each of the cartridges, the electronics module being configured to selectively control operation of the first and second cartridges based on a user input.

16. The vaping system of claim 15, further comprising a user input device coupled to the electronics module and configured to enable user selection of one of the following: (1) a first operating mode for activating only the first cartridge, (2) a second operating mode for activating only the second cartridge, and (3) a third operating mode for simultaneously activating both cartridges.

17. The vaping system of claim 16, wherein the electronics module is configured to control delivery of power from the power source to one or more of the cartridges based on a selected one of the operating modes.

18. The vaping system of claim 17, wherein the electronics module comprises first and second airflow sensors configured to detect airflow through the first and second cartridges, respectively, the electronics module being further configured to:

identify the airflow sensor corresponding to each cartridge being activated by the selected operating mode,

activate each identified airflow sensor, and

upon detecting airflow at said sensor or sensors, deliver power to the corresponding cartridge or cartridges.

19. The vaping system of claim 18, wherein each cartridge includes a heating element for heating the respective substance into a vapor, the heating element being activated upon receiving power from the power source.

20. The vaping system of claim 14, further comprising a mouthpiece configured to receive a top end of each of the first and second cartridges, wherein a bottom end of each cartridge is disposed within the housing.

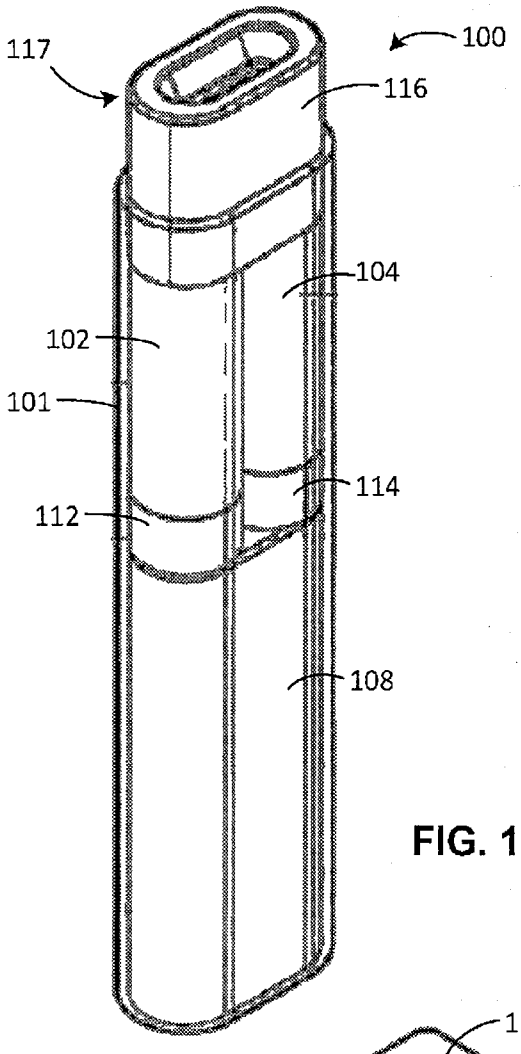


FIG. 1

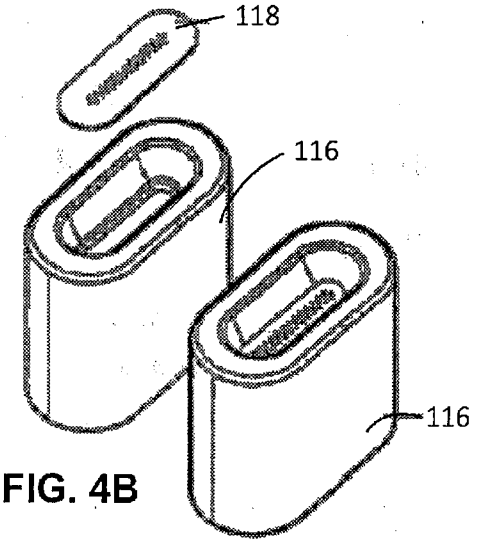


FIG. 4B

FIG. 4A

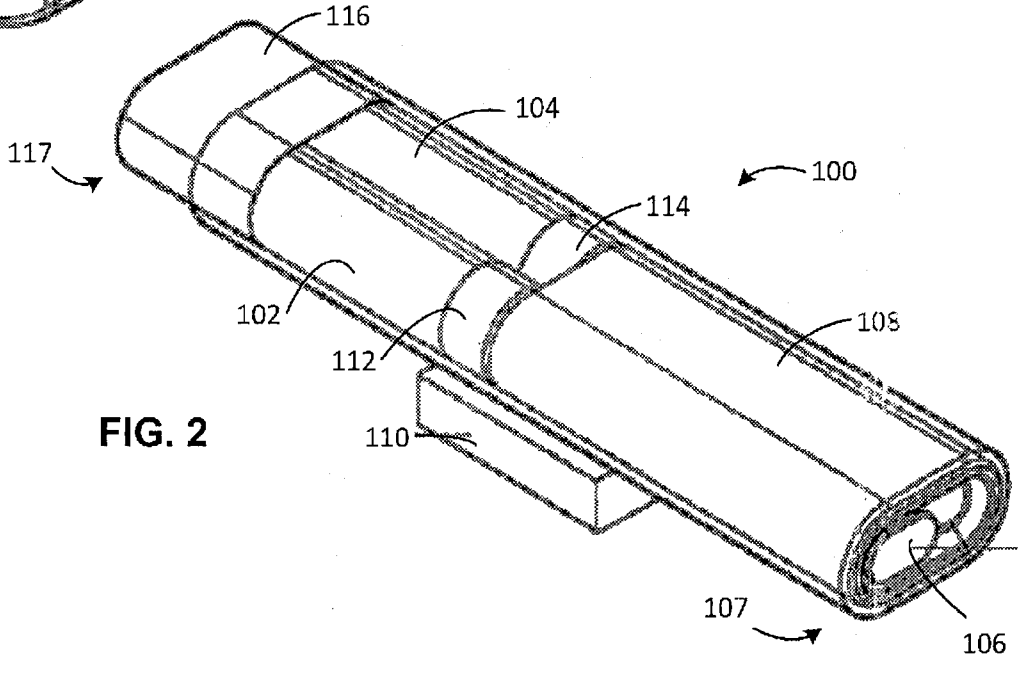


FIG. 2

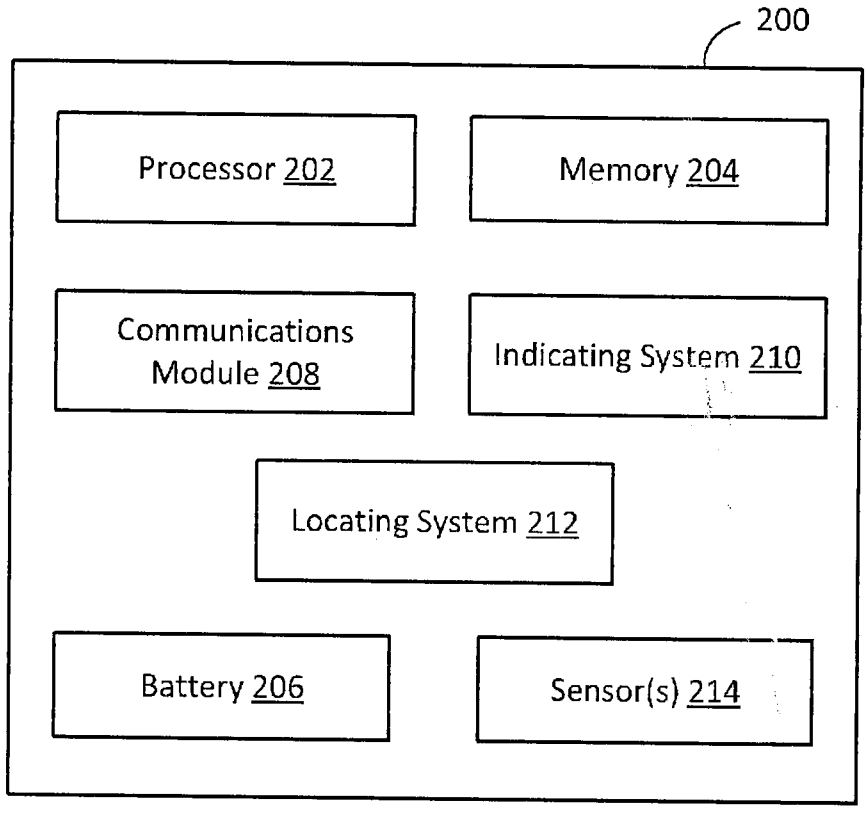

200
Processor 202
Memory 204
Communications Module 208
Indicating System 210
Locating System 212
Battery 206
Sensor(s) 214

FIG. 3

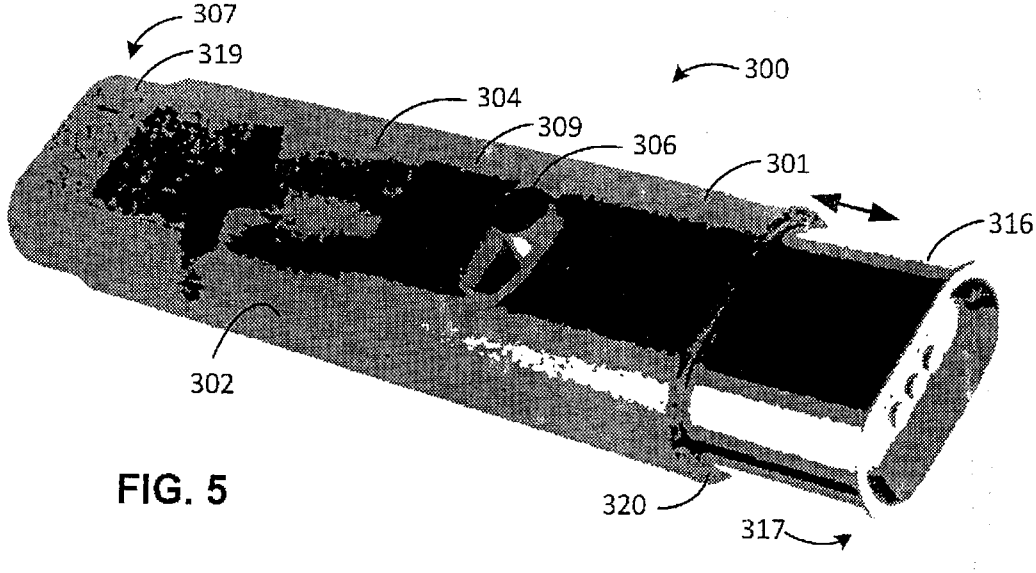

307
319
300
304
309
306
301
316
302
320
317

FIG. 5

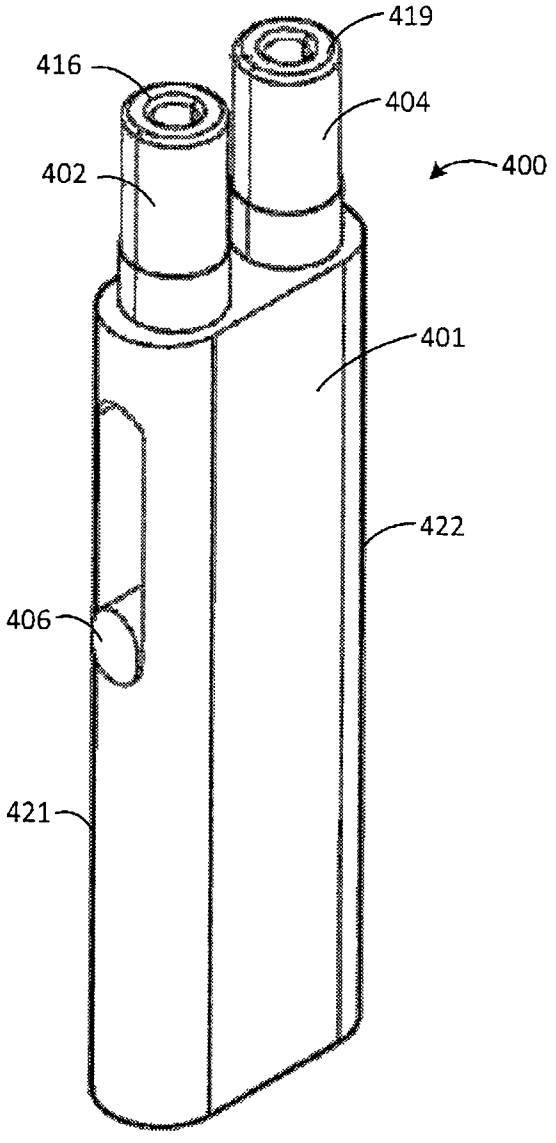

419
416
404
400
402
401
422
406
421

FIG. 6

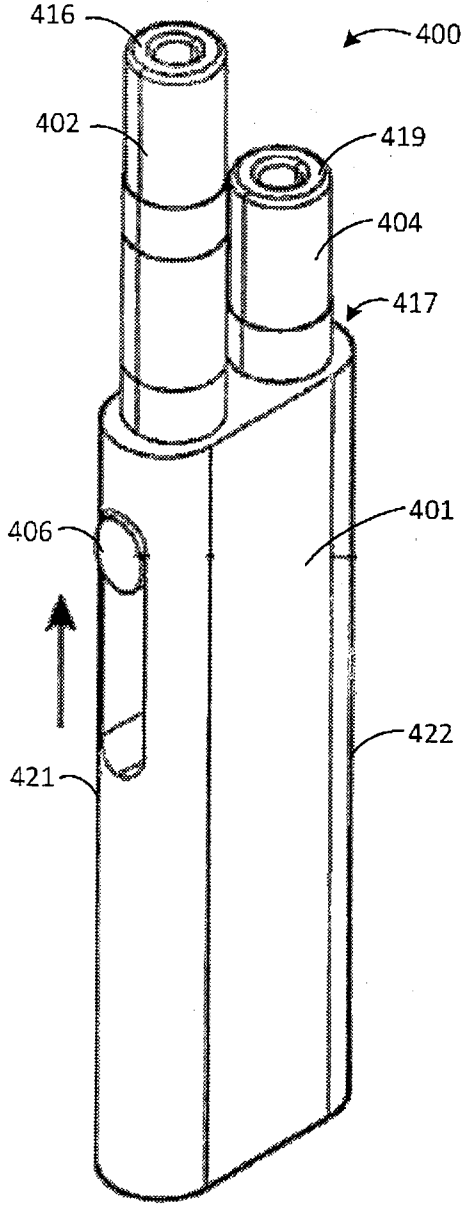

416
400
402
419
404
417
406
401
422
421

FIG. 7

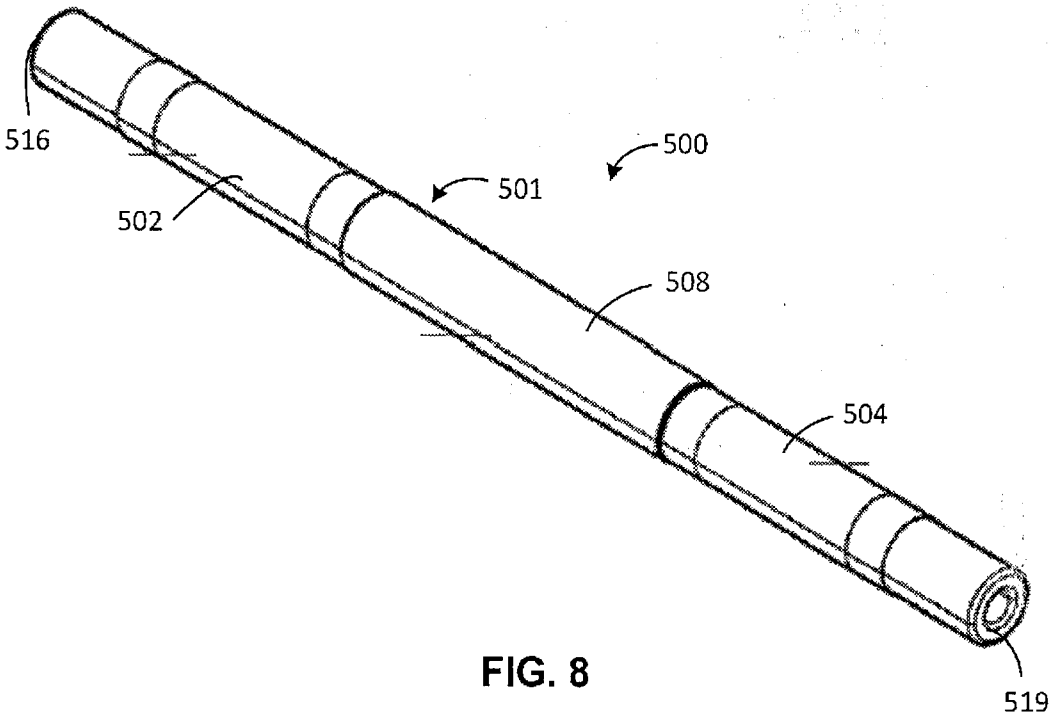


FIG. 8

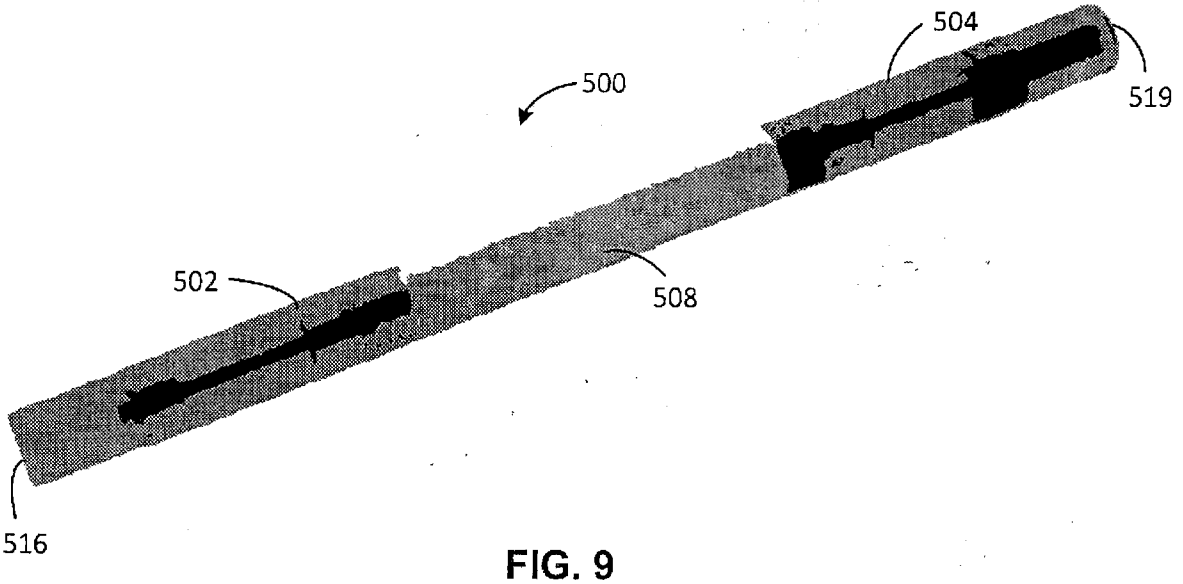


FIG. 9

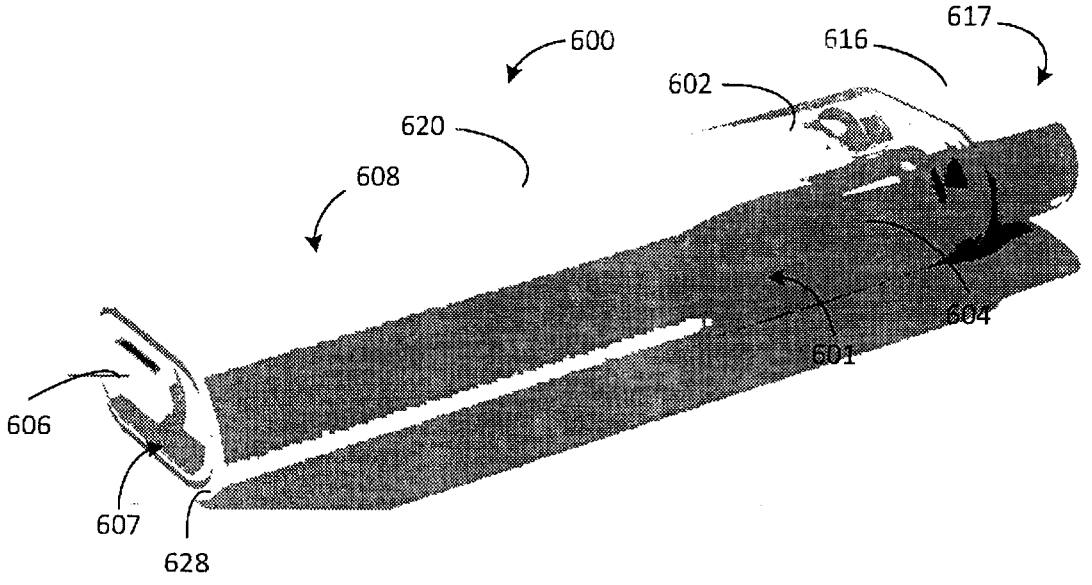

600
616
617
602
620
608
604
601
606
607
628

FIG. 10

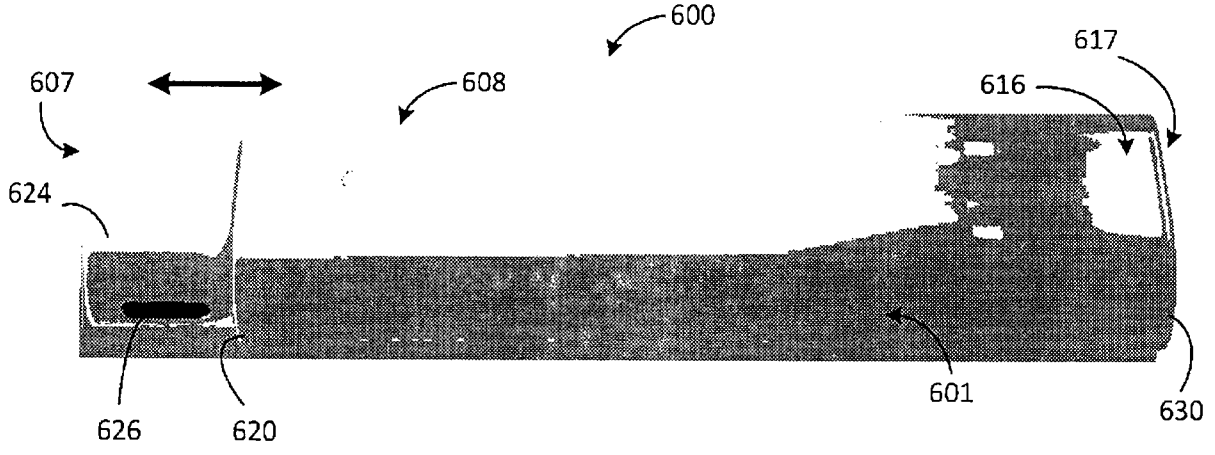

600
617
607
608
616
624
626
620
601
630

FIG. 11

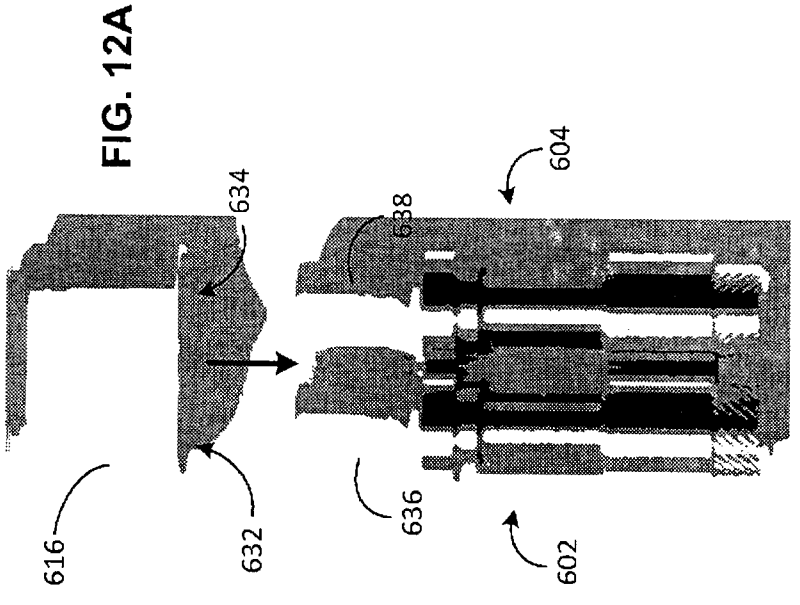


FIG. 12A

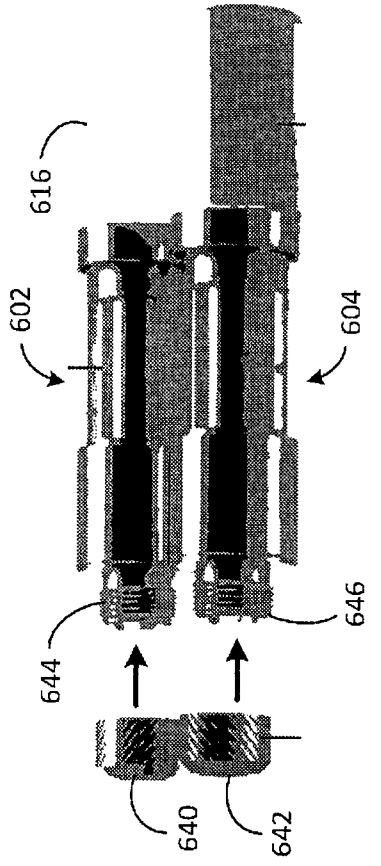


FIG. 12B

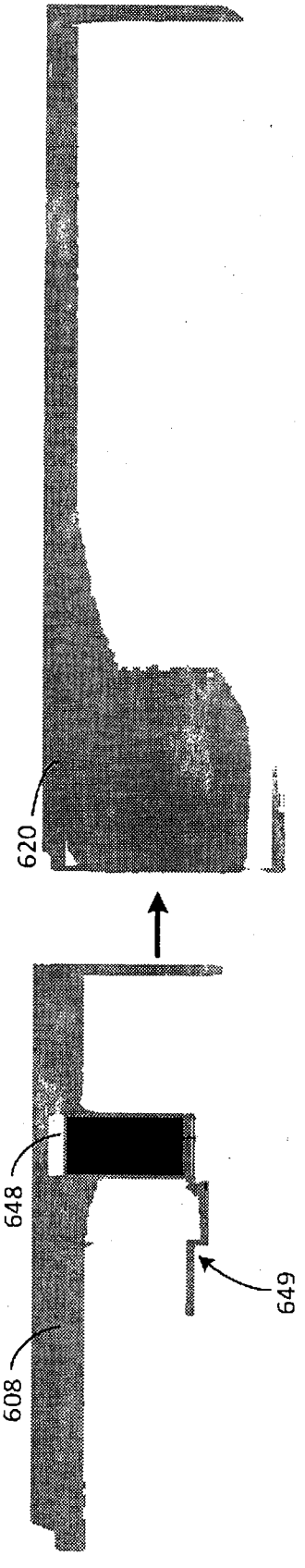


FIG. 12C

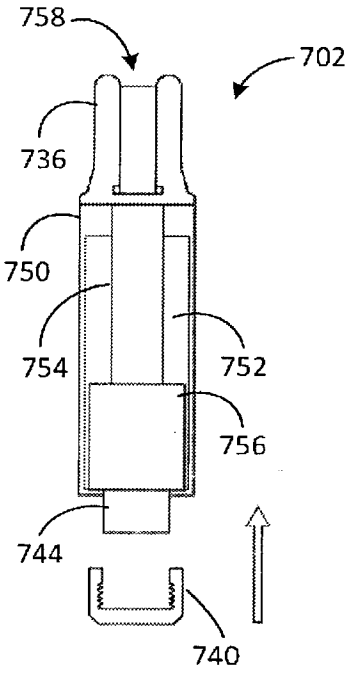


FIG. 13A

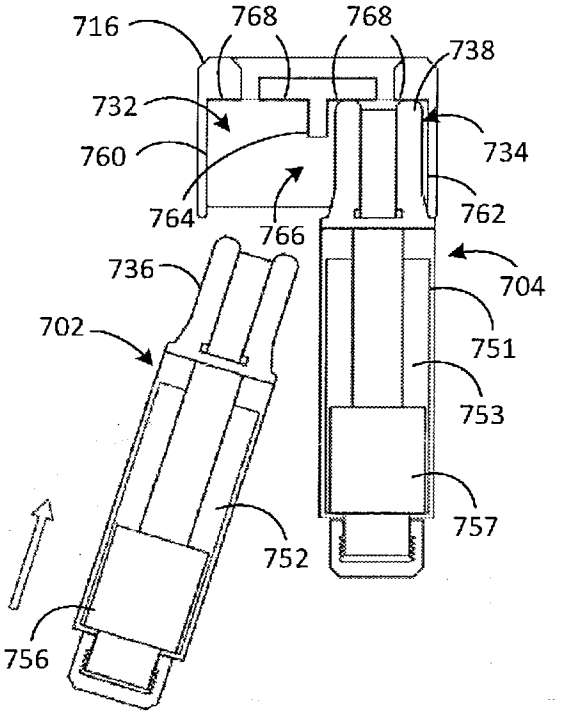


FIG. 13B

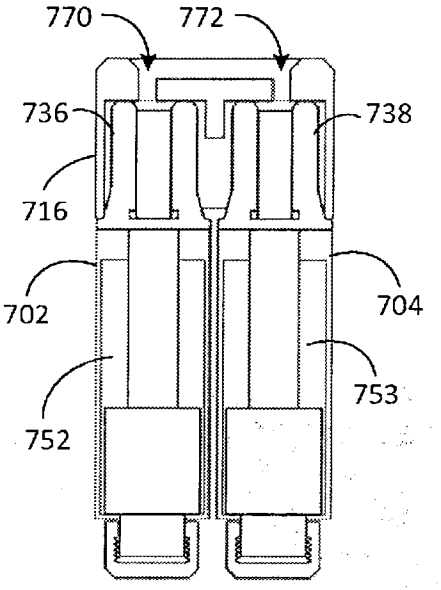


FIG. 13C

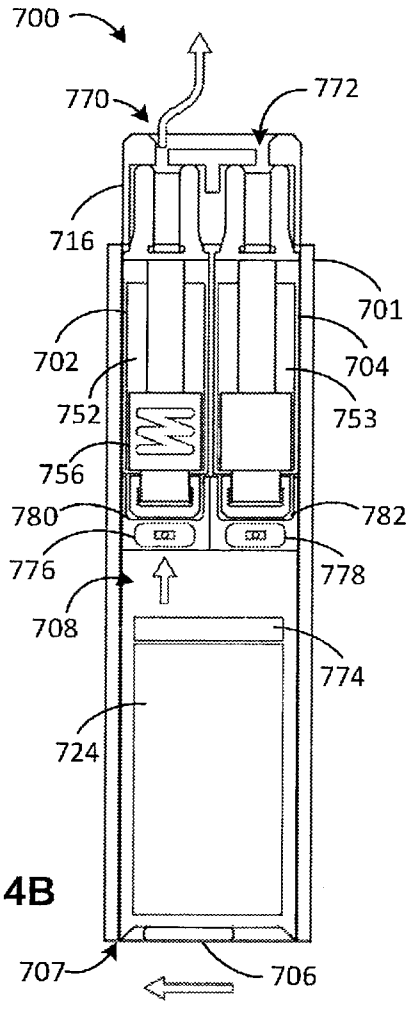


FIG. 14B

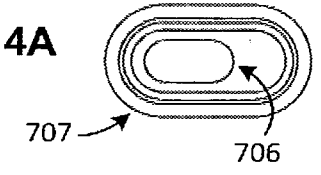


FIG. 14A

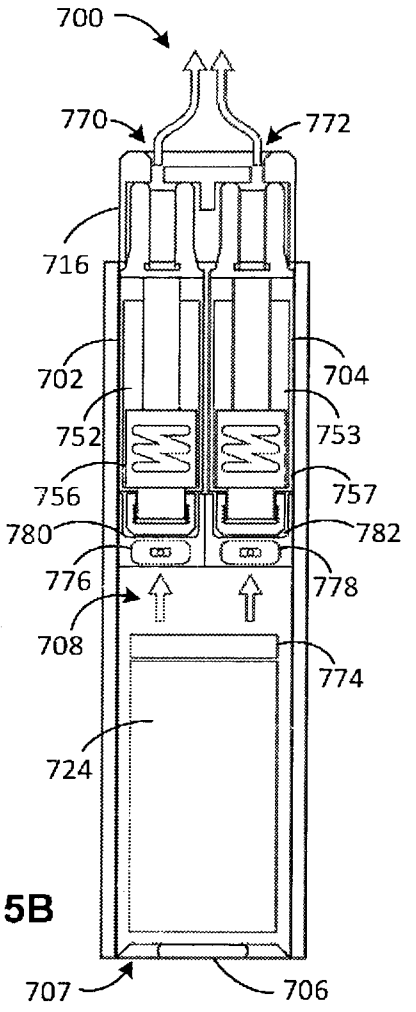


FIG. 15B

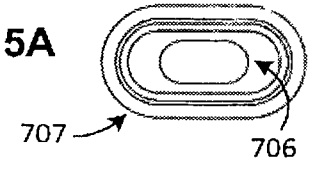


FIG. 15A

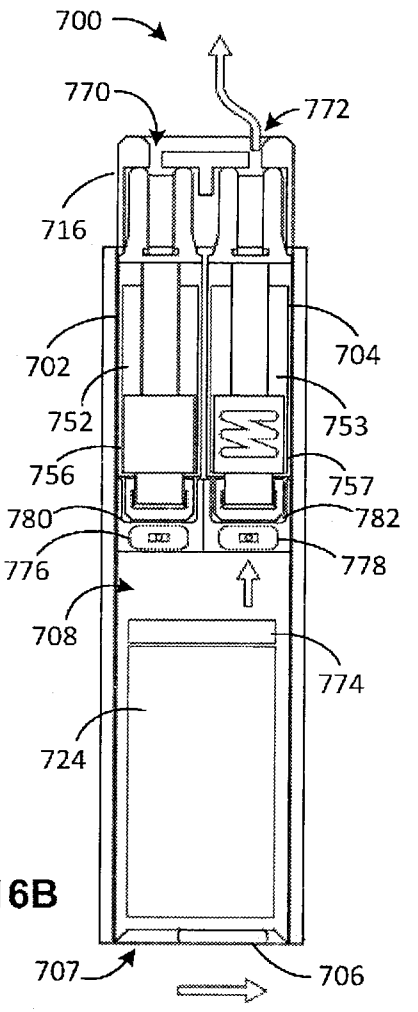


FIG. 16B

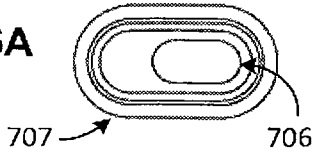


FIG. 16A

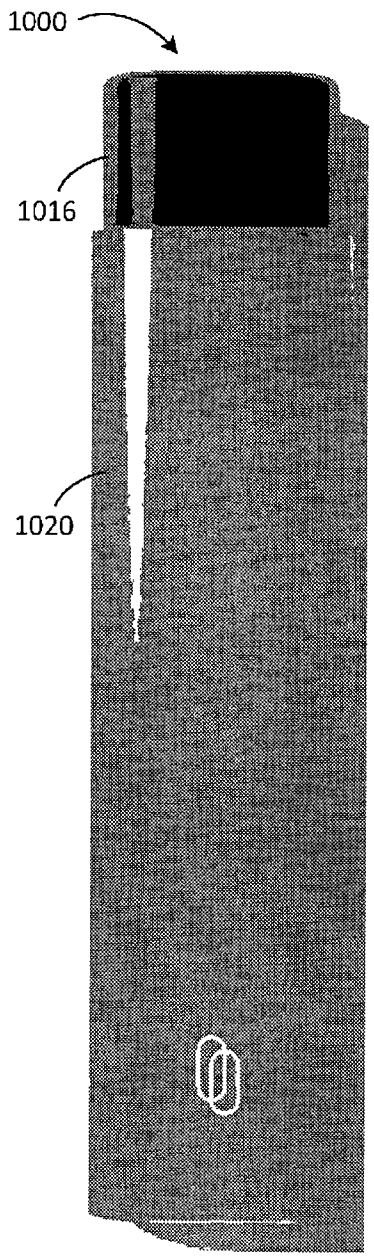

1000
1016
1020

FIG. 19

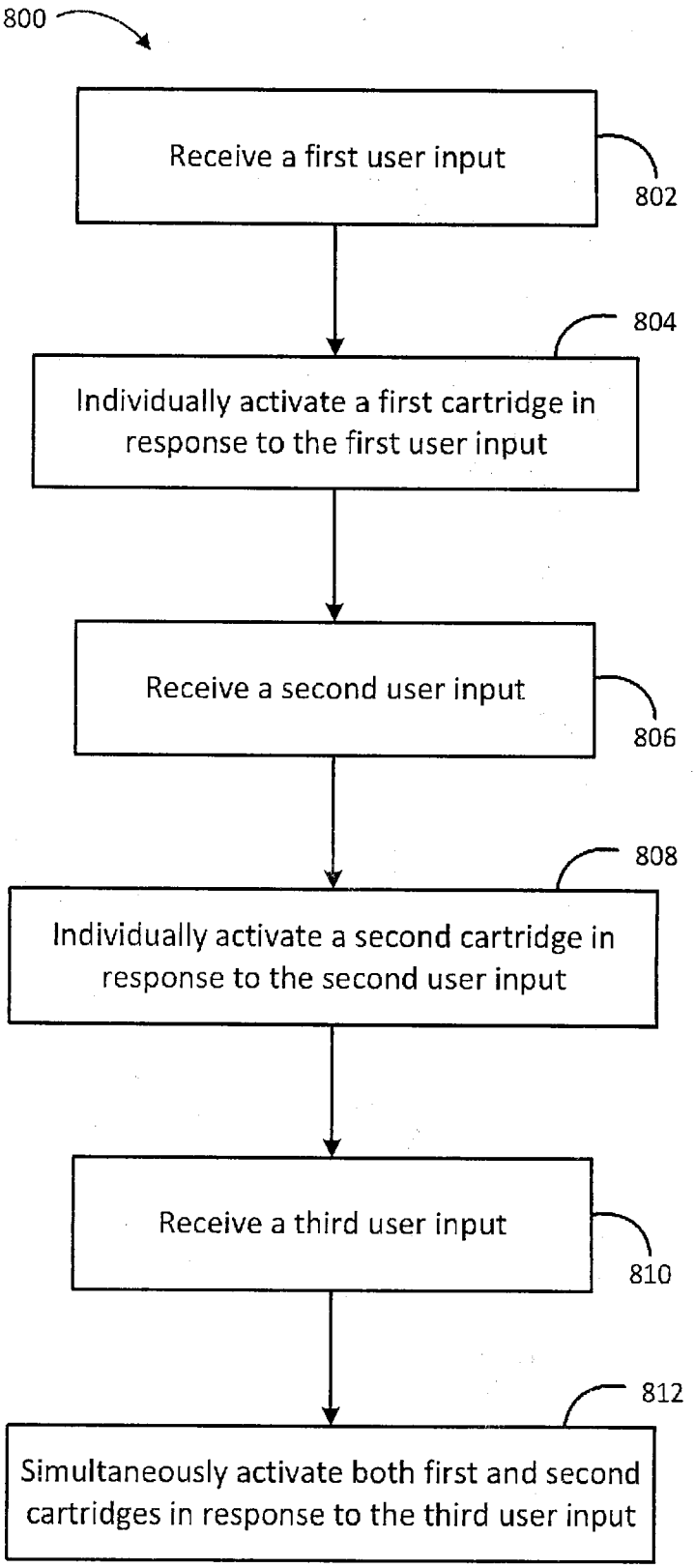

800
Receive a first user input
802
804
Individually activate a first cartridge in response to the first user input
Receive a second user input
806
808
Individually activate a second cartridge in response to the second user input
Receive a third user input
810
812
Simultaneously activate both first and second cartridges in response to the third user input

FIG. 17

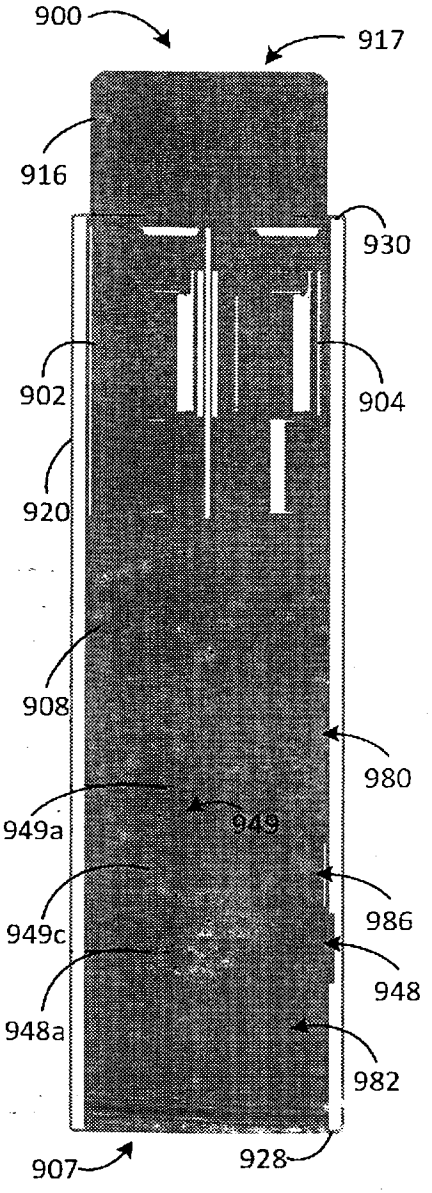


FIG. 18A

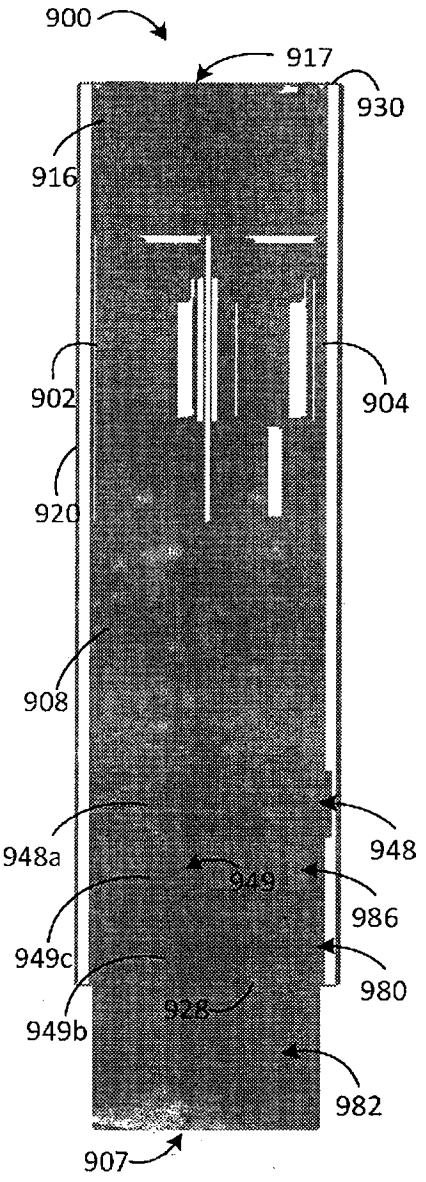


FIG. 18B

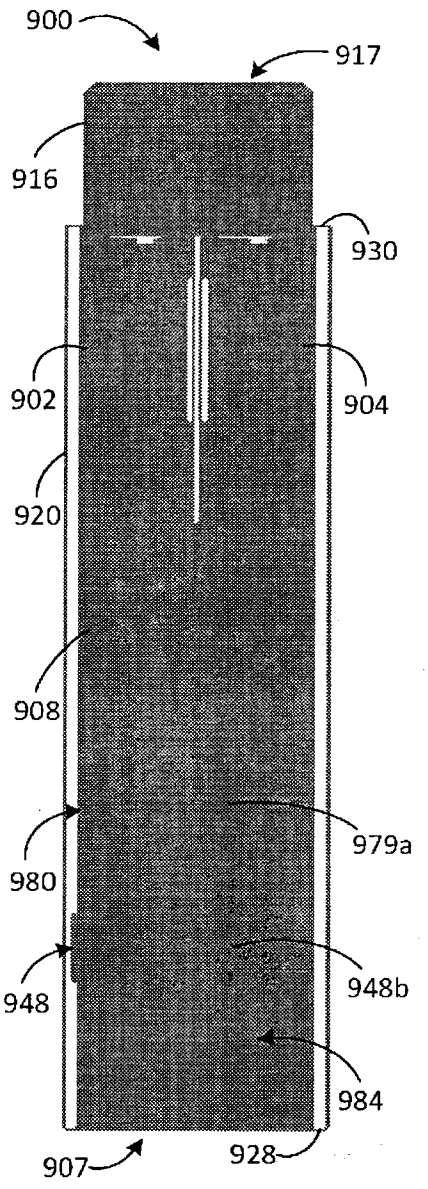


FIG. 18C

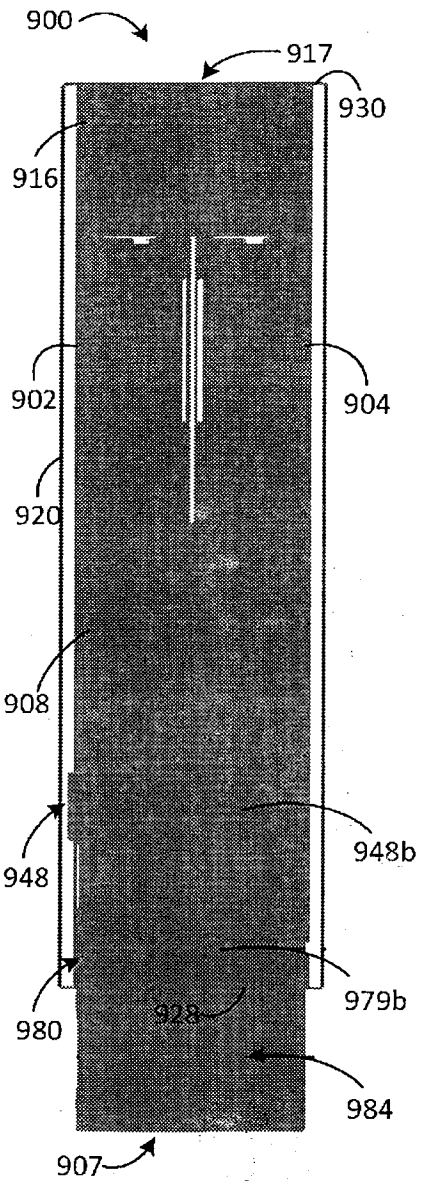
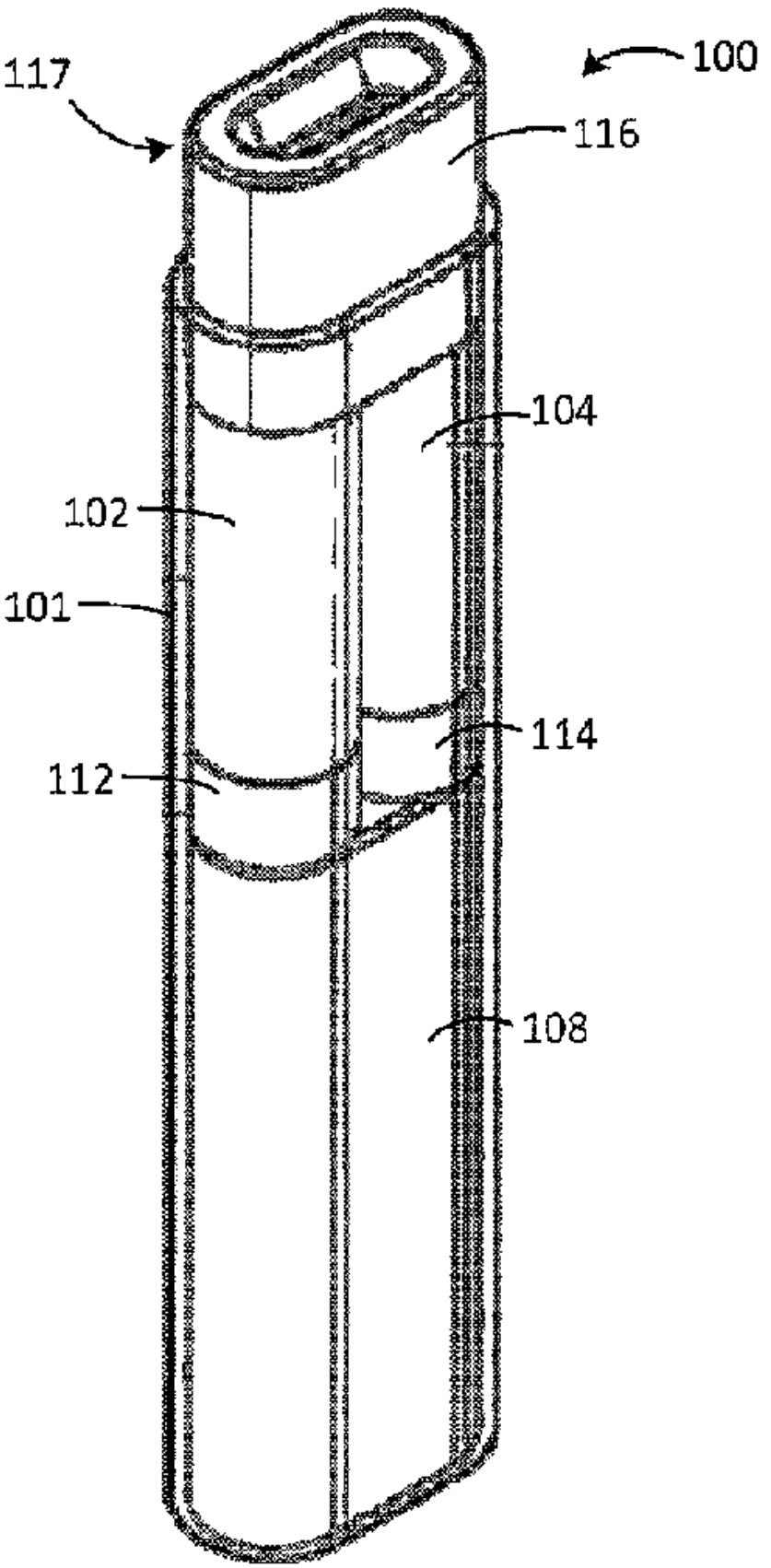


FIG. 18D


117
100
116
104
102
101
114
112
108