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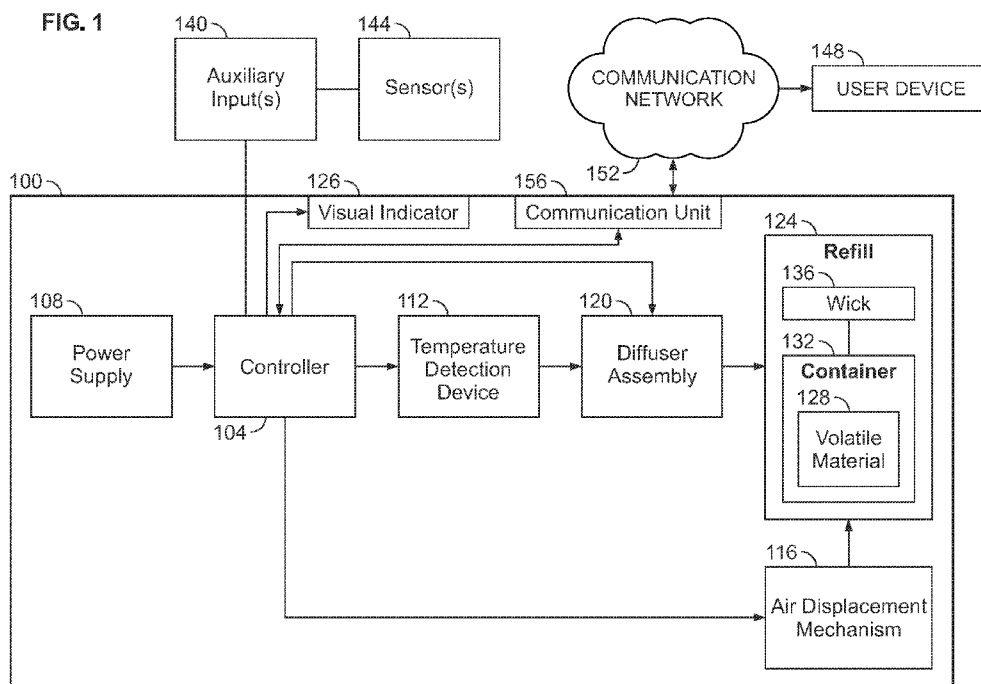
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(57) Abstract: An apparatus for dispensing a volatile material includes a dispenser having a diffuser assembly, a controller, a temperature detection device, and a power source. A method of dispensing the volatile material includes receiving a refill unit including a wick, the refill unit being recognized by the controller. The method further includes activating the diffuser assembly to a first heat setting for a first interval and activating the diffuser assembly to a second heat setting for a second interval. The first heat setting is different from the second heat setting, and the first heat setting corresponds to a first fragrance characteristic of the volatile material and the second heat setting corresponds to a second fragrance characteristic of the volatile material.

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SYSTEMS AND METHODS FOR CONTROLLING A VOLATILE MATERIAL
DISPENSER

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of and priority to U.S. Provisional Application No. 63/524,482, filed on June 30, 2023, which is incorporated by reference herein in its entirety.

REFERENCE REGARDING FEDERALLY SPONSORED RESEARCH OR
DEVELOPMENT

[0002] Not applicable.

SEQUENTIAL LISTING

[0003] Not applicable.

BACKGROUND OF THE DISCLOSURE

1. Field of the Disclosure

[0004] The present disclosure relates generally to methods and systems for dispensing volatile materials, and more particularly, to systems and methods for controlling the dispensing of a volatile liquid to improve a user's experience.

2. Description of the Background of the Disclosure

[0005] A multitude of volatile material diffusion devices or diffusers exist in the marketplace. Many of such devices are passive devices that require only ambient air flow to

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disperse the liquid active material therein. Other devices are battery-powered or receive household power via a plug extending from the device. Some known diffusers include a heating element for heating a volatile material to promote vaporization thereof. Other diffusers employ a fan or blower to generate air flow to direct volatile material out of the diffuser into the surrounding environment. Still other diffusers that dispense volatile materials utilize ultrasonic means to dispense the volatile materials therefrom. Fragrance compositions that are used in the aforementioned volatile material dispensers are composed of a mixture of volatile perfume raw materials, and it is not uncommon for a fragrance composition to be composed of over twenty different perfume raw materials. The chemical properties of perfume raw materials in a fragrance composition often vary widely in terms of polarity, density, vapor pressure, flash point, and other properties.

[0006] A problem with past volatile material dispensers is the limited number of controls made available to the user. Often, volatile material dispensers are manually adjusted by the user and, thus, require proximity to the volatile material dispenser in the space. Similarly, a user must physically approach past volatile material dispensers to identify operating issues, such as a need to refill the volatile material. Further, the heating elements of past volatile material dispensers are often limited to default settings regardless of the particular volatile material used, such that users have limited control over the particular fragrances or volatiles dispensed at any given time.

SUMMARY OF THE DISCLOSURE

[0007] In some aspects, an apparatus for dispensing a volatile material includes a dispenser having a diffuser assembly, a controller, a temperature detection device, and a power source. A method of dispensing the volatile material includes receiving a refill unit including a wick, the refill unit being recognized by the controller. The method can further include activating the diffuser assembly to a first heat setting for a first interval and activating the diffuser assembly to a second heat setting for a second interval. The first heat setting can be different from the second heat setting, and the first heat setting can correspond to a first fragrance characteristic of the volatile material and the second heat setting can correspond to a second fragrance characteristic of the volatile material.

[0008] In some embodiments, a first interval is different from a second interval and, upon the controller receiving a signal, a second heat setting occurs before completion of a first interval. In some embodiments, a first interval and a second interval are the same and, upon a controller receiving a signal, a second heat setting occurs before completion of a first interval. In some embodiments, a third interval and a third heat setting correspond to a third fragrance characteristic of a volatile material. In some embodiments, a third heat setting occurs after a second interval is completed. In some embodiments, a first heat setting includes a diffuser assembly operating at a first temperature and being located a first distance from a distal end of a wick, a second heat setting includes the diffuser assembly operating at a second temperature and being located a second distance from the distal end of the wick, and the first temperature and the second temperature are equal. In some embodiments, the first distance and the second distance may be different.

[0009] In some embodiments, a first heat setting includes a diffuser assembly operating at a first temperature and being located a first distance from a distal end of a wick, a second heat setting includes the diffuser assembly operating at a second temperature and being located a second distance from the distal end of the wick, and the first temperature and the second temperature are different. In some embodiments, the first distance and the second distance may be equal. In some embodiments, a temperature detection device is in thermal communication with at least one of a diffuser assembly or a wick. In some embodiments, a temperature detection device includes a first sensor and a second sensor, and a refill unit carries the first sensor and a dispenser carries the second sensor. In some embodiments, a controller is configured to receive a signal indicating a time of day, an ambient temperature, an ambient humidity, a room use, a room size, or a weather condition.

[0010] In some embodiments, a controller is configured to detect a refill unit identifier provided by a refill unit. In some embodiments, a refill unit identifier is associated with an operating profile corresponding to a volatile material of the refill unit. In some embodiments, a refill unit includes at least one of a tag or a code. In some embodiments, the tag can include one of a NFC chip or a RFID chip. In some embodiments, the code is a computer-readable code. In some embodiments, upon detecting a refill unit identifier, a controller retrieves an operating profile from a local memory. In some embodiments, the operating profile includes a first interval and the first heat setting, a second interval and a second heat setting, and first

and second fragrance characteristics. In some embodiments, a controller is in communication with a user device that displays a graphical user interface associated with an operating profile of the dispenser.

[0011] In some aspects, a volatile material dispenser includes a diffuser assembly, a controller, and a temperature detection device. The dispenser can be configured to receive a refill unit having a volatile material and a wick. The diffuser assembly may be configured to be activated by the controller to dispense the volatile material from the refill unit. The diffuser assembly can be adjustable between a first heat setting and a second heat setting. Further, a visual indicator can be configured to display a color that corresponds with a first fragrance characteristic of a plurality of fragrance characteristics of the volatile material during operation of the dispenser.

[0012] In some embodiments, a diffuser assembly changes in temperature when adjusted from a first heat setting to a second heat setting. In some embodiments, a visual indicator changes in brightness intensity from a first heat setting to a second heat setting. In some embodiments, a visual indicator changes color from a first heat setting to a second heat setting. In some embodiments, a visual indicator changes a light sequence from a first heat setting to a second heat setting. In some embodiments, a visual indicator is a light ring including at least one LED. In some embodiments, a controller is configured to receive a signal from a user device to cause a diffuser assembly to adjust from a first heat setting to a second heat setting.

[0013] In some aspects, a volatile material dispenser system includes a volatile material dispenser having a controller and a diffuser assembly. The system further includes a refill unit having a wick, a volatile material, and a refill unit identifier. The refill unit can be configured to be removably received by the volatile material dispenser. Further, the controller can be configured to adjust the diffuser assembly based on a refill data profile associated with the refill unit identifier.

[0014] In some embodiments, a refill unit identifier is detected by a dispenser upon being located within a proximity of the dispenser. In some embodiments, a refill unit identifier is detected by a user device that is in communication with a dispenser. In some embodiments, a refill data profile includes at least one of a fragrance profile, a volatile material composition, a quantity, a mood setting, a purity score, a sustainability score, or a refill status. In some

embodiments, after a dispenser detects a refill unit identifier, a notification can be sent to a user device. In some embodiments, a notification includes a refill status and an interactive menu comprising at least one of a start option, a schedule option, and a link. In some embodiments, a link is associated with a web application or mobile application. In some embodiments, a link is associated with a third-party website or third-party mobile application. In some embodiments, a link is associated with an online marketplace. In some embodiments, a schedule option includes fields for inputting a date, a start time, a stop time, a reoccurrence frequency, and an operation setting.

[0015] In some aspects, a method of dispensing a volatile material includes providing a volatile material dispenser having a controller and a diffuser assembly, providing a refill unit including a volatile material and a wick that is configured to be received by the volatile material dispenser, and providing a visual indicator in communication with the controller of the volatile material dispenser. The dispenser can be configured to automatically adjust a characteristic of the visual indicator based on a fragrance characteristic of the volatile material.

[0016] In some embodiments, a visual indicator is provided on a volatile material dispenser and, upon detection of a refill unit, the visual indicator is configured to perform a recognition light sequence. In some embodiments, a visual indicator displays a color that corresponds to a fragrance note of a refill unit. In some embodiments, a visual indicator displays a color at a brightness intensity that corresponds to a heater setting. In some embodiments, upon detecting an unauthorized refill unit, a visual indicator is configured to perform an error light sequence. In some embodiments, a controller of a volatile material dispenser is in communication with a user device that can be configured to detect a refill unit identifier of the refill unit. In some embodiments, subsequent to detection of a refill unit identifier, a user device displays a plurality of options associated with operating a volatile material dispenser to dispense a volatile material of the refill unit. In some embodiments, a plurality of options includes a plurality of fragrances that are selectable. In some embodiments, after selection of one fragrance from a plurality of fragrances, a user device communicates with a controller of a volatile material dispenser to activate a diffuser assembly and a visual indicator according to an operational profile associated with the selected fragrance and a detected refill unit. In some embodiments, an operational profile includes a temperature and a color corresponding to a selected fragrance.

In some embodiments, upon selection of two fragrances of a plurality of fragrances, a user device displays a prompt including a plurality of pre-set modes.

[0017] In some aspects, a volatile material delivery system includes a plurality of volatile material dispensers. Each of the volatile material dispensers includes a diffuser assembly, a controller, and a temperature detection device. A refill unit including a wick is removably mounted to each volatile material dispenser. The system can include a communication network to which the plurality of volatile material dispensers are operably connected. In addition, a user device can be configured to communicate with the plurality of volatile material dispensers via the communication network. The plurality of volatile material dispensers may be configured to communicate with one another via the communication network.

[0018] In some embodiments, a user device is configured to select a multi-unit operational setting that includes operation parameters for at least two dispensers of a plurality of volatile material dispensers. In some embodiments, at least two dispensers are located in different rooms relative to one another. In some embodiments, a multi-unit operational setting includes a heater setting and a setpoint for each of at least two dispensers. In some embodiments, a communication network is a mesh network topology having a plurality of nodes corresponding to a plurality of volatile material dispensers. In some embodiments, each node of a plurality of nodes includes a sensor that is configured to detect a location of a user device within a predetermined range. In some embodiments, upon detection of a user device within a predetermined range of one node of a plurality of nodes, at least one other node of the plurality of nodes switches to a low duty cycle. In some embodiments, upon entry of a user device within a predetermined range of one node of a plurality of nodes, at least one other node of the plurality of nodes switches to a high duty cycle.

[0019] In some aspects, a volatile material dispenser system includes a diffuser assembly, a controller, and a user device. The diffuser assembly is in communication with a refill unit including a wick. The controller is in communication with a sensor that defines a predetermined range. The user device is configured to be detected by the sensor. The controller adjusts an operation of a dispenser between a first duty cycle and a second duty cycle based on a location of the user device relative to the predetermined range defined by the sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIG. 1 is schematic representation of a configuration of a volatile material dispenser, according to an embodiment of the present disclosure;

[0021] FIG. 2 is a first graph illustrating varying volatile material evaporation rates of a volatile material and volatile material dispenser in a first environment and in a second environment;

[0022] FIG. 3 is a second graph illustrating varying volatile material evaporation rates of three different volatile materials with different embedded fragrances based on a power output or temperature of a heater of the volatile material dispensers disclosed herein;

[0023] FIG. 4 is a schematic representation of a graphical user interface for use with a volatile material dispenser;

[0024] FIG. 5 is a graph illustrating an example operational profile of a volatile material dispenser;

[0025] FIG. 6 is a graph illustrating another example operational profile of a volatile material dispenser;

[0026] FIG. 7 is a flow chart of a method of operating a volatile material dispenser;

[0027] FIG. 8 is a schematic representation of a refill unit for a volatile material dispenser;

[0028] FIG. 9 is a schematic representation of an example floor plan and a plurality of nodes;

[0029] FIG. 10 is a flow chart of a method of operating a volatile material dispenser;

[0030] FIG. 11 is a flow chart of another method of operating a volatile material dispenser;

[0031] FIG. 12 is a flow chart of still another method of operating a volatile material dispenser;

[0032] FIG. 13 is a schematic representation of a diffuser assembly including a piezoelectric element; and

[0033] FIG. 14 is a schematic representation of the piezoelectric element of FIG. 13.

DETAILED DESCRIPTION OF THE DRAWINGS

[0034] The present disclosure is directed to the control of volatile material dispensers, including control of such dispensers with an electronic user device. While the present invention may be embodied in many different forms, several specific embodiments are discussed herein with the understanding that the present invention is to be considered only as an exemplification of the principles of the invention, and it is not intended to limit the invention to the embodiments illustrated.

[0035] Commercial products are rapidly evolving and gaining the ability to connect wirelessly to user devices capable of internet (*e.g.*, Wi-Fi, or Bluetooth®) communication. Such user devices can include phones, laptop computers, desktop computers, special purpose computers, Google® Nest®, Amazon® Alexa®, a Ring® Video Doorbell, a home security system, a motion detector, a garage door opener, a gate access opener, a neighborhood guardhouse, a smart T.V., a thermostat, an automatic lock, an HVAC unit, and/or any other smart home device, etc. There exists a need for a dispensing device that includes smart functionality and is capable of wireless communication with one or more user devices. The smart functionality is inclusive of operations in which the dispenser starts, stops, or adjusts an operation mode or setting based on an input and without requiring manual activation from a user, such that the dispenser can “think” and/or “decide” for itself. The smart functionality is also inclusive of communicating with the user to provide alerts, metrics, recommendations, confirmations, or other information, such that the dispenser can “talk” and/or “speak” for itself.

[0036] Allowing users to wirelessly communicate with a dispensing device provides the user with the opportunity to modify dispensation characteristics of the dispensing device with greater speed and convenience. With one or more clicks of a soft button on a software application, dispensation characteristics of the wirelessly connected dispensing device can be changed from virtually anywhere, giving the user greater control over dispensation characteristics of their dispenser, such as an operating profile, a release rate, or a duration of release of a volatile material. The volatile material released includes pleasant fragrances, or may be a useful repellent of pests. Providing users with an increased control over the dispensation characteristics allows users to enhance fragrance experiences that, in turn, enhance a user’s mood and behavior. Further, providing a smart, automated or semi-automated

volatile material dispenser system can increase the time a user has to focus on other tasks in a work or personal environment.

[0037] The user device may wirelessly control a rate of energy transfer of a diffuser assembly to a volatile material. The differences in characteristics of the function of the volatile material dispenser and the volatile material may be attributed to different settings available to the user. The setting selected by the user may further be influenced by factors such as the presence of a child, the presence of a pet, the time of day, the season, the location of the dispensing device, the location of the user, the size of the room the dispenser is located, and even the weather. The differences in the setting selected by the user may affect the rate, duration, or dispensation pattern of the dispensing device. Thus, a variety of different control techniques are used to dictate the energy transfer rate from the heater.

[0038] By regulating the energy applied to a volatile material, the volatile material concentration and fragrance characteristics from the volatile material in a first environment can be controlled and adjusted, which can improve a user's experience. The systems and methods disclosed herein allow the volatile material dispensing system to control an energy transfer rate of the diffuser assembly to the volatile material, and to thus control a volatile material concentration in an environment to achieve the desired fragrance experience or to reduce a number of pests in the environment.

[0039] Further, the systems and methods disclosed herein provide for a visual indicator that is capable of improving communication between the volatile material dispenser and the user. In addition, the present disclosure provides the user with easily accessible and relevant information about the refill unit, which can establish trust with the user. By providing information to the user device, the information is readily available to the user and can be provided with aesthetically appealing visuals or graphics for enhancing the user's understanding. Further, the system and methods disclosed herein offer the user simplified solutions for achieving sophisticated outcomes, such as maintaining a cohesive fragrance experience in a residence while realizing energy savings.

[0040] The term "volatile material," as used herein, refers to any substance or a mixture of substances such as a perfume designed to emit an aromatic scent, or a pest repellent designed to repel one or more types of pests from a user environment. The volatile material compositions

of the present application may comprise a single chemical or may comprise a mixture of natural and/or synthetic chemical components, all chosen to provide any desired odor or effect.

[0041] The term “fragrance,” as used herein, refers to any substance or a mixture of substances such as a perfume designed to emit an aromatic scent. A wide variety of chemicals are known for fragrance (*i.e.*, perfume) uses, including materials such as aldehydes, ketones, and esters. More commonly, naturally occurring plant and animal oils and exudates comprising complex mixtures of various chemical components are known for use as fragrances. The present disclosure relates to volatile material dispensers that are configured to emit any fragrance or combinations of fragrances. More specifically, the volatiles configured for use with the volatile material dispensers 100 disclosed herein may include any of the perfume raw materials that are listed within U.S. Patent No. 9,855,361, which is incorporated by reference herein in its entirety.

[0042] Many fragrances comprise a number of different perfume raw materials, each having their own chemical characteristics or properties, which generally vary in terms of polarity, density, vapor pressure, flash point, and other properties. By identifying the chemical characteristic of vapor pressure of various perfume raw materials or combinations of perfume raw materials, a targeted fragrance character or characteristic can be released from the volatile material dispenser. By referencing the vapor pressure of an identified fragrance, a particular amount of power or heat may be applied to the volatile within the refill, which can achieve a targeted fragrance characteristic from within the volatile, allowing for the reduction of scent habituation.

[0043] The fragrances and other volatile compositions of the present application may comprise a single chemical or may comprise a mixture of natural and synthetic chemical components, all chosen to provide any desired odor or effect. For example, the fragrances and perfumes of the present application may comprise one or more perfume raw materials. The term “perfume raw materials,” as used herein, refers to any compound (*e.g.*, those having molecular weight of at least 100 g/mol) or substance that are useful in imparting an odor, fragrance, essence, or scent either alone or in combination with other “perfume raw materials.” Mixtures of perfume raw materials are known by those skilled in the art of fragrances and perfumes as “accords.” The term “accord,” as used herein, refers to a mixture of two or more

perfume raw materials that are combined to impart a scent, odor, essence, or fragrance characteristic.

[0044] Also as used herein, ordinal numbers are used for convenience of presentation only and are generally presented in an order that corresponds to the order in which particular features are introduced in the relevant discussion. Accordingly, for example, a "first" feature may not necessarily have any required structural or sequential relationship to a "second" feature, and so on. Further, similar features may be referred to in different portions of the discussion by different ordinal numbers. For example, a particular feature may be referred to in some discussion as a "first" feature, while a similar or substantially identical feature may be referred to in other discussions as a "third" feature, and so on.

[0045] As used herein, unless otherwise limited or specified, "substantially identical" refers to two or more components or systems that are manufactured or used according to the same process and specification, with variation between the components or systems that are within the limitations of acceptable tolerances for the relevant process and specification. For example, two components can be considered to be substantially identical if the components are manufactured according to the same standardized manufacturing steps, with the same materials, and within the same acceptable dimensional tolerances (*e.g.*, as specified for a particular process or product).

[0046] Also as used herein, unless otherwise limited or defined, "integral" and derivatives thereof (*e.g.*, "integrally") describe elements that are manufactured as a single piece without fasteners, adhesive, or the like to secure separate components together. For example, an element stamped, cast, or otherwise molded as a single-piece component from a single piece of sheet metal or using a single mold, without rivets, screws, or adhesive to hold separately formed pieces together is an integral (and integrally formed) element. In contrast, an element formed from multiple pieces that are separately formed initially then later connected together, is not an integral (or integrally formed) element.

[0047] Also as used herein, unless otherwise specified or limited, directional terms are presented only with regard to the particular embodiment and perspective described. For example, reference to features or directions as "horizontal," "vertical," "front," "rear," "left,"

“right,” “upper,” “lower,” and so on are generally made with reference to a particular figure or example and are not necessarily indicative of an absolute orientation or direction. However, relative directional terms for a particular embodiment may generally apply to alternative orientations of that embodiment. For example, “front” and “rear” directions or features (or “right” and “left” directions or features, and so on) may be generally understood to indicate relatively opposite directions or features for a particular embodiment, regardless of the absolute orientation of the embodiment (or relative orientation relative to environmental structures). “Lateral” and derivatives thereof generally indicate directions that are generally perpendicular to a vertical direction for a relevant reference frame.

[0048] Referring to FIG. 1, a schematic representation of a volatile material dispenser system 100 is shown, which will be referred to herein as a dispenser. The volatile material dispenser 100 comprises a controller 104 that is connected to a power supply 108, a temperature detection device 112, an air displacement mechanism 116, a diffuser assembly 120, a refill unit 124, and a visual indicator 126. The refill unit 124 includes a volatile material 128 disposed within a container 132. The refill unit 124 also comprises a fluid delivery system, shown as a wick 136, that is in fluid communication with the volatile material 128. In some embodiments, the wick 136 is in thermal communication with the diffuser assembly 120, such as when a heater is used during operation. In some embodiments, the diffuser assembly 120 includes a piezoelectric assembly that diffuses the volatile material 128 from the refill 124 by the use of an absorbent material and vibrational movement caused by the application of an oscillating electric field. In some embodiments, the refill unit 124 is provided as a unitary element. It will be appreciated that the dispenser 100 and the refill unit 124, in combination, comprise a volatile material delivery system. In some embodiments, the dispenser 100 is configured to receive a single refill unit 124, which must be ejected or removed before the dispenser 100 can receive a replacement refill unit. In some embodiments, the dispenser 100 is configured to receive multiple refill units 124, such that the dispenser 100 is adapted for operating with more than one refill unit 124 at a time. In some embodiments, the dispenser 100 is configured to hold two refill units 124, one being designated as a secondary, back-up unit and the other being designated as a primary, in-use unit.

[0049] In some embodiments, the temperature detection device 112 is in thermal communication with the diffuser assembly 120 and in electrical communication with the

controller 104. The diffuser assembly 120 is in thermal communication with the volatile material 128 through the wick 136. The volatile material 128 is also in fluid communication with the air displacement mechanism 116 via the wick 136. The temperature detection device 112 may be configured to be in direct contact with the diffuser assembly 120, or the temperature detection device 112 may be in thermal communication with the diffuser assembly 120 such that the temperature detection device 112 can measure a small change in temperature (*e.g.*, at least a change of 0.1°C) or the change of another parameter. In some embodiments, the temperature detection device 112 is an integral component of the diffuser assembly 120. The temperature detection device 112 and the controller 104 are in electrical communication using a wired connection or a wireless connection. Additionally, the controller 104 is in electrical communication with the air displacement mechanism 116 and the visual indicator 126. It will be appreciated that in embodiments where the diffuser assembly 120 utilizes vibration rather than heat to diffuse the volatile material 128, the temperature detection device 112 and air displacement mechanism 116 are optionally included.

[0050] Referring to FIG. 1, the controller 104 is used to control operation of the diffuser assembly 120 and other electrical components such as the air displacement mechanism 116. The controller 104 may include a voltage regulator and may also include a number of other electrical components, including capacitors, resistors, inductors, fuses, diodes, and so forth. In some embodiments, the controller 104 may include a timer, which may allow the controller 104 to shut off specific electronic components for a predetermined amount of time after a predetermined amount of time of use. In some embodiments, the controller 104 may be capable of varying a frequency at which the diffuser assembly 120 vibrates to dispense volatile material 128, or an amount of time that the diffuser assembly 120 is energized or deenergized, or a temperature at which the diffuser assembly 120 operates.

[0051] Still referring to FIG. 1, the controller 104 may also include a plurality of components disposed thereon, which may include a wireless communication device or receiver that may be a module that supports wireless communication. The controller 104 may further include a first regulator and a second regulator, either of which may be a voltage regulator. The wireless communication system may support Bluetooth® Low Energy (BLE) wireless communication, Wi-Fi, or other types of wireless communication. In a preferred embodiment, the wireless communication system includes one or more of onboard crystal oscillators, chip

antenna, and/or passive components. The wireless communication system may support a number of peripheral functions, *e.g.*, application deliver controller (“ADC”), timers, counters, pulse width modulation (“PWM”), and serial communication protocols. Some of the serial communication protocols used through the wireless communication system’s programmable architecture may include I2C, universal asynchronous receiver/transmitter (“UART”), and serial peripheral interface (“SPI”). The controller 104 may be or include a microcontroller unit (“MCU”) and/or an application-specific integrated circuit (“ASIC”). The controller 104 may include a processor, a flash memory, and additional components not specifically noted herein. The controller 104 may utilize one or more auxiliary inputs 140 that are configured to provide information such as user preferences, switch selection, and environmental factors.

[0052] Still referring to FIG. 1, the power supply 108 may be configured to receive a USB-C type plug, that can be used to charge or power the volatile material dispenser 100. In some embodiments, the volatile material dispenser 100 may receive power from a wall outlet, a car lighter socket, or another source of power as the power supply 108. In some embodiments the power supply 108 may be a battery which could include a rechargeable battery, a one-time use battery, a lead-acid battery, a nickel-cadmium battery, a nickel-metal hybrid battery, a lithium-ion battery, an alkaline battery, a zinc-carbon battery, a coin cell battery, a zinc-air battery, a sealed lead-acid battery, or any other device known in the art that holds energy in the form of chemicals. In some embodiments, the power supply 108 may use a combination of battery types and/or the power supply 108 may be a combination of power sources such as a battery and a wall charger. In some embodiments, the power supply 108 may implement power conditioning to transform the line voltage to 5V DC. In some embodiments, the power supply 108 may not implement power conditioning.

[0053] In some embodiments, the volatile material dispenser 100 may comprise a base and a housing that are detachable from one another. The base may include the air displacement mechanism 116 and a charging apparatus for the power supply 108, such as a battery. The housing may contain the refill unit 124, the diffuser assembly 120, the visual indicator 126, the controller 104, and the power supply 108. In these embodiments, the volatile material dispenser 100 may be configured to be charged on the base that is connected to a wall outlet or other power source. While the volatile material dispenser 100 is connected to the base, the volatile material dispenser 100 may be configured to use the air displacement mechanism 116

to disperse the evaporated volatile material 128 into the surrounding environment. When the housing of the volatile material dispenser 100 is not attached to the base, the volatile material dispenser 100 may be configured to be placed in a more desirable location that is beyond the reach of a power source. Thus, the volatile material dispenser 100 may operate without the air displacement mechanism 116 by taking advantage of a placement that is closer in proximity to the user or another desirable location.

[0054] In the illustrated embodiment, the temperature detection device 112 is in electrical communication with the controller 104 and in thermal communication with the diffuser assembly 120. In some embodiments, the temperature detection device 112 is a negative temperature coefficient (“NTC”) thermistor. In some embodiments, the temperature detection device 112 is a positive temperature coefficient (“PTC”) thermistor. In some embodiments, the temperature detection device 112 is a thermocouple or any similar temperature measuring mechanisms.

[0055] Still referring to FIG. 1, the diffuser assembly 120 is in thermal communication with the volatile material 128 and the temperature detection device 112. In some embodiments, the diffuser assembly 120 may be a ceramic annular disk with an inlaid potted metal oxide resistor. In some embodiments, the diffuser assembly 120 comprises ceramic with an inlaid potted metal oxide resistor that is not in an annular shape. Further, the diffuser assembly 120 may be a tubular metal oxide resistor, a kapton heater, a foil heater, or a copper heating coil. In some embodiments, the diffuser assembly 120 comprises a honeycomb configuration such that it is considered a honeycomb heater. Further, the diffuser assembly 120 may be configured to receive the wick 136 that extends upwardly into contact with the diffuser assembly 120. Alternatively, the diffuser assembly 120 may be a contactless laser LED or a consumable heating element such as a tungsten filament. In some embodiments, the diffuser assembly 120 may be integrated in the refill unit 124. In some embodiments, the diffuser assembly 120 comprises a plurality of heating elements that surround the wick 136. The plurality of heating elements may be arranged in such a way that they are able to sequentially heat the wick 136. In some embodiments, the diffuser assembly 120 may be a nichrome wire that is embedded in the wick 136 that is attached to and/or along portions of the container 132 of the refill unit 124. In some embodiments, the diffuser assembly 120 may be a pin-point heater. In some embodiments, the diffuser assembly 120 may comprise one or more resistors.

[0056] Still referring to FIG. 1, the volatile material 128 may be in direct contact with the diffuser assembly 120 through the wick 136. In some embodiments the wick 136 is not in direct contact with the diffuser assembly 120. In some embodiments, the refill unit 124 is in thermal communication with the diffuser assembly 120 such that the wick 136 brings the volatile material 128 close enough in proximity to the diffuser assembly 120 to facilitate evaporation of the volatile material 128 faster than an evaporation in a controlled setting. In some embodiments, the diffuser assembly 120 is in communication with the refill unit 124 via the wick 136 and transports the volatile material 128 from the container 132 to the diffuser assembly 120. In some embodiments, the wick 136 may be a sintered wick such as a POREX[®] Wick. In some embodiments, the fluid delivery system shown as the wick 136 in FIG. 1 is another different type of liquid transfer mechanism. In some embodiments, the fluid delivery system may be a gravity fed injector or an apparatus for storing fluid that has a connection to a drip pipe disposed below the apparatus. In some embodiments, the fluid delivery system is a solenoid or an electronic fuel injector type dispenser that can periodically deliver a metered amount of volatile material from the refill unit 124 to the diffuser assembly 120 for volatilization. The timing and delivery of volatile material 128 can be controlled by the controller 104, which can then provide a precise heating sequence to the diffuser assembly 120 based upon when volatile material 128 is placed into contact with the diffuser assembly 120. Regardless of the type of fluid delivery system (*e.g.*, the wick 136), the diffuser assembly 120 is in thermal communication (*e.g.*, direct contact or indirect contact) with liquid carried by the fluid delivery system. In some embodiments, the wick 136 is a sintered wick to which a spring is coupled to facilitate contact between the wick 136 and the diffuser assembly 120. The sintered wick with the spring may offer compliant contact to accommodate varying tolerances of components of the volatile material dispenser 100. In some embodiments, the diffuser assembly 120 and the refill unit 124 may be in communication by the diffuser assembly 120 extending into a small cylinder cutout within the top of the refill unit 124.

[0057] Still referring to FIG. 1, the refill unit 124 may be a pre-dosed pad or gel. In some embodiments, the refill unit 124 is integral and nonremovable from the volatile material dispenser 100. In some embodiments, the refill unit 124 may be a refillable container that may include a cartridge. The cartridge may be configured to include additional elements, such as a base that is coupled with the cartridge. In some embodiments, the refill unit 124 may be a

glassomizer, a clearomizer, or a cartomizer, or may be another type of device that is used to deliver liquid to vapor. In some embodiments, the refill unit 124 includes a tank defining the container 132. The refill unit 124 may be configured to be removeable from the volatile material dispenser 100. In some embodiments, the refill unit 124 is configured for one-time use such that the wick 136 and the diffuser assembly 120 are embedded within the refill unit 124. In some embodiments, the refill unit 124 may be configured to be used for multiple uses and may also be detachable from the volatile material dispenser 100. In some embodiments, the refill unit 124 may be an Aspire™ Nautilus tank that implements an adjustable airflow ring at a bottom end thereof that allows for various heat settings. In some embodiments, the refill unit 124 includes a removable tank, which may comprise Pyrex®.

[0058] In some embodiments, the refill unit 124 holds the volatile material 128 that may include one or more compositions, which may be any suitable liquid or liquids, and may include one or more active ingredients. Active ingredients include, but are not limited to, one or more of a cleaner, an insecticide, an insect repellent, an insect attractant, a disinfectant, a mold or mildew inhibitor, an antimicrobial, a fragrance comprised of one or more aroma chemicals, a disinfectant, an air purifier, an aromatherapy scent, an antiseptic, an odor eliminator, a positive fragancing active material, an air-freshener, a deodorizer, a medicinal component, an inhalant (*e.g.*, for relieving a cough or congestion), or the like, and combinations thereof. The volatile material dispenser 100 disclosed herein may be used as a pest control product that has the ability to operate in both an unfragranced and a fragranced repellent mode (*e.g.*, at a lower temperature setting which outputs a very light or negligible fragrance and at a higher temperature setting which outputs a fragrance).

[0059] Still referring to FIG. 1, the air displacement mechanism 116 is in electrical communication with the controller 104 and in fluid communication with the volatile material 128. The air displacement mechanism 116 may be a fan at the base of the volatile material dispenser 100 that blows the evaporated volatile material from the refill unit 124 through and out of the volatile material dispenser 100. In some embodiments, the air displacement mechanism 116 may be a secondary heating element (not shown) that creates a convection tube within the volatile material dispenser 100 that carries the evaporated volatile material from the refill unit 124 away from the volatile material dispenser 100. In some embodiments, the air displacement mechanism 116 may include internal or external structure that is configured to

take advantage of naturally occurring diffusion or the surrounding air flow in the environment to provide enhanced air flow and/or mitigate power consumption of the volatile material dispenser 100. In some embodiments, the air displacement mechanism 116 is an air pump or a pneumatic pump. Alternatively, the air displacement mechanism 116 may be a venturi tube with a secondary heating element (not shown) separate from the first diffuser assembly 120. The venturi tube may be configured to create a pressure differential that may promote air movement and function as the air displacement mechanism 116. In some embodiments, the air displacement mechanism 116 is a ceiling fan wherein the volatile material dispenser 100 is mounted on one of the fan blades. In some embodiments, the air displacement mechanism 116 may be a diaphragm, a vacuum pump, or a compressor. In some embodiments, the air displacement mechanism 116 is an external apparatus that moves and has the volatile material dispenser 100 attached to the external apparatus. The external apparatus that moves may be a car, a bike, a scooter, a pet, a treadmill, a stationary bike, a door, a window, a height-adjustable desk or adjustable furniture, a portable electronic device, a wearable device, apparel, footwear, or any other object that moves.

[0060] Still referring to FIG. 1, the air displacement mechanism 116 may be a vehicle air vent and the volatile material dispenser 100 may be configured to be mounted to the vehicle air vent. In some embodiments, the air displacement mechanism 116 may be configured to have an adjustable nozzle that is designed to influence the exit of the evaporated volatile material into the surrounding environment. In such embodiments, the nozzle may be configured to increase or decrease the exit angle to influence the dispersion of the evaporated volatile material into the surrounding environment. In some embodiments, the air displacement mechanism 116 uses ionic wave generation. In some embodiments, the nozzle may provide a venturi effect. In some embodiments, the nozzle may include several ports, ducts, or conduits for delivering evaporated volatile material in disparate areas or regions. In some embodiments, the nozzle includes a filter or media for altering a characteristic of the evaporated volatile material.

[0061] In some embodiments, the volatile material dispenser 100 may not include the air displacement mechanism 116. Thus, the evaporated volatile material from the refill unit 124 may be a passive dispenser and is configured to disperse amongst the environment through ordinary diffusion and/or other environmental forces. In some embodiments, the air

displacement mechanism 116 may be configured to push air through a hose which enters an emission cavity within the refill unit 124 and mixes with the evaporated volatized material within the tank of the refill unit 124, after which the air and volatile combination is expelled out of a nozzle of the refill unit 124 due to a pressure differential caused by the air displacement mechanism 116.

[0062] Still referring to FIG. 1, the volatile material dispenser 100 may be configured to control the volatile material concentration in the environment by controlling an amount of the volatile material 128 that is evaporated from the refill unit 124 by using the temperature detection device 112 to monitor the power output of the diffuser assembly 120. In some embodiments, the controller 104 is configured to monitor the temperature of diffuser assembly 120 using the temperature detection device 112. In some embodiments, the temperature detection device 112 may be a PTC thermistor. In such embodiments, the PTC thermistor may be in contact or close proximity to the diffuser assembly 120 such that the PTC thermistor has a resistance value that reacts to a heat output of the diffuser assembly 120. The controller 104 is connected to the PTC thermistor and may be configured to detect the heat output and/or temperature of the diffuser assembly 120 by determining a change in resistance of the PTC thermistor. In some embodiments, the temperature detection device 112 may be a NTC thermistor. In such embodiments, the NTC thermistor may be in contact or close proximity to the diffuser assembly 120 such that the NTC thermistor has a resistance value that reacts to a heat output of the diffuser assembly 120. The controller 104 is connected to the NTC thermistor and may be configured to detect a heat output and/or temperature of the diffuser assembly 120 by using the change in resistance of the NTC thermistor. In some embodiments, the temperature detection device 112 may be a thermocouple. In such embodiments, the thermocouple is in contact or close proximity to the diffuser assembly 120 such that the thermocouple has a voltage value that reacts to a heat output of the diffuser assembly 120. The controller 104 is connected to the thermocouple and may be configured to detect a heat output and/or temperature of the diffuser assembly 120 by using the change in voltage of the thermocouple.

[0063] Still referring to FIG. 1, the volatile material 128 within the refill unit 124 is in fluid communication with the diffuser assembly 120, which may be a pin-point heater, such as the heater embodiments described in U.S. Provisional Application Serial No. 63/395,218, filed

August 4, 2022, which is herein incorporated by reference in its entirety. By using a heater such as a pinpoint heater, desirable temperatures can be achieved relatively quickly. In some embodiments, the diffuser assembly 120 may be turned “on” for a few seconds, every few minutes to achieve an activation period. During the activation period, the power level delivered to the diffuser assembly 120 may be varied (*e.g.*, between a range of power settings) to achieve an average target power setting (*e.g.*, 5.0 W) over the activation period. In other examples, the diffuser assembly 120 may be activated and held at a constant power level throughout the activation. Through the use of PWM, the diffuser assembly 120 can be adjusted to a range of different temperatures, and by achieving varying temperatures, different volatile material evaporation rates can be produced and output. Further, through the use of PID, the diffuser assembly 120 can be adjusted to maintain a setpoint parameter that can be detected by the sensor 144 or that has been selected by the user and communicated via the user device 148.

[0064] Since small deviations in temperature may cause different volatile material concentrations or different scent notes in the environment that are perceptible by a user, some embodiments of the present disclosure may implement the auxiliary inputs 140 that may include discrete user inputs through settings that provide for different intensities that are perceptible by a user, *e.g.*, “low,” “medium,” and “high.” In some embodiments, 4.0 Watts (W) of power may be associated with a “low” setting, 5.0 W of power may be associated with a “medium” setting, and 6.0 W of power may be associated with a “high” setting. In some embodiments, the user may be able to input a plurality of fragrance preferences as one of the auxiliary inputs 140. The volatile material dispenser 100 may be configured to utilize the plurality of fragrance preferences to oscillate between different run cycles that correlate with a preferred fragrance characteristic of the evaporated volatile material 128. In some embodiments, the user may input a selection of “lavender,” “jasmine,” and “vanilla.” The volatile material dispenser 100 may be configured to cycle through a low heat cycle to produce a “lavender” fragrance followed by a medium heat cycle to produce a “jasmine” fragrance and then a high heat cycle to produce a “vanilla” fragrance. In some embodiments, the controller 104 may have a randomizer that determines what intensity of heat to use for a given cycle. Thus, the fragrance output from the evaporated volatile material may be varied to prevent the user from experiencing fragrance habituation. Thus, the volatile material dispenser 100 includes the controller 104, the diffuser assembly 120, the air displacement mechanism 116,

and the temperature detection device 112 for selective emission of one or more fragrance characteristics or notes present within the fragrance profile and composition of the volatile material 128 of the refill unit 124. In this way, the volatile material dispenser 100 is configured to modulate among settings or operations to selectively emit one fragrance characteristic (*e.g.*, fragrance note or scent) in a higher concentration and, thus, a greater intensity. Such modulation of the volatile material dispenser 100 for selective emission may occur as a result of pre-programmed modes or sequences or as a result of user input.

[0065] In some embodiments, the diffuser assembly 120 includes a piezoelectric element (not shown) that may be formed of any suitable shape and/or may be made of any suitable material having piezoelectric properties and which causes the material to change dimensionally in response to an applied electric field. Examples of diffuser assemblies utilizing piezoelectric elements are described in U.S. Patent No. 11,407,000 and U.S. Patent Application Nos. 17/844,579, 17/878,629, and 18/077,899, each of which is incorporated by reference herein in its entirety. Illustrative examples of suitable materials include, but are not limited to, lead zirconate titanate (PZT) or lead metaniobate (PN). Any actuator may be utilized, for example, a piezoelectric vibrating mesh actuator, a piezoelectric standing wave actuator, a piezoelectric vibrating needle, or any other suitable piezoelectric actuator. As described above, the diffuser assembly 120 may be controlled among “high,” “medium,” and “low” settings or intensities to vary the fragrance output and fight fragrance habituation. Further, the diffuser assembly 120 can be controlled to modulate among settings or operations to achieve certain fragrance characteristics, such as those of pre-programmed modes or sequences or as a result of user input.

[0066] Still referring to FIG. 1, the volatile material dispenser 100 may be configured to move the diffuser assembly 120 closer to or farther from the volatile material 128 depending on an intensity selection of the user and/or other factors including environmental factors and measurements from the temperature detection device 112. In such embodiments, the volatile material dispenser 100 may be configured to move the diffuser assembly 120 closer to the refill unit 124 to increase the intensity of the heat transferred from the diffuser assembly 120 to the refill unit 124. Thus, the amount of the volatile material 128 evaporated into the environment may increase as a result of an increased rate in energy transfer from the diffuser assembly 120 to the volatile material contained within the refill unit 124. In contrast, the volatile material

dispenser 100 may be configured to move the diffuser assembly 120 away from the refill unit 124 to decrease the amount and intensity of the energy transferred from the diffuser assembly 120 to the refill unit 124. Thus, the amount and intensity of the volatile material released into the environment may decrease. In some embodiments, the volatile material dispenser 100 is configured to move the refill unit 124 or the wick 136 relative to the diffuser assembly 120 to achieve the functions described above.

[0067] In some embodiments, the volatile material dispenser 100 may be configured to control the rate of volatile material evaporation by moving the diffuser assembly 120 along the refill unit 124, which may comprise a pre-dosed pad or gel, to continuously expose the diffuser assembly 120 to a new area or region of the volatile material composition. In some embodiments, the diffuser assembly 120 may be moved using a pendulum or another type of oscillating device.

[0068] Still referring to FIG. 1, the flow rate of the volatile material 128 from the refill unit 124 to the diffuser assembly 120 through the wick 136 may be controlled to control the amount of the volatile material 128 that is evaporated and released into the environment. In some embodiments, the flow rate of volatile material 128 from the refill unit 124 to the diffuser assembly 120 can be controlled using a secondary heating element (not shown) to heat or cool the refill unit 124. Heating the refill unit 124 with the secondary heating element (not shown) may decrease the viscosity of the volatile material 128, thereby increasing the flow from the refill unit 124 to the diffuser assembly 120 via the wick 136. In a similar fashion, the secondary heating element (not shown) may be turned off or the power output may be lowered to increase the viscosity of the volatile material 128 in the refill unit 124 to reduce the flow rate of the volatile material 128 from the refill unit 124 to the diffuser assembly 120 via the wick 136.

[0069] In some embodiments, the volatile material dispenser 100 may use duty cycles to achieve the desired volatile material concentration in the surrounding environment. The volatile material dispenser 100 may be configured to have a power switch that is used to power “on” and “off” the volatile material dispenser 100. When the power switch is activated to an “on” position, the controller 104 can direct electric current to flow to the diffuser assembly 120 and the air displacement mechanism 116 using power supplied by the power supply 108, thereby energizing the diffuser assembly 120 and the air displacement mechanism 116. Once a temperature setpoint or target is achieved, the controller 104 can de-energize the diffuser

assembly 120 by shutting off the electrical current supplied to the diffuser assembly 120 while continuously monitoring a current temperature of the diffuser assembly 120 using signals provided by the temperature detection device 112 or another environmental sensor arranged on or in proximity to the diffuser assembly 120. When the measured temperature drops to a predetermined value, the controller 104 may be configured to restore electrical current to initiate another operation cycle. In some embodiments, a PWM algorithm is used to allow the diffuser assembly 120 to heat up quickly, which in turn may allow a faster fragrance or volatile material release. In some embodiments, a PID algorithm is used to accurately reach and maintain a setpoint, which in turn may allow for precise and reliable control of a fragrance or volatile material release while mitigating energy consumption.

[0070] Still referring to FIG. 1, the controller 104 may be configured to receive information from the auxiliary inputs 140 which may include environmental sensors, user inputs, and/or information from a lookup table regarding chemical characteristics from a set of fragrance characteristics. In some embodiments, the environmental sensors may comprise the sensors listed below that may detect the cartridge or the type of volatile material within the cartridge. The controller 104 may include a processor that processes the information to determine an optimal power level for each of the discrete fragrance characteristic switching levels, *i.e.*, an optimal heating temperature can be determined to produce a desired scent. In addition, the controller 104 may determine a power level to be sent to the air displacement mechanism 116 to produce a desired airflow.

[0071] The environmental sensors that may be used may include, but are not limited to, a microphone, an acoustic wave sensor, a camera, a turbidity sensor, a thermometer or temperature sensor, a humidity sensor, a passive infrared sensor, a light sensor, a lightning sensor, a wind transducer, a compass, a Global Positioning System (“GPS”), a gyroscope, an accelerometer, a barometer, a crash sensor, a proximity sensor, a radar, an ultrasonic sensor, a photoelectric sensor, a reflectance sensor, a current sensor, a biometric sensor, a swipe sensor, a capacitive sensor, or any combination thereof. The chemical characteristics of the volatile material may be measured by the volatile material dispenser 100 or transmitted to the controller 104 through a wireless communication device or other means. Some of the user inputs may include but are not limited to time preferences for operation, intensity level, and fragrance selection. In some embodiments, the controller 104 receives the information from the

environmental sensor(s), the user inputs, and the chemical characteristics of the volatile material, and regulates the volatile material dispenser 100 to achieve a desired heating temperature of the heating element and a desired airflow of the air displacement mechanism 116. Thus, the desired airflow and temperature correlate with a desired volatile material concentration level in the surrounding environment.

[0072] In some embodiments, the auxiliary inputs 140 include user inputs which may be input into the volatile material dispenser 100 via external switches provided on a housing (not shown) for physical interaction by the user or as digital switches (*e.g.*, soft buttons) via the user device 148. In some embodiments, a first switch may be configured to control an intensity of the fragrance. A first switch setting may define a “low” setting, which may set the diffuser assembly 120 to operate with 5 minutes between each operational cycle. A second switch setting may define a “medium” setting that may set the diffuser assembly 120 to operate with 3 minutes between each operational cycle. A third switch setting may define a “high” setting that may set the diffuser assembly 120 to operate with 1 minute between each operational cycle. By adjusting the first switch between the three or more switch settings, the timing between operational cycles differs so that different fragrance intensities and volatile material intensities can be achieved in the surrounding environment. In some embodiments, there may be more than one switch. For example, there may be a second switch, that allows a user to control a fragrance output of volatile material, *e.g.*, apple, apple/cinnamon, cinnamon. In some embodiments, the first switch and the second switch may additionally or alternatively be provided via a display screen of an electronic device that is in communication with one or more of the electrical components within the volatile material dispenser 100.

[0073] In some embodiments, the volatile material dispenser 100 may include features that provide enhanced customization and adaptation capabilities. Algorithms may be used by the volatile material dispenser 100 to modify the operational parameters according to user preferences and/or volatile material requirements. Generally, the controller 104 operates the volatile material dispenser 100 according to pre-programmed sequences, which are designed to control the temperature of the heating element within 1°F (0.55°C) of the targeted temperature. More specifically, algorithms may be used to vary the power applied to the heater, as well as the output of the air displacement mechanism 116 (*e.g.*, controlling the speed or revolutions per minute (RPM) of the air displacement mechanism 116). For example, PWM

algorithms or PID algorithms may be used to adjust the diffuser assembly 120 to different temperatures according to various duty cycles.

[0074] Controlling the temperature of the diffuser assembly 120 and rate of air displacement may result in controlling evaporated volatile material 128 intensities and fragrance characteristics of the evaporated volatile materials 128, which creates a consistent volatile material intensity and fragrance experience despite the particular user environment. The operation of the volatile material dispenser 100 may be adjusted directly through user manipulated controls or wirelessly through an electronic device, such as a user's mobile device. In some embodiments, the diffuser assembly 120 is configured to achieve a temperature of between about 100°F and about 300°F, or between about 125°F and about 275°F, or between about 150°F and about 250°F, or between about 175°F and about 225°F. The diffuser assembly 120 may comprise one or more resistors having a resistance of between about 0.5 Ohms (Ω) and about 50.0 Ω , or between about 1.0 Ω and about 15.0 Ω , or between about 1.5 Ω and about 10.0 Ω , or between about 2.5 Ω and about 7.5 Ω , or between about 3.5 Ω and about 5.0 Ω .

[0075] In some embodiments, the power limits may vary for different volatile materials or different environments. Further, the intensity limits (*e.g.*, on time/off time between activations) may also be different among different volatile materials and environments. In some embodiments, both duration and intensity limits may be changed throughout operation of the volatile material dispenser 100 due to changes that may occur over time and/or due to one or more of a number of external factors that may be measured or identified either automatically or from information input by a user. In some embodiments, automatic triggers may cause the duration limits or intensity limits (*e.g.*, minimum and maximum switch positions) to be adjusted, for example, based on a time of the day, a measured room temperature, a size of the room, a predetermined use of the room, a season of the year, or vital signs of a person acquired from the electronic device (*e.g.*, a cell phone, a smart watch, or another type of device having sensors or that can receive user inputs). The user inputs may be received from environmental sensors, which may include external sensors along any number of devices that are configured to communicate either directly with the volatile material dispenser 100, or with the electronic device, and that are configured to provide feedback to the volatile material dispenser 100. The changes in intensity levels can also be triggered via request from an app or via direct physical interaction with the volatile material dispenser 100.

[0076] In some embodiments, the fragrance characteristics and volatile material characteristics can be enhanced through different durations of operation and/or different frequencies of operation. For example, different frequencies of operation could include the volatile material dispenser 100 operating a duty cycle every 5 minutes or every 15 minutes. In some embodiments, the fragrance characteristics and volatile material characteristics can be enhanced through an algorithm that varies the temperature of activation in a predetermined fashion and/or through the use of an on/off timer. In some embodiments, the varying of a speed of the air displacement mechanism 116 when the diffuser assembly 120 is turned “on” is used to enhance the characteristics of the volatile material 128. In some embodiments, a user is capable of controlling the various parameters discussed above through an app, which allows a user to vary characteristics of the volatile material by choosing different pre-determined operational setpoints that are connected to volatile material characteristics, such as a fragrance. In some embodiments, the operational setpoints may be pre-determined or pre-programmed.

[0077] In some embodiments, the refill unit 124 includes a cartridge having embedded information or identifiers (*e.g.*, along an outer side thereof) which may be automatically detected via one or more sensors within the volatile material sensor. To that end, the volatile material dispenser 100 includes one or more sensors 144, such as an infrared (IR) sensor, an optical sensor, a weight sensor, a hall effect sensor, one or more magnets, a radio frequency identification (RFID) sensor or reader, a near field communication (NFC) sensor or reader, a barcode scanner, a QR scanner, a proximity sensor, a reflective photo interpreter, a humidity sensor, a fluid property sensor, a light sensor, an alcohol sensor, or another type of sensor. In some embodiments, the volatile material dispenser 100 is configured to retrieve data that provides information regarding the collected sensory input from the sensors 144. For example, the volatile material dispenser 100 may be configured to read or scan a QR code (*e.g.*, via a camera) provided along an exterior of the refill unit 124. The QR code is computer-readable code that may be associated with embedded information including anticipated humidity level, pressure levels, temperature, or any other type of information that may influence the timing of the run cycle(s) and the heating intensity of the diffuser assembly 120. In some embodiments, the volatile material may be produced for or configured for volatilization in a tropical environment. The volatile material dispenser 100 may then vary the temperature of the diffuser

assembly 120 based on receiving information from the refill unit 124 that the volatile material is likely in a particular environment, such as a tropical environment.

[0078] In some embodiments, data from one or more of the above-referenced sensors 144 may be received by the controller 104. The controller 104 may be configured to have a memory, a processor, and information stored within a lookup table that may be compared against data that is retrieved by any of the sensors. A refill data profile may include an identified fragrance or fragrance characteristic of the volatile material 128. The controller 104 can determine the fragrance or fragrance characteristic, among other aspects of the refill unit 124, based on the comparison of the data with the information stored within the lookup table. However, in some embodiments a user may manually input information that identifies a refill type or the environmental conditions. In some embodiments, the controller 104 retrieves information associated with the refill unit identifier from a remote database via the communication network 152 and stores or writes information to the local memory. In some embodiments, the refill unit 124 is a cartridge that includes two fragrances that are configured to release two different fragrance characteristics, *i.e.*, the cartridge is a 2-tone cartridge. In some embodiments, the refill unit 124 is a cartridge that includes a fragrance composition having multiple fragrance notes or dimensions, each fragrance note being associated with a predetermined temperature. In some embodiments, the volatile material may be identified based on data that is retrieved by the one or more sensors noted above in combination with data manually input by a user. In some embodiments, the controller 104 communicates with a remote database or server via the communication unit 156 and communication network 152. The remote database or server may include a refill

[0079] In some embodiments, a lock-and-key feature is provided with the refill unit 124 in the form of a cartridge. For example, the lock-and-key feature may be a protrusion along an upper rim of the cartridge, which may provide information to the volatile material dispenser 100 regarding the volatile material within the cartridge. The lock-and-key feature may be disposed along the exterior surface of the cartridge or may be provided along an inner surface of the cartridge (*e.g.*, along a channel defining a mouth of the cartridge). The volatile material dispenser 100 may be configured to detect a type of volatile material 128 that is within the refill unit 124 based on a location of the lock-and-key feature. For example, a cartridge filled with

a volatile material that works well in the tropics may be identified based on a location of two radially offset protrusions along an exterior surface of the cartridge.

[0080] In some embodiments, the sensor 144 measurements and temperature measurements are associated with different, pre-determined wattages, which can be pre-determined based on an identified vapor pressure of each of the particular volatile materials to be emanated from the volatile material dispenser 100 that corresponds with a temperature that is achieved based upon a specified power setting, *e.g.*, 5.0 W, 5.5 W, and 6.0 W. Although ranges of 5.0 to 6.0 W are discussed, various other operating profiles are possible (*e.g.*, between 1.0 W and 9.0 W) and can be chosen based upon the volatile material present within the refill unit 124.

[0081] The visual indicator 126 can be a light ring for conveying information associated with the volatile material dispenser 100, such as an annular ring that provides 360 degree visual indication to a user, similar to the light ring embodiments disclosed in the U.S. Patent Application Serial No. 16/743,933, filed on January 15, 2020, which is incorporated herein by reference in its entirety. The visual indicator 126 may be an integrally formed component or may comprise two or more components that are separable. The visual indicator 126 may use a variety of light sources, such as an LED light ring, an LED light strip, a plurality of individually housed LED lights, or a single LED. Further, the visual indicator 126 may include incandescent light bulbs, halogen light bulbs, fluorescent light bulbs, or any combination of incandescent, fluorescent, and LED bulbs. It is also contemplated that the visual indicator 126 may house a luminescent structure, such as a tape, paint, or another artificially luminescent article. In some embodiments, the visual indicator 126 may incorporate a natural luminescent structure or organism.

[0082] In some embodiments, the visual indicator 126 can be a display or screen for conveying information associated with the volatile material dispenser 100. The visual indicator 126 may use a variety of display formats, including an electrophoretic display, liquid crystal display (LCD), an LED display, or any suitable display technology. The visual indicator 126 may be capable of presenting alphanumeric characters, emoji symbols, grammar or punctuation symbols, or graphics of various colors, fonts or typefaces, and languages.

[0083] The volatile material dispenser 100 is configured to regulate the visual indicator 126 in accordance with various operational and functional preferences. To that end, the controller 104 can regulate the brightness (or lux) intensity, color, and pattern produced by the visual indicator 126. In some embodiments, the controller 104 may cause the visual indicator 126 to perform a feedback sequence or indication sequence in connection with various operation events. Such operation events can include, for example, detecting a refill unit, powering on or off, switching among operational settings or modes, or pairing with a user device or network, among other events. The controller 104 may cause the visual indicator 126 to perform a feedback sequence or indication sequence to indicate a system or component status, such as, *e.g.*, a refill status or level, an interruption in connectivity, a power outage, or a lower battery, among other information. The controller 104 may cause the visual indicator 126 to perform an operational sequence as part of a setting or mode of the volatile material dispenser 100. The operational sequence can include, for example, changing a color to correspond to a fragrance, adjusting a brightness (lux) intensity to correspond to a heat intensity, or changing a pattern to correspond to an audio source or mood setting, among other operations.

[0084] With continued reference to FIG. 1, the volatile material dispenser 100 is in communication with a user device 148 via a communication network 152 and a communication unit 156. The communication unit 156 can be contained within the volatile material dispenser 100, such as within a housing (not shown). In some embodiments, the communication unit 156 is provided adjacent to or externally of the volatile material dispenser 100, while being connected to the controller 104 via a wireless or wired connection.

[0085] Each component listed above may be coupled via various mechanisms (*e.g.*, snap-fit, press-fit, sliding-fit, spring tabs, hooks, etc.). In some embodiments, any component of the volatile material dispenser 100 is configured to be removed and replaced by another component. For example, a plug deck configured to plug into a wall socket, may be replaced by a plug deck configured to plug into a car socket. Though the components mentioned in this paragraph may be separable or integrally formed, it is contemplated that each component mentioned may be either separable from or integrally formed with any other component.

[0086] Referring to FIG. 2, a bi-modal graph 160 is provided showing differing evaporation rates for the same volatile material with the same volatile material dispenser 100 of FIG. 1 in two different environments. A first distribution 164 is of the volatile material evaporation rate of the volatile material 128 and the volatile material dispenser 100 being used in a hot, dry, desert like environment. The hot and dry environment may lead to a higher temperature of the wick 136, which lowers the amount of energy needed to evaporate the volatile material 128. Thus, the first distribution 164 is skewed closer 5.5 W of power output. A second distribution 168 is of the volatile material dispenser 100 being used in a cool, humid, arctic environment. The cold and humid environment may lead to a lower temperature of the wick 136, which increases the amount of energy needed to evaporate the volatile material 128. Thus, the second distribution 168 is skewed closer to 6 W of power output. The difference in evaporation rates can be attributed to both the performance of the volatile material dispenser 100 and the environmental factors that alter the evaporation rate of the volatile material 128 and the temperature of the wick 136.

[0087] Referring to FIG. 3, a tri-modal accord 174 is illustrated for some example embodiments of the volatile material 128 of FIG. 1. In these embodiments, the volatile material 128 has three different fragrance characteristics that are emitted at different temperature and power outputs of the volatile material dispenser 100. As an example, the three different fragrances may be associated with “lavender,” “jasmine,” and “vanilla” fragrance characteristics. In some embodiments, one or more additional fragrance characteristics may be included, and each fragrance characteristic may have a different optimal fragrance release temperature and power output of the volatile material dispenser 100, as illustrated by the peaks within the graph of FIG. 3. In FIG. 3, a first fragrance characteristic 178 smells more like “lavender” with a hint of “jasmine” and “vanilla,” a second fragrance characteristic 182 smells more like “jasmine” with more subtle notes of “lavender” and “vanilla,” and a third fragrance characteristic 186 smells more like “vanilla” with hints of “jasmine” and “lavender.” Still referring to FIG. 3, the optimal power output of the volatile material dispenser 100 for the first fragrance characteristic 178 is about 5.4 W because the power output of about 5.4 W corresponds with the highest fragrance intensity of “lavender,” the first fragrance characteristic 178. Further, the optimal power output of the volatile material dispenser 100 for the second fragrance characteristic 182 is about 5.6 W because the power output of about 5.6 W

corresponds with the highest fragrance intensity of “jasmine,” the second fragrance characteristic 182. Additionally, the optimal power output of the volatile material dispenser 100 for the third fragrance characteristic 186 is about 6.0 W because the power output of about 6.0 W corresponds with the highest fragrance intensity of “jasmine,” the third fragrance characteristic 186. More fragrance characteristics may be included, and additional, non-fragranced compositions may be included and configured for release within one or more temperature schemes, as described in greater detail below. In some embodiments, the optimal power output may correspond with the highest rates of volatile material evaporation.

[0088] Still referring to FIG. 3, the three different temperature and power outputs that correlate with the three different fragrance characteristics can fluctuate based on the temperature of the wick 136 and other environmental factors. The fluctuation of the three different temperature and power outputs that correlate with the three different fragrance characteristics can be similar to the fluctuations of evaporation rates that were shown in the bi-modal graph 160 of FIG. 2.

[0089] In some embodiments, the user may be able to control which fragrance note the volatile material dispenser outputs by switching the volatile material dispenser 100 to a lower or first setting that emits the first fragrance characteristic 178. By switching the volatile material dispenser to a middle or second setting, the user can cause emission of the second fragrance characteristic 182. Further, by switching the volatile material dispenser to a higher or third setting, the user can cause emission of a third fragrance characteristic 186. By allowing for three different fragrance characteristics to be emitted from the volatile material dispenser based on a selected input from a user, the volatile material dispenser is configured to provide a user the ability to select, within pre-determined minimum and maximum limits, how a fragrance will smell.

[0090] It should be noted that intensity selection is (*e.g.*, an intensity selection of high, medium, or low) different than an amount of time of activation and/or an amount of time between activations or operation cycles. The fragrance characteristic selection allows an end user to be able to select a fragrance characteristic. In the illustrated embodiments of FIG. 3, the first, second, and third fragrance characteristics 178, 182, 186 are associated with different, pre-determined wattages, which can be pre-determined based on an identified vapor pressure

of each of the particular fragrances to be emanated from the volatile material dispenser that corresponds with a temperature that is achieved based upon a specified power output setting, *e.g.*, 5.0 W, 5.5 W, and 6.0 W. In some embodiments, the second switch may include discrete positions such that only a pre-determined number of fragrance characteristics may be implemented, *e.g.*, 2, 3, 4, etc. However, in alternative embodiments, an infinite number of fragrance characteristics may be implemented. To that end, the second switch may be a dial that is movable between a minimum setting and a maximum setting and may be adjustable to achieve an infinite number of temperature settings. Although ranges of 5.0 to 6.0 W are discussed, various other operating profiles are possible (*e.g.*, between 1.0 W and 9.0 W) and can be chosen based upon the fragrance present within the refill unit 124.

[0091] In some embodiments, the first fragrance characteristic 178 is achieved using a temperature scheme among one of the following temperature schemes, although varying power schemes may also be utilized depending on the type of fragrance to be emitted. In some embodiments, the first fragrance characteristic 178 is achieved at a temperature within a first range of between about 150°F and about 200°F, or between about 160°F and about 190°F, or about 175°F. In some embodiments, the second characteristic 182 is achieved at a temperature within a second range of between about 175°F and about 225°F, or between about 185°F and about 215°F, or about 200°F. In some embodiments, the third fragrance characteristic 186 is achieved at a temperature within a third range of between about 200°F and about 250°F, or between about 210°F and about 240°F, or about 225°F. In some embodiments, the optimal temperature schemes are influenced by the temperature of the wick 136. For example, if the wick 136 has a temperature of 65°F the temperature schemes may be increased to achieve the desired fragrance characteristics. In contrast, if the temperature of the wick 136 is 95°F the temperature schemes may be decreased to achieve the desired fragrance characteristics. In some embodiments, the temperature ranges between the first fragrance characteristic 178, the second fragrance characteristic 182, and the third fragrance characteristic 186 may overlap. In such embodiments, overlapping portions of the ranges may denote two of the fragrances being identifiable by a user. In other embodiments, the temperature ranges between the first fragrance characteristic 178, the second fragrance characteristic 182, and the third characteristic 186 do not overlap.

[0092] For example, the first fragrance characteristic 178 may be achieved at a temperature within the first range of between about 150°F and about 200°F, the second fragrance characteristic 182 may be achieved at a temperature within the second range of between about 175°F and about 225°F, and the third fragrance characteristic 186 may be achieved at a temperature within the third range of between about 200°F and about 250°F. In some embodiments, a fragrance profile may be identified to align with a pre-defined temperature scheme of the volatile material dispenser 100, *e.g.*, 175°F, 200°F, and 225°F. To that end, a first fragrance may be identified that has a fragrance characteristic that is achieved within the first temperature range, a second fragrance may be identified that has a fragrance characteristic that is achieved within the second temperature range, and a third fragrance may be identified that has a fragrance characteristic that is achieved within the third temperature range. Additionally, the first fragrance may have a peak or desired first fragrance characteristic at a first temperature, the second fragrance characteristic may have a peak or desired second fragrance characteristic that is different than the first fragrance characteristic at a second temperature, and the third fragrance may have a peak or desired third fragrance characteristic that is different than the first and second fragrance characteristics at a third temperature.

[0093] In some embodiments, there may be a second switch that allows a user to choose a particular power output, which allows for the fragrance characteristics to be achieved that are associated with a first composition, a second composition, and a third composition. The first composition defines the first fragrance characteristic 178 (*e.g.*, “lavender”), the second composition defines the second fragrance characteristic 182 (*e.g.*, “jasmine”), and the third composition defines the third fragrance characteristic 186 (*e.g.*, “vanilla”). The fragrance characteristics 178, 182, 186 may be associated with a peak in fragrance intensity of the chemical compositions or the fragrance characteristics may be associated with relative increases in fragrance intensities. In some embodiments, the chosen particular power output may be associated with a particular unique mix of the fragrance characteristics, such that the particular power output may correspond to the particular mix of smells that smell more like “jasmine” and “lavender” with subtle notes of “vanilla.” In some embodiments, the particular power output may correspond with a particular volatile material evaporation rate. In some embodiments, the particular power output is the optimal power output for the highest rate of volatile material evaporation and/or the highest fragrance intensity. In some embodiments, the

particular power output may correspond with a particular measurement of the temperature of the wick 136.

[0094] In some embodiments, the controller 104 may choose what optimum temperature the diffuser assembly 120 should be for each cycle. In some embodiments, the controller 104 may vary the power output to the diffuser assembly 120 in each cycle to vary the fragrance characteristics of the evaporated volatile material 128 in each cycle. In some embodiments, the scents may be in a random order to prevent a user from becoming accustomed to or habituated to a particular volatile material because the perception of a scent by a user of a dispensed fragrance at a constant intensity tends to decay over time. In some embodiments, the controller 104 may have a predetermined order of power outputs that can correlate with the season or time of day. In some embodiments, the controller 104 uses a randomizer to determine what power output and fragrance characteristic should be discharged. In some embodiments, the volatile material dispenser 100 may not have varying cycles that correlate with different fragrance characteristics.

[0095] In some embodiments, the fragrance characteristics are associated with peak fragrance intensities of the respective compositions, or only some of the fragrance characteristics are associated with peak fragrance intensities. Still further, in some embodiments, the fragrance characteristic may be associated with a non-fragranced active, such as a pest control active, which may be volatilized at a higher rate than other compositions within the refill unit 124. In such an embodiment, the fragrance characteristics are reflective of an attribute or characteristic of the composition that is non-fragrance based.

[0096] Turning back to FIG. 1, the volatile material dispenser 100 comprises the controller 104 that is connected to the power supply 108, the heating element or diffuser assembly 120, the visual indicator 126, the communication unit 156, and the refill unit 124. The controller 104 is used to control operation of the diffuser assembly 120 and other electrical components, such as the visual indicator 126 and the air displacement mechanism 116. The controller 104 includes a voltage regulator and may also include a number of other electrical components, including capacitors, resistors, inductors, fuses, diodes, and so forth. In some embodiments, the controller 104 includes a timer, which may allow the controller 104 to shut off specific

electronic components for a predetermined amount of time after a predetermined amount of time of use.

[0097] Still referring to FIG. 1, the controller 104 may also include a plurality of components disposed thereon, which includes the communication unit 156 or receiver that may be a module that supports wireless communication to the user device 148. The controller 104 may further include a first regulator and a second regulator, either of which may be a voltage regulator. The communication unit 156 may support Bluetooth® Low Energy (BLE) wireless communication, Wi-Fi, or other types of wireless communication. In a preferred embodiment, the communication unit 156 includes one or more of onboard crystal oscillators, chip antenna, and/or passive components. The communication unit 156 may support a number of peripheral functions, *e.g.*, an application deliver controller (“ADC”), timers, counters, pulse width modulation (“PWM”), and serial communication protocols. Some of the serial communication protocols used through the wireless communication system’s programmable architecture includes I2C, universal asynchronous receiver/transmitter (“UART”), and serial peripheral interface (“SPI”). The controller 276 may be or include a microcontroller unit (“MCU”) and/or an application-specific integrated circuit (“ASIC”). The controller 104 includes a processor, a flash memory, and additional components not specifically noted herein. The controller 104 may utilize one or more auxiliary inputs 140 that are configured to provide information such as user preferences, switch selection, and environmental factors.

[0098] Still referring to FIG. 1, the volatile material dispenser 100, which may be referenced herein simply as the dispenser, is configured to control the volatile material concentration in the environment by controlling an amount of the volatile material 128 that is evaporated from the refill unit 124 by controlling a voltage or a current supplied to the diffuser assembly 120. In some embodiments, the controller 104 is configured to monitor the temperature of the diffuser assembly 120 by monitoring the voltage or current supplied to the diffuser assembly 120.

[0099] Still referring to FIG. 1, the communication network 152 is in communication with the user device 148 and the dispenser 100. The user device 148 that is in communication with the communication network 152 includes, but is not limited to, a Google® Nest® Thermostat, a home security system, an Amazon® Alexa®, a Ring® Video Doorbell, a motion detector, a

garage door opener, a gate access opener, a neighborhood guardhouse, a smart T.V., a thermostat, an automatic lock, an HVAC unit, and/or any other smart home device. In some embodiments, the user device 148 includes a wireless communication device such as a mobile phone with a graphical user interface (GUI), or any other device, such as, *e.g.*, a laptop, a tablet, a desktop, a server, or a special purpose computer. In some embodiments, the dispenser 100 may be in communication with more than one of the user devices 148.

[00100] The communication network 152 can be any suitable communication network or combination of communication networks. For example, the communication network 152 includes a Wi-Fi network (which can include one or more wireless routers, one or more switches, etc.), a peer-to-peer network (*e.g.*, a Bluetooth® network), a cellular network (*e.g.*, a 3G network, a 4G network, a 5G network, etc., complying with any suitable standard, such as CDMA, GSM, LTE, LTE Advanced, NR, etc.), a wired network, etc. In some embodiments, the communication network 152 can be a local area network (LAN), a wide area network (WAN), low power wide area network (LPWAN), public network (*e.g.*, the Internet), a private or semi-private network (*e.g.*, a corporate or university intranet), a mesh network topology, a hierarchical network topology, any other suitable type of network, or any suitable combination of networks.

[00101] Communications links shown in FIG. 1 can each be any suitable communications link or combination of communications links, such as wired links, fiber optic links, Wi-Fi links, Bluetooth® links, cellular links, etc. In a preferred embodiment, the communication network 152 is a Bluetooth® network that is compatible with all the components of the volatile material dispenser 100. The communications network systems (not shown) that are used to comprise the communication network 152 can include any suitable hardware, firmware, and/or software for communicating information over the communication network 152 and/or any other suitable communication networks 152. For example, the communication network systems (not shown) can include one or more transceivers, one or more communication chips and/or chip sets, etc. In a more particular example, the communication network systems (not shown) include hardware, firmware and/or software that can be used to establish a Wi-Fi connection, a Bluetooth® connection, a cellular connection, an Ethernet connection, etc.

[00102] In some embodiments, the user may scan a QR code on the side of the refill unit 124 using the user device 148, such as a smart phone. The user device 148 may then send information pertaining to the optimal power output cycles to the dispenser 100 from data stored on the QR code using BLE or a Wi-Fi network. In some embodiments the user device 148 may send information to the dispenser 100 by selecting a volatile material type, or a mood setting, or a room type, or an operating schedule, an operational setpoint, or a fragrance selection from a drop-down list in a software application, or by inputting a numerical in the software application on the user device 148. The information may be sent to the dispenser using BLE or a wi-Fi network. In some embodiments, the user may input information that describes the current geographic location of the device and/or the current atmospheric conditions/weather into the user device 148 (*e.g.*, a mobile phone). The inputted information from the user could then be sent to the controller 104 to be used to determine the optimal power output cycles or the user device 148 may use the information to determine the optimal power output cycles and send the optimal power output cycles to the controller 104.

[00103] Still referring to FIG. 1, the volatile material dispenser 100 is configured to receive information related to the ambient temperature received from the user device 148, which may be a thermostat, a phone, or other user device, and the controller 104 is configured to adjust the power output to the diffuser assembly 120 based on the ambient temperature received from the user device 148. Further, the controller 104 is configured to only apply the ambient temperature from the user device 148 and may not take into account the temperature of the refill unit 124 and/or the temperature of the diffuser assembly 120 when determining and outputting the output power to the diffuser assembly 120. In some embodiments, the temperature detection device 112 is in thermal communication with the refill unit 124 to monitor and communicate a temperature of the volatile material 128 or the wick 136 to the controller 104, similar to the dispensers of U.S. Provisional Patent Application No. 64/435,494, filed December 27, 2022. Further, the volatile material dispenser 100 may include multiple temperature detection devices 112. In some embodiments, the temperature detection devices 112 are each dedicated to monitoring a temperature of a single component, such as, *e.g.*, one temperature detection device being in thermal communication with the diffuser assembly 120 and another temperature detection device being in thermal communication with the refill unit 124. In some embodiments, the refill unit 124 carries a temperature detection device thereon

for removable connection with the controller 104. Accordingly, the refill unit 124 may have a temperature detection device embedded or integrally provided in the wick 136 and a refill electrical contact (not shown) may be positioned for establishing an electrical connection with a dispenser electrical contact (not shown) on the dispenser 100. In some embodiments, the dispenser 100 is removably mounted to a base station (not shown) that has a base station power supply, a controller, a communication unit, a sensor, and an air displacement mechanism. Accordingly, the dispenser 100 is configured to be mounted to the base station (not shown) to establish physical, electrical, and thermal communications therewith.

[00104] Referring to FIG. 4, an example graphical user interface 200 hereafter “GUI,” may send commands from the user device 148 to the dispenser 100. The GUI 200 may be an interactive software application that is downloadable to the user device 148. The GUI 200 includes a plurality of fields including a labeling feature 204, a location feature 208, a power selector 212, an operating mode feature 216, an operating schedule feature 220, a refill dashboard 224, a refill data profile 228, a visual indicator dashboard 232, a visual indicator control 236, an operational profile 240, a messaging or notification feature 244, and an instant boost 248. The plurality of fields may be provided in the form of a plurality of soft buttons, toggle switches, dials, sliders, scrolling pickers, list pickers, drop-down menus, input fields, or the like. The GUI 200 may be editable and/or customizable so that, for example, the instant boost 248 can be relocated to a position between the operation mode 216 and the refill dashboard 224. In some embodiments, a color theme or field type or translucency of the GUI 200 can be selected or adjusted. The example GUI 200 may be presented to the user when the user opens the software application on the user device 148. In some embodiments, the GUI 200 is only accessible after the user device 148 is registered in connection with a purchase of a unit, such as the volatile material dispenser 100 or refill unit 124. In some embodiments, the user device 148 is used to scan an identifier, such as a code or tag, provided on the volatile material dispenser 100 or the refill unit 124, or packaging therefor. After scanning, the user device 148 is directed to a website or digital marketplace or mobile application through which the GUI 200 is accessible, whether by downloading or via a plug-in, or web applet, or API.

[00105] The GUI 200 may allow the user to perform a variety of functions. From the user device 148, the user can turn the dispenser 100 on and off via the power selector 212, which may operate as a toggle switch. The user may name the dispenser 100 via the labeling feature

204, which may be an input field or a drop-down menu or a scrolling picker. The user may input a room type or location of the dispenser 100 via the location feature 208, which may operate as a swipe selector or picker. The user may select an operating mode from the feature 216, which may function as a drop-down menu or scrolling picker. The user may set a start time, stop time, and repeat or reoccurrence frequency value of the dispenser 100 via the operating schedule feature 220, which may include a combination of scrolling pickers, drop-down menus, and input fields. The user can access the refill data profile 228 to call up information about the volatile material 128 of the refill unit 124. The user can access the operating profile 240 to call up information about the specific temperatures and fragrance notes associated with the refill unit 124. The user may adjust the brightness, color, or light sequence of the visual indicator 126 via the visual indicator controls 236. The user can access, read, delete, and send messages or notifications via the messaging feature 244. The GUI 200 offers the option of the instant boost 248. Selecting the instant boost 248 may cause the dispenser 100 to dispense a large volume of the volatile material 128 in response to the command. The instant boost 248 may be selected when the user is overwhelmed by a powerful stench or a large number of pests. The GUI 200 may provide a first visual status indicator (*e.g.*, a spinning wheel) when the user inputs a command. The GUI 200 may then provide a second visual status indicator to communicate that the command is completed.

[00106] The GUI 200 may provide the user an indication of the amount of volatile material 128 remaining in the refill unit 124. The dispenser 100 may calculate the amount of volatile material 128 remaining in the refill unit 124 by tracking a temperature of the diffuser assembly 120 and a duration that the diffuser assembly 120 has heated the volatile material 128. Using the temperature of the diffuser assembly 120 and the duration that the diffuser assembly 120 has heated the volatile material 128, the dispenser 100 can estimate a volume of volatile material emanated from the dispenser 100. The dispenser 100 may then communicate an estimate of the amount of volatile material remaining in the refill unit 124 to the user device 148 in the form of a percentage of the total volatile material remaining, or in the form of a volume unit such as milliliters or fluid ounces that remain within the refill unit 124. The software application may notify the user device 148 when a predetermined amount of the volatile material 128 remains in the refill unit 124. The software application includes the refill

status displayed in association with the refill dashboard 224 that has a button configured to open an online marketplace for the user to purchase additional refills 124.

[00107] The dispenser 100 may be capable of sensing when the user device 148 is wirelessly connected to the dispenser 100. The dispenser 100 is configured to heat the volatile material 128 using the diffuser assembly 120 when the user device 148 is wirelessly connected to the dispenser 100. The dispenser 100 may further be capable of sensing how far the user device 148 is from the dispenser 100. The dispenser 100 may sense that the user device is in a predetermined range or radius and activate the visual indicator 126 or the diffuser assembly 120. For example, the dispenser 100 may be provided with a Bluetooth or BLE beacon that defines the predetermined range or radius in which the user device 148 may be detected to indicate proximity to the dispenser 100. For instance, the user device 148 may be carried by a user while moving about a residence having the dispenser 100 located therein. When the user enters the predetermined range of the dispenser 100, the user device 148 is detected by the sensor and the dispenser 100 recognizes that the user is nearby. In some embodiments, the controller 104 activates the diffuser assembly 120 or the visual indicator 126 in response to a location of the user device 148, such as when the user is proximate to the dispenser 100. Similarly, the dispenser 100 may recognize when the user moves away from the dispenser 100 by the sensor indicating that the user device 148 is no longer within the predetermined range of the dispenser 100. In some embodiments, the controller 104 deactivates the diffuser assembly 120 or visual indicator 126 when in response to a location of the user device 148, such as when the user moves away from the dispenser 100. In some embodiments, the connection of the user device 148 to the dispenser 100 does not trigger the visual indicator 126 or the diffuser assembly 120.

[00108] Referring to FIGS. 5 and 6, the dispenser 100 is configured to release the volatile material 128 at different rates. FIGS. 5 and 6 depict examples of operating profiles 300 and 304, respectively, of the diffuser assembly 120 for a preset mode. The operating profiles 300, 304 include one or more diffuser settings that are used to diffuse the volatile material 128. Referring to FIG. 5, the operating profile 300 of an example pre-set mode is configured to diffuse the volatile material 128 at a first diffuser setting 308 for a first interval or first amount of time 312, such as a first heat setting of the diffuser assembly 120. The operating profile 300 may then be configured to de-energize the diffuser assembly 120 and/or air displacement

mechanism 116 in a second diffuser setting 316, or second heater setting, for a second interval or second amount of time 320. Finally, the operating profile 300 may then be configured to diffuse the volatile material 128 at a third diffuser setting 324 for a third interval or third amount of time 328, such as a third heat setting of the diffuser assembly 120. The operating profile 300 can include temperatures of between about 100°F and about 300°F, or between about 125°F and about 275°F, or between about 150°F and about 250°F, or between about 175°F and about 225°F. Further, the operating profile 300 can include other ranges of parameters to vary the diffusion of the volatile material 128. For instance, where the diffuser assembly 120 utilizes vibration to diffuse the volatile material 128, the operating profile 300 can include variation in frequency, amplitude, a number of orifices, or an orifice size, among other aspects. The intensity setting 316 corresponds to a standby or off cycle, such that the diffuser assembly 120 and/or air displacement mechanism 116, and in some instances the visual indicator 126, are de-energized to conserve power or maintain a setpoint while the controller 104 monitors signals incoming from the communication unit 156 and/or auxiliary input 140. Further, the operating profile 300 can include adjustments to a distance between a distal end of the wick 136 and the diffuser assembly 120.

[00109] As illustrated by the operating profile 300 of FIG. 5 and the operating profile 304, the fragrance characteristics and volatile material characteristics can be enhanced through different durations of operation and/or different frequencies of operation. For example, different frequencies of operation could include the volatile material dispenser 100 operating a duty cycle every 5 minutes or every 15 minutes or every 20 minutes or every 1 hour or every 2 hours or every 4 hours. The dispenser 100 may operate in high, medium, low, and standby duty cycles by activating the diffuser assembly 120, air displacement mechanism 116, and other components more or less frequently over a period of time. For example, the high duty cycle may include activation every 5 minutes, the medium duty cycle may include activation every 15 minutes, the low duty cycle may include activation every 30 minutes, and the standby duty cycle may include activation upon the controller 104 receiving a signal from the user device 148 or the sensor 144. In some embodiments, the fragrance characteristics and volatile material characteristics can be enhanced through an algorithm that varies the temperature of activation in a predetermined fashion and/or through the use of an on/off timer. To accomplish this, the PWM algorithm or PID algorithm may be employed by the controller 104 according to pre-

programmed sequences or settings. Such sequences or settings may be adjustable by a user via the user device 148 and/or a switch on the dispenser 100.

[00110] In some embodiments, the varying of a speed of the air displacement mechanism 116 when a heating element of the diffuser assembly 120 is turned “on” is used to enhance the characteristics of the volatile material 128. In some embodiments, a user is capable of controlling the various parameters discussed above through an app, which allows a user to vary characteristics of the volatile material by choosing different pre-determined operational points that are connected to volatile material characteristics such as a fragrance. In some embodiments, the operational points may be pre-determined or pre-programmed. The duration of the first, second, or third, amount of time 312, 320, 328 may be between about 0 minutes and 120 minutes, or between about 0 minutes and 90 minutes, or between about 0 minutes and 60 minutes, or between about 0 minutes and 30 minutes, or between about 0 minutes and 20 minutes, or between about 0 minutes and 15 minutes, or between about 0 minutes and 10 minutes, or between about 0 minutes and 5 minutes. Though the present example shows a maximum of three intensity settings 308, 316, 324 and three amounts of time 312, 320, 328, the operating profile 300 includes any number of intensity levels and any number of amounts of time.

[00111] Referring to FIG. 6, the operating profile 304 of a preset mode is configured to diffuse the volatile material 128 at the first diffuser setting 308 for the first interval 312, the second diffuser setting 316 for the second interval 320, and the third diffuser setting 324 for the third interval 328, which may differ with regard to temperatures and/or times from the settings and intervals illustrated in FIG. 5. Further, the operating profile 304 may oscillate between the first diffuser setting 308 and third diffuser setting 324 at a fourth diffuser setting 332 for a fourth interval 336. As illustrated in FIG. 6, the controller 104 may adjust the diffuser assembly 120 to ramp up to the fourth diffuser setting 332 with a setpoint band or threshold in which the diffuser assembly 120 may oscillate. The controller 104 can vary the temperature level of the heat assembly 120 to hover around the setpoint heat setting, or the controller varies a distance between the distal end of the wick 136 and the diffuser assembly 120, or a combination thereof. It will be appreciated that the representative magnitudes of the first diffuser setting 308, the second diffuser setting 316, the third diffuser setting 324, and the fourth diffuser setting 332 may be different than shown.

[00112] Referring to FIG. 7, an example method 400 is illustrated for dispensing a volatile material, which includes fewer or more steps than depicted. Further, the following steps may be performed in any order or sequence and may further include pauses or spans of time in between. The following steps may be performed by a single entity, a single device or system, multiple entities, or multiple devices or systems. The method 400 may be performed using a volatile material dispenser, such as the dispenser 100 having the diffuser assembly 120, controller 104, temperature detection device 112, and power supply 108. The method 400 includes a step 404 of receiving a refill unit including a wick, such as the refill unit 124 having the wick 136. In some embodiments, the controller 104 of the dispenser 100 detects the refill unit 124 using the sensor 144 or by receiving a signal from the user device 148 that has detected the refill unit 124. The controller 104 may recognize the refill unit 124 by looking up an operating profile associated with the refill unit 124, which may contain preferred temperatures associated with different fragrance characteristics. Further, the controller 104 of the dispenser 100 may communicate with the user about the recognized refill unit 124 by, *e.g.*, illuminating the visual indicator 126 in a light sequence that cycles through different colors associated with different fragrance characteristics or notes of the refill unit 124.

[00113] The method 400 of FIG. 7 further includes a step 408 of operating the diffuser assembly 120 at a first diffuser setting for a first interval. In some embodiments, the diffuser assembly 120 is energized to the first diffuser setting 308 and the first interval 312. The method includes a step 412 of activating a visual indicator to indicate a first fragrance characteristic and the first diffuser setting. In some embodiments, the visual indicator 126 is activated by the controller 104 to display a color, a brightness intensity, and a light sequence associated with the first fragrance characteristic and the first diffuser setting. In some embodiments, the visual indicator 126 is activated by the controller 104 to display a color associated with the first fragrance characteristic and a brightness intensity that corresponds with the first diffuser setting. The method 400 includes a step 416 of operating the diffuser assembly 120 at a second diffuser setting for a second interval. In some embodiments, the diffuser assembly 120 is operated at the second diffuser setting 316 for the second interval 320. In some embodiments, the diffuser assembly 120 is operated at the third diffuser setting 328 for the third interval 328. The method 400 includes a step 420 of activating the visual indicator to indicate the second diffuser setting. In some embodiments, the visual indicator 126 is activated by the controller

104 to display a color, a brightness intensity, and a light sequence associated with the second diffuser setting. In some embodiments, the visual indicator 126 is activated by the controller 104 to display a color associated with the second fragrance characteristic and a brightness intensity that corresponds with the second diffuser setting.

[00114] It will be appreciated that the first diffuser setting and second diffuser setting referenced in the method 400 may correspond to any of the first diffuser setting 308, the second diffuser setting 316, the third diffuser setting 324, and the fourth diffuser setting 332. Similarly, it will be appreciated that the first interval and the second interval of the method 400 may correspond to any of the first interval 312, the second interval 320, the third interval 328, and the fourth interval 336. Further, the visual indicator 126 may be adjusted to indicate any of the first diffuser setting 308, the second diffuser setting 316, the third diffuser setting 324, or the fourth diffuser setting 332.

[00115] It is within the scope of the present disclosure for the first diffuser setting of the method 400 to correspond to a characteristic of the volatile material 128 of the refill unit 124, such as a first fragrance note. Additionally, the second diffuser setting of the method 400 can correspond to another characteristic of the volatile material 128 of the refill unit 124, such as a second fragrance note. The first and second fragrance notes may be different from one another. For example, the first fragrance note having a “vanilla” scent and the second fragrance note having a “lavender” scent.

[00116] Adjusting the visual indicator 126 may include changing one characteristic of the visual indicator 126, such as displaying a soft white color to indicate the first diffuser setting and displaying a purple color to indicate the second diffuser setting, while the brightness intensity and light sequence remain unchanged. Adjusting the visual indicator 126 to indicate different diffuser settings may include changing more than one characteristic of the visual indicator 126, such as displaying a different light sequence and colors, or different brightness intensities and colors, or different brightness intensities and light sequences, or adjusting all three characteristics. The controller 104 may automatically adjust the diffuser assembly 120, the air displacement mechanism 116, and the visual indicator 126 in accordance with pre-set programs or settings stored in memory or retrieved from a remote database, without relying on manual activation or adjustment by the user.

[00117] The first and second diffuser settings may differ from one another with respect to various operation parameters, such as a temperature level, a power level of the air displacement mechanism 116 or the diffuser assembly 120, or a heater arrangement. In some embodiments, the heater arrangement includes a position of the wick 136 relative to the diffuser assembly 120. The first interval and the second interval may differ from another, such that the first interval is greater than the second interval, or such that the second interval is greater than the first interval. In some embodiments, the first and second intervals are about equal to or the same as one another. The method 400 may include any number of intervals, such as, three, four, five, six, seven, eight, nine, ten, or even eleven intervals, or twenty intervals, or more. In some embodiments, the first and second intervals correspond to morning, *i.e.*, A.M., and evening, *i.e.*, P.M., times of day. In some embodiments, the intervals define a ratio relative to one another, such as 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, or 10:1, or more. In some embodiments, the intervals are determined based on the type of algorithm used or executed by the controller 104 of the dispenser 100, which may be a PWM algorithm or a PID algorithm. In some embodiments, the intervals may be fractions of a second. In other instances, the intervals may endure for multiple minutes or multiple hours. The PWM algorithm or PID algorithm may be used to adjust the diffuser assembly 120 and/or air displacement mechanism 116 to different settings or duty cycles.

[00118] In some embodiments of the method 400, the second diffuser setting occurs after the first interval has completed. In some embodiments of the method 400, the second diffuser setting occurs prior to completion of the first interval. For example, the diffuser assembly 120 may operate the diffuser assembly 120 at the first diffuser setting and, at some point during the first interval, the user device 148 may be detected by the sensor within the predetermined range of the dispenser 100 and the controller 104, in response, may interrupt the first interval by adjusting the diffuser assembly 120 to the second diffuser setting. Likewise, the controller 104 may receive a signal from the user device 148 indicating a time of day, an ambient temperature, an ambient humidity, a room use or type, a room size, or a weather condition, or combinations thereof, and the controller 104 may, in response, adjust the diffuser assembly 120 among the heater settings before or after completion of the intervals. For instance, the controller 104 may receive a signal from the user device 148 indicating that the weather will change to rain at 1:00 P.M. and, in response, the controller 104 may wait until that time to adjust the diffuser assembly

120 from one diffuser setting to another diffuser setting to provide a “fresh rain” scent to amplify the user experience. For example, the controller 104 may extend operation of the first diffuser setting beyond the first interval or repeat the first interval until reaching the scheduled time (*e.g.*, 1:00 P.M.) before adjusting the diffuser assembly 120 from one diffuser setting to another diffuser setting.

[00119] FIG. 8 depicts a schematic representation of the refill unit 124 of the present disclosure. As disclosed herein, the refill unit 124 is configured to be received by the dispenser 100 and includes the wick 136, the volatile material 128, and the container 132. Additionally, wick 136 has a distal end 440 and defines an outer diameter 444 for arrangement in relation to the diffuser assembly 120 for effectuating different rates of emission or volatilization of the volatile material 128. To that end, the diffuser assembly 120 can include a tapered or narrowing channel in which the wick 136 is received to define a distance or radial gap 446 therebetween. This distance 446 may be selectively modulated (*e.g.*, increased or decreased) by movement of the refill unit 124 and the diffuser assembly 120 relative to one another, as described in U.S. Patent No. 11,554,191, filed on January 15, 2020, which is herein incorporate by reference in its entirety.

[00120] Further, the refill unit 124 may include a tag 448 and/or a code 452 thereon, such as on the container 132. In addition, the refill unit 124 may carry a refill temperature sensor 456 embedded in the wick 136 or applied thereto. The refill temperature sensor 456 is configured to measure a temperature of the wick 136. It will be appreciated that the temperature detection device 112 of FIG. 1 can include a plurality of sensors, one of which can be the refill temperature sensor 456 and another of which can be located in a housing (not shown) of the dispenser 100. In some embodiments, the refill temperature sensor 456 is a NTC thermistor. In some embodiments, the refill temperature sensor 456 is a PTC thermistor. In some embodiments, the refill temperature sensor 456 is a thermocouple or any similar temperature measuring mechanisms. The refill unit 124 may include an electrical contact 460 for connection with a corresponding terminal or contact (not shown) of the dispenser 100, thereby providing communication between the controller 104 and the refill temperature sensor 456.

[00121] In some embodiments, the refill unit 124 is configured for single-use, such that the container 132 is sealed by connection with a cap 464 that has an anti-tamper feature 468. In some embodiments, the anti-tamper feature 468 prevents physical tampering or indicates when physical tampering of the refill unit 124 has occurred. For example, the anti-tamper feature 468 may have a frangible piece that must be broken to access or tamper with the contents, *i.e.*, the volatile material 128, of the refill unit 124. In some embodiments, the anti-tamper feature 468 includes a digital component that communicates to the controller 104 any occurrence or condition associated with unauthorized tampering. For example, as schematically depicted in FIG. 8, the frangible piece may include a lead that forms an electrical connection between the electrical contact 460 and the refill temperature sensor 456, such that tampering causes displacement or removal of the lead and, in turn, the refill temperature sensor 456 becomes disconnected from the electrical contact 460. Upon installation within the dispenser 100, the controller 104 may detect the absence of the expected input from the refill temperature sensor 456, thereby indicating to the controller 104 and, ultimately, the user that tampering has occurred. Similarly, the anti-tamper feature 468 may serve as an authentication feature for exclusivity with the dispensers 100 of particular models or brands. Such exclusivity may additionally or alternatively be provided by the code 452 or tag 448, such that the controller 104 will prevent activation of the diffuser assembly 120 if an authorized identifier or key is not detected by the sensor 144 of the dispenser 100.

[00122] In some embodiments, the refill unit 124 is configured to be re-used or refilled by the user. To that end, the cap 464 and container 132 may be separable so that the user can refill or replenish the volatile material 128. Further, the container 132 may include a recommended fill line 472 or other indicia to assist a user in refilling the container 132. In addition, the refill unit 124 may include a content selector 476 that is capable of being manually adjusted by the user based on a mixture or composition placed into the container 132. For instance, some users desire natural, organic compositions or mixtures that can be formulated by a ratio of water (*e.g.*, distilled water) and natural concentrates (*e.g.*, essential oils). The user may refill the container 132 with the mixture of natural ingredients including a “lavender” essential oil and distilled water. The user may adjust the content selector 476 to a position corresponding with the “lavender” scent. When the refill unit 124 is received by the dispenser 100, the controller 104 may detect the position of the content selector 476 and automatically operate the diffuser

assembly 120 and the air displacement mechanism 116 in accordance with preferred or optimal operating profiles, such as certain temperature levels, based on the position of the content selector 476 of the refill unit 124. The content selector 476 may be provided in the form of a variable switch for electrical communication with the electrical contact 460. The content selector 476 may be provided with differently colored panels corresponding to different fragrance notes, and the dispenser 100 may be configured to detect the selected color by way of the sensor 144, such as an optical sensor. The controller 104 may include memory and a processor for accessing a lookup table of pre-set operating profiles or modes corresponding to each position of the content selector 476. In this way, the dispenser 100 and refill unit 124 are configured to reduce waste associated with the disposal of single-use refill units while also offering the user greater control over the contents to be dispensed, which may benefit users desiring or prioritizing a lifestyle that is “chemical free,” “natural,” or “organic.” In some embodiments, the content selector 476 is provided on the GUI 200 as a soft button or picker or drop-down menu, such that the contents or mixture placed into the refill unit 124 can be communicated to the controller 104 through the GUI 200 operated on the user device 148.

[00123] Further, the controller 104 can detect information about the refill unit 124 and communicate such information to the user. In some embodiments, the sensor 144 of the dispenser 100 allows the controller 104 to detect the tag 448 or code 452 on the refill unit 124. The tag 448 or code 452 may include a refill unit identifier (RUI) that is associated with values in a lookup table stored in memory of the controller 104. In some embodiments, the controller 104 accesses a remote database or server using the communication network to retrieve information associated with the refill unit 124. In some embodiments, the notification includes the refill status and an interactive menu, which may be similar to the GUI 200. The menu may include a plurality of options, such as a start option, a schedule option, and a link (*e.g.*, a URL). In some embodiments, the refill data profile is embedded within the tag 448 or code 452 of the refill unit 124. In some embodiments, the tag 448 or code 452 of the refill unit 124 includes a refill unit identifier (RUI) and a pointer (*e.g.*, a URL) to direct the user device 148 or controller 104 to retrieve the refill data profile via the communication network 152. In some embodiments, the link directs the user device 148 or controller 104 to a website or splash screen or other media, such as, a video or photo or music playlist.

[00124] As an example, the refill unit 124 may be associated with a refill data profile including various characteristics, such as a content composition, quantity, fragrance notes, preferred operating temperatures, content volume, estimated duration of use, expiration date, recycled materials, and sourcing information, among other aspects. In some embodiments, the refill data profile includes scores or ratings based on one or more of the characteristics. For example, the refill data profile may include a Purity Score that is based on details of the composition of the volatile material 128. The more natural and/or organic materials making up the composition of the volatile material 128, the greater the Purity Score. The Purity Score may be any numerical range or alphanumerical grading, or emoji scale. The refill data profile may include a Sustainability Score based on the composition of the volatile material 128, preferred operating temperatures, recycled materials, and sourcing. The Sustainability Score may be any numerical range or alphanumerical grading, or emoji scale. The Purity Score and Sustainability Score may be displayed on the GUI 200 of the user device 148, or communicated through the messaging feature 244 upon detection of the refill unit 124 by the dispenser 100. In some embodiments, the Purity Score and Sustainability Score are printed or applied to the refill unit 124, such as on the container 132. The refill data profile may include a Mood Enhancer in the form of a soft button on the GUI 200 based on the fragrance notes and operating temperatures. For instance, the fragrance note of “lavender” may correspond to a relaxing or calming mood that can be enhanced by selection of the Mood Enhancer, which links to a music playlist of relaxing, calming sounds accessed by the user device 148. The music playlist may be pre-determined or configured so as to be generic across refill units 124 containing the same fragrance notes. In some embodiments, the music playlist is streamed or downloaded from a third-party site, such as by interfacing with a mobile application or web application (*e.g.*, Pandora® or Spotify®) via an API and the user device 148. Further, the Mood Enhancer may include pre-set controls for the visual indicator 126 of the dispenser 100, such as calming or relaxing colors, brightness intensities, or light sequences.

[00125] FIG. 9 depicts an example residential floor plan 500 having a plurality of units or nodes 504 that each represent a connected volatile material dispenser (*e.g.*, the dispenser 100) so as to form a volatile material delivery system. In the illustrated embodiment, the nodes 504 may be located near entryways, in bedrooms, in a bathroom, in a kitchen, in a pantry, along a stairway, or even outside on a patio. The nodes 504 may vary from one another with regard to

a power configuration of each dispenser 100. For instance, several of the nodes 504 may be dispensers 100 with power supplies 108 that are plugged into an electrical outlet provided on a wall, while others of the nodes 504 may be dispensers 100 with power supplies 108 that are battery powered. The nodes 504 may be wirelessly connected to one another via the communication network 152, which may be generated or maintained by network equipment 508, such as a modem and/or router.

[00126] The nodes 504 can be connected to one another via a mesh network topology, such that there are no hierarchical relationships among the nodes 504. The communication network 152 may comprise a Bluetooth®, Low Power Wide Area Network (LPWAN), or Zigbee® or IEEE 802.11 interface to provide the mesh network topology. In some embodiments, the nodes 504 are arranged in a hierarchical network topology, such that one of the nodes 504 is primary and others of the nodes 504 are secondary. In some embodiments, there are multiple primary nodes 504 each having a grouping or chain of secondary nodes 504. A hierarchical network topology may also include a switching device, such as the network equipment 508, as the primary node. It is further contemplated that the network 152 may have a different topology, such as a ring topology or a tree topology or a star topology or a line topology or a bus topology. The network equipment 508 may further include repeaters, extenders, and any other components required to provide the network stack and layering required for connectivity and interoperability of the nodes 504.

[00127] The nodes 504 may communicate with one another via the communication network 152 to share status information, operating information, environment information, error information, or the like. For example, when one node 504 fails or the associated refill unit 124 runs out of volatile material 128, a signal may be sent to surrounding nodes 504 to adjust operational settings, such as by increasing the surrounding intensity of diffuser settings or switching any nodes 504 running in a low duty cycle to a higher duty cycle. Further, a message may be delivered to the user via user device 148 to alert of the empty or failed node 504. In some embodiments, the message is delivered via a push notification, an email, a text, or a message within the messaging feature 24 of the GUI 200.

[00128] Further, the nodes 504 may be controlled individually via the user device 148, which is depicted as a smartphone for illustrative purposes. For instance, the user device 148

may display the GUI 200 through which the user can select among one of the nodes 504 to adjust the operating mode, or to adjust the visual indicator 126, or to view the refill status, or to access the Mood Enhancer or instant boost. In this way, the user device 148 and nodes 504 can allow each bedroom to have a unique fragrance. Further, the user device 148 can provoke occupant behavior by selectively controlling the nodes 504. In one example, the user device 148 may select a “mint” fragrance to evoke energetic behavior in the office during typical work hours. The node 504 in the office may then be adjusted to a “lavender” fragrance that evokes calm, relaxing behavior, which may be particularly useful in the evening hours. In addition, the nodes 504 can be grouped into zones and controlled collectively. For example, the nodes 504 in the entry, living room, dining space, and kitchen may be grouped together as an open zone, such that operating settings may be grouped or linked to one another for enhanced user experiences. This may involve each of the nodes 504 in the open zone dispensing complementary or identical fragrances for providing a cohesive experience in areas of the floor plan 500 frequented by guests. In this way, the nodes 504 may be configured for multi-unit operational settings. In some embodiments, the multi-unit operational setting includes one node 504 in the group or zone operating at a different heater setting or power level than another node 504 in the group or zone. In some embodiments, the multi-unit operational setting includes each node 504 in the group or zone operating at the same heater setting or power level. In some embodiments, the user device 148 is configured to select a multi-unit operation setting that includes operation parameters for at least two nodes 504 that are located in different rooms relative to one another. It is also contemplated that there may be one-unit zones, such as the node 504 on the patio. In some embodiments, the node 504 in the patio zone may be located on furniture, such as a table, and provided with insect repellant that may be modulated by the user device 148 to deter insects, which tend to vary seasonally and relative to dusk and dawn hours.

[00129] According to embodiments of the present disclosure, the nodes 504 may be adjusted based upon a geo-location of the user device 148. In some embodiments, the nodes 504 are operating in an “away” mode to conserve energy while no occupants are present. This may occur when the geo-location of the user device 148 is detected as being outside of or beyond a predetermined radius. The predetermined radius may be set by the user via the GUI 200 and user device 148. In some embodiments, the predetermined radius may be based on a property

address, such as a residential address. In some embodiments, the predetermined radius may be based on location coordinates that are automatically detected through the user device 148. When the user device 148 enters within the predetermined radius, the nodes 504 may be adjusted to a “home” setting, which may include adjusting one or more of the nodes 504 to a higher duty cycle. In some embodiments, when the user device 148 enters the predetermined range, a prompt or notification is delivered to the user device 148 through which the user can select from among a plurality of options (*e.g.*, pre-set modes, fragrances, power settings, etc.). It is further contemplated that each of the nodes 504 may include a local predetermined range or radius for detecting the location of the user device 148 within a residence or space. For instance, when the user device 148 enters the bathroom, the node 504 in the bathroom may detect the user device 148 in its predetermined range and adjust to a higher duty cycle or a different fragrance note. In some embodiments, the node 504 in the bathroom may adjust again to a higher duty cycle after the user device 148 exits the predetermined range in bathroom. To conserve energy, at least one of the nodes 504 outside of the bathroom may temporarily adjust to a lower duty cycle, thereby preventing spikes in energy consumption.

[00130] FIG. 10 depicts an example method 600 for a recognition sequence of a volatile material dispenser (*e.g.*, dispenser 100) and a refill unit (*e.g.*, the refill unit 124), which includes fewer or more steps than depicted. Further, the following steps may be performed in any order or sequence and may further include pauses or spans of time in between. The following steps may be performed by a single entity, a single device or system, multiple entities, or multiple devices or systems. The method 600 includes a step 604 of receiving the refill unit. In some embodiments, the refill unit includes the refill unit 124 having the wick 136 and volatile material 128 having multiple fragrance notes associated with various temperature levels. The method 600 includes a step 608 of activating a visual indicator to indicate the dispenser is attempting to detect the refill unit. In some embodiments, the visual indicator is the visual indicator 126 provided on the dispenser 100. In some embodiments, the visual indicator is provided separately from the dispenser 100, such as part of or on the user device 148. In some embodiments, the visual indicator 126 displays a single color (*e.g.*, blue) in a blinking light sequence. In some embodiments, the visual indicator 126 varies one or more of the light sequence, brightness intensity, or color, or a combination thereof.

[00131] The method 600 includes a step 612 of detecting the refill unit identifier (RUI) of the refill unit. In some embodiments, the refill unit includes the code 452 or tag 448. In some embodiments, the tag 448 is a NFC chip, a RFID chip, or any short range wireless communication device. In some embodiments, the code 452 is a barcode, a QR code, or any computer-readable code. The method 600 includes a step 616 of searching a local database stored in memory to identify the data associated with the RUI of the refill unit. The local database may be any memory storage provided with the controller 104 of the dispenser 100. In some embodiments, the local database is removable from the dispenser 100, such as, *e.g.*, a flash drive or SIM card. The controller 104 may compare the RUI with stored information in a lookup table of the local database.

[00132] If the RUI is not found in the local database, the method 600 may proceed to a step 620 of searching a remote database for data associated with the RUI. In some embodiments, the controller 104 is in connection with the communication network 152 via the communication unit 156 to access information stored in a remote database. The controller 104 can compare the RUI with information stored in the remote database, such as in a lookup table of the remote database. If the RUI is found in either of the local database in step 616 or the remote database in step 620 the method 600 may proceed to a step 624 of activating the visual indicator to perform a recognition light sequence to indicate the dispenser has successfully recognized the refill unit. In some embodiments, the controller 104 retrieves information associated with the refill unit identifier from the remote database via the communication network 152 and stores or writes information to the local memory or database. In some embodiments, the visual indicator 126 displays a single color (*e.g.*, green) in a blinking light sequence. In some embodiments, the visual indicator 126 varies one or more of the light sequence, brightness intensity, or color, or a combination thereof, in the recognition light sequence in a manner recognizable to a user as indicating successful operation. For example, a user may associate a successful operation with a light sequence involving a quickly blinking green light at high intensity, alternating two or more blinking lights of a green, white, or blue color, or gradually increasing and decreasing the intensity of one or more lights displaying a green, white or blue color.

[00133] The method 600 further includes a step 628 of activating the visual indicator to indicate the dispenser is operating in a smart mode, such that pre-set modes or operational

profiles may be used by the controller 104 to operate the diffuser assembly 120 and air displacement mechanism 116 to emit the volatile material 128 from the dispenser 100. If the RUI is not found in the local database in step 616 and the remote database in step 620 the method 600 may proceed to a step 632 of activating the visual indicator to perform an error light sequence indicate the dispenser does not recognize the refill unit. In some embodiments, the visual indicator 126 displays a single color (*e.g.*, red) in a solid, steady light sequence. In some embodiments, the visual indicator 126 varies one or more of the light sequence, brightness intensity, or color, or combinations thereof in the error light sequence in a manner recognizable to a user as indicating an error, such as, *e.g.*, a quickly blinking red light at high intensity, alternating two or more blinking lights of a yellow or red color, or gradually increasing and decreasing the intensity of one or more lights displaying a red or yellow color. In some embodiments, an unrecognized refill unit may actually be identified as an unauthorized refill unit that is incompatible for use with the dispenser 100 and, as a result, the controller 104 may prevent operation of the diffuser assembly 120 with the unauthorized refill unit. In some embodiments, the unauthorized refill unit is associated with a list of identifiers that are categorized and stored in memory (*e.g.*, locally in a lookup table or remotely) as being unauthorized, which may be compiled and pre-determined based on competitor refill units, counterfeit or imitation refill units, or obsolete refill units. In some embodiments, an unrecognized refill unit may still be operable with the dispenser 100 in a manual or “dumb” mode, which requires manual adjustment and activation of the dispenser 100 by the user.

[00134] The visual indicator 126 of the dispenser 100 may be activated and/or adjusted in response to various conditions. In some embodiments, the visual indicator 126 is activated to a brightness intensity that corresponds to a magnitude of power draw of the diffuser assembly 120 or the air displacement mechanism 116 or a sum total power draw of the dispenser 100. For example, as the power drawn by the diffuser assembly 120 increases, the visual indicator 126 may proportionally increase in brightness intensity to indicate the increasing heat intensity and/or energy transfer rate of the volatile material 128. In some embodiments, the visual indicator 126 may be activated to indicate a lack of power incoming from the power supply 108. In this instance, the visual indicator 126 may be operably coupled to a power storage device (*e.g.*, a battery or capacitor) to temporarily provide power to the visual indicator 126. In some embodiments, the visual indicator 126 is activated to indicate a low power or low duty

cycle by decreasing the brightness intensity (*e.g.*, dimming). In some embodiments, the visual indicator 126 is activated in response to incoming information received from the user device 148 or the communication network 152. For example, the user device 148 may send information about a user's selection of room type or operational profile or scheduling, each of which may initiate the visual indicator 126 to display a confirmation sequence. The confirmation sequence may include blinking temporarily, or at different speeds, or at different brightness intensities, or in different colors. In some embodiments, the visual indicator 126 is activated in response to the particular fragrance characteristics (*e.g.*, a fragrance note) being emitted by the dispenser 100. For instance, the visual indicator 126 may display a warm red color that corresponds to a "cinnamon" fragrance note or a festive mood, a bright orange color that corresponds to an "orange" fragrance note or a happy mood, and a soft purple color that corresponds to a "lavender" fragrance note or a relaxing mood. In this way, the visual indicator 126 can accentuate or enhance the fragrance notes in the surrounding environment (*e.g.*, a room or space). Similarly, the negative effects of displaying a color that conflicts with or counteracts a fragrance note are avoided by enabling the visual indicator 126 to display colors appropriate to the dispensed fragrance notes. It is also contemplated that the visual indicator 126 may include a spectrum or array of colors for blends of fragrance notes.

[00135] FIG. 11 illustrates an example method 700 of operating a volatile material dispenser (*e.g.*, dispenser 100) and a refill unit (*e.g.*, the refill unit 124), which includes fewer or more steps than depicted. Further, the following steps may be performed in any order or sequence and may further include pauses or spans of time in between. The following steps may be performed by a single entity, a single device or system, multiple entities, or multiple devices or systems. The method 700 includes a step 704 of detecting a refill unit identifier of a refill unit. In some embodiments, refill unit identifier (RUI) may be detected by the user device 148, such as by scanning or reading the code 452 or tag 448 provided with the refill unit 124. In some embodiments, the dispenser 100 detects the RUI by scanning or reading the code 452 or tag 448 of the refill unit 124.

[00136] The method 700 includes a step 708 of sending to a user a notification or prompt including information associated with the refill unit 124 or dispenser 100. In some embodiments, the notification or prompt is delivered to the user device 148 via a text message, a push notification, an email, or a mobile application having a messaging feature, such as the

feature 244 of the GUI 200. In some embodiments, the notification or prompt is delivered to the user audibly by a speaker, such as through a device running Google® Home or Amazon® Alexa®. In some embodiments, the notification includes the refill data profile associated with the refill unit 124. In some embodiments, the notification includes an interactive menu with the operational profiles associated with the refill unit 124 and the dispenser 100, such as a start option, a schedule option, a fragrance selection, and a link (*e.g.*, URL) to a web application or mobile application. In some embodiments, the link is associated with a third-party website or third-party mobile application, such as the Spotify® web player or mobile application. In some embodiments, the notification directs the user to download or access the GUI 200. The GUI 200 may include several blank input fields, such as fields for completing the scheduling feature 220 or visual indicator controls 236. In some embodiments, the notification includes the Purity Score, or the Sustainability Score, or a link (*e.g.*, URL) to an online marketplace where other compatible refill units may be purchased.

[00137] The method 700 further includes a step 712 of receiving a selection from the user based on the notification or prompt. Further, the method 700 includes a step 716 of performing at least one function in response to the user selection. In some embodiments, the selection triggers a pre-set mode or sequence, such as the operational profiles 300, 304. In some embodiments, the selection is a multi-unit operational setting, as discussed in connection with the nodes 504 of FIG. 9. In some embodiments, the selection is directed to one single node 504. In some embodiments, the selection initiates or adjusts a characteristic of the visual indicator 126 of the dispenser 100. In some embodiments, the selection initiates or adjusts a characteristic of the air displacement mechanism 116 or diffuser assembly 120. In some embodiments, the selection causes one dispenser 100 or node 504 to communicate with another dispenser 100 or node 504.

[00138] Volatile material dispensers 100 or nodes 504 may be controlled to account for interactions between fragrance profiles or characteristics to produce a desired flow or combination, such as between adjacent dispensers 100 or nodes 504 or among units situated in pre-determined zones or pathways. With reference to FIG. 12, a method 800 of achieving a fragrance flow includes a step 804 of receiving user input to indicate a selection of dispensers or nodes, such as the dispensers 100 and nodes 504, which may be referred to collectively as “units” for brevity. The user input may be received via the GUI 200 displayed on the user

device 148. In some embodiments, a map graphic is displayed on the user device 148 so a user can input, e.g., swipe, touch, type, click, scroll, or otherwise indicate, a region, a zone, or a plurality of units selected for the flow combination. For instance, and with reference to the floor plane 500 of FIG. 9, a user may indicate a flow by swiping from the entry to the kitchen, which indicates a selection of nodes 504 in the entry, the dining space, and the kitchen. The user device 148 may display a prompt or notification where certain units may be optionally added or removed from the flow, such as, *e.g.*, requesting the user to verify whether or not to include the node 504 in the living room in the flow.

[00139] A step 808 includes receiving user input to indicate characteristics of the flow formed by interaction between or among the selected units. In doing so, the user may be presented with control graphics, such as a slider bar, a drop-down menu, or a multi-hue color wheel that allows the user to select from among a plurality of optional fragrance characteristics or profiles for the flow to provide. The user may select from pre-programmed flow operations, such as those saved as part of the user's history of use, pre-set by the manufacturer, or recommended based on flows having similar criteria as sourced from a remote database. For instance, the user may be presented with a graphic that shows the entry unit has a "jasmine" fragrance, the dining space has a "lavender" fragrance, and the kitchen has a "cinnamon" fragrance, and the user may choose to increase the intensity of the kitchen unit's fragrance and decrease the intensity of the other units to allow the "cinnamon" fragrance to welcome a visitor at the entry. Similarly, the mixture or combination of fragrances can be performed to create custom or unique fragrance characteristics. Such combinations may be selected to complement one another, such that the "cinnamon" fragrance and the "lavender" fragrance may be combined at various intensities and times to achieve a unique fragrance in both areas or a gradient of fragrances therealong. Further, combination of fragrances can also prevent fragrance habituation, such that the user may select a flow that oscillates the intensity settings of the units throughout a time period to create varying fragrance characteristics

[00140] A step 812 includes operating the units in the flow in accordance with the user input of the flow characteristics. In some examples, the units may achieve the flow characteristics by regulating "on" and "off" time intervals, such that units output fragrance for certain times in relation to one another to maintain the desired fragrance characteristics of the flow. In some examples, the units achieve the flow characteristics by operating the diffuser assembly 120 at

varying power levels, temperatures, frequencies, or relative distances from the wick 136, among other variables. An example flow operation may include operating a first unit to emit a first fragrance characteristic and operating a second unit to emit a second fragrance characteristic for a first time period, de-activating the first and second units for a second timer period, operating the first unit to emit the first fragrance characteristic for a third time period, de-activating the first unit for a fourth time period, and operating the second unit to emit the second fragrance characteristic for a fifth time period. In some examples, the first time period is 3 seconds, the second time period is 10 seconds, the third time period is 6 seconds, the fourth time period is 10 seconds, and the fifth time period is 6 seconds. In some examples, the first fragrance characteristics and the second fragrance characteristics are different from one another, such as, *e.g.*, the first fragrance characteristic is “cinnamon” and the second fragrance characteristic is “jasmine.” In some examples, the first, second, third, fourth, or fifth time periods are shortened or extended to achieve the desired fragrance profile or flow operation. In some examples, the flow operation is repeated over the course of a flow duration to correspond, *e.g.*, with an event, a time of day, an auxiliary input, or the like. In some examples, the units consider ambient conditions, such as changes in ambient temperature or humidity, the detection of a human voice, the detection of artificial or natural light, a time of day, or a signal from the user device 148.

[00141] It will be appreciated that the visual indicator 126 of each unit may also be controlled as part of the flow in method 800. The visual indicator 126 may be adjusted based on the intensity settings of the units, thereby enhancing the experience provided by the flow. In some embodiments, the visual indicator 126 alone is adjusted in accordance with a dedicated flow independent of the intensity settings.

[00142] Regarding the user inputs for selecting the flow, a slider bar may be presented for each of the units in the flow to control the individual intensity in context of the other selected units. In another instance, a graphic symbol may be movable along an X-Y plot where, *e.g.*, the X axis represents a value of intensity or diffusion and the Y axis represents a relative location between a start and end of the flow. This way, the user can control the intensity at one point or along multiple points of the flow by positioning the graphic symbol, or multiple symbols, along the X-Y axes. A line formed by a regression model or polynomial, exponential, or logarithmic function may be manipulated by the location of the graphic symbol, such that

the user's selection influences the intensity setting of all of the units in the flow in accordance with the preferred averaging or normalizing function.

[00143] It will be appreciated that the methods described herein may be implemented by volatile material dispensers 100 or nodes 504 using piezoelectric elements that emit fragrances through electromechanical vibration, with or without the application of heat. For instance, the diffuser assembly 120 may be regulated by the controller 104 in accordance with a pre-programmed sequence or algorithm for preventing fragrance habituation, emitting or enhancing fragrance characteristics, or achieving output intensities with or without consideration of ambient characteristics, *e.g.*, temperature, humidity, human presence, etc.

[00144] FIG. 13 illustrates an example diffuser assembly 850 that includes a piezoelectric element 854 in the form of a plate that is in communication with a controller 858. In the illustrated embodiment, the element 854 is depicted as a planar plate, but it will be appreciated that the element 854 may be dome-shaped or curved. The element 854 is arranged to be adjacent a dual refill unit 862 having a first wick 866A in communication with a first volatile material 870A and a second wick 866B in communication with a second volatile material 870B. A divider 872 separates the first volatile material 870A from the second volatile material 870B. The dual refill unit 862 is held in place by tabs 874, or any suitable structure for retaining the dual refill unit 862 in position relative to the element 854. In the illustrated embodiment, the first wick 866A and the second wick 866B extend from the dual refill unit 862 into contact with an absorbent media 876, which can be interposed between the element 854 and the first and second wicks 866A, 866B to form an indirect configuration. In some embodiments, the first and second wicks 866A, 866B are in direct contact with the element 854, without the use of the absorbent media 876. The first volatile material 870A may have different fragrance characteristics from the second volatile material 870B.

[00145] The element 854 can be activated by the controller 858 to execute a pre-programmed operation, or by manual user input, to emit desired fragrance characteristics from at least one of the first wick 866A or the second wick 866B. Further, operation of the element 854 can be controlled in accordance with certain parameters or diffuser settings. For example, the element 854 can be controlled to operate in different operation profiles or diffuser settings,

such as those described above. Further, the piezoelectric element 854 may be adjusted among high, medium, or low intensity settings.

[00146] FIG. 14 illustrates an example of the element 854 that may be used with the diffuser assembly 850. The element 854 includes a plurality of orifices 880 that extend through a thickness thereof to receive the volatile material 870A, 870B from the wick 866A, 866B for diffusion. Diffusion characteristics are influenced by the arrangement of the plurality of orifices 880 of the element 854, as the element 854 is displaced or vibrated to cause diffusion of the volatile material 870A, 870B from the orifices 880 into the surrounding environment. The plurality of orifices 880 may vary in size, *e.g.*, diameter or thickness, relative to one another. The plurality orifices 880 may vary in shape, *e.g.*, circular, elliptical, polygonal, square, triangle, rectangle, or irregular shape, relative to one another. The plurality of orifices 880 may vary in spacing relative to one another, such that a number of orifices per unit area, *e.g.*, 10 orifices per square millimeter, may vary along the element 854. The plurality of orifices 880 may be arranged in a pattern or array, such as an ordered pattern or a non-ordered pattern. A midplane MP intersects a center point CP of the element 854 to form a first zone 884 and a second zone 888. When the element 854 is arranged adjacent the dual refill unit 862, the divider 872 may be aligned to be collinear with the center point CP of the element 854, as illustrated in FIG. 13. The first and second zones 884, 888 may have equivalent surface areas. The first and second zones 884, 888 may have different surface areas. The plurality of orifices 880 in the first zone 884 may be arranged differently than in the second zone 888. Further, a thickness (not shown) of the element 854 may vary to correspond with variations in thickness of the plurality of orifices 880.

[00147] During operation, the first wick 866A can be selectively positioned to provide communication of the first volatile material 870A with the plurality of orifices 880 in the first zone 884, which may be associated with a “low” diffusion setting. Similarly, the second wick 866B can be selectively positioned to provide communication of the second volatile material 870B with the plurality of orifices 880 in the second zone 888, which may be associated with a “high” diffusion setting. In this way, a fragrance profile emitted by the diffuser assembly 850 can be regulated to accentuate the fragrance characteristics of the second volatile material 870B in relation to the fragrance characteristics of the first volatile material 870A. Further, the controller 858 can vary the frequency at which the element 854 vibrates to further adjust the

diffusion settings for greater or lower intensity. In addition, the controller 858 can selectively activate and de-activate the element 854 to produce the desired fragrance profile.

[00148] In some embodiments, the dual refill unit 862 can be rotated so that the first wick 866A communicates with the second zone 888 and the second wick 866B communicates with the first zone 884, such that the fragrance characteristics of the first volatile material 870A are accentuated relative to the fragrance characteristics of the second volatile material 870B. To that end, the dual refill unit 862 can be rotated manually, such as with a lever or dial (not shown) that protrude through a housing (not shown) of the dispenser 100. In some instances, the dual refill unit 862 is retained by the tab 874 (see FIG. 13) that can be rotated by a drive unit (not shown) in the dispenser 100, which may be activated by the controller 858 in response to a user selection, a setting, or another input. It is contemplated that the piezoelectric element 854 can be provide with more than two zones to provide greater levels of adjustment among settings.

[00149] In accordance with the systems and methods disclosed herein, the dispenser 100 and refill unit 124, 862 offer greater control of an energy transfer rate of the diffuser assembly 120, 850 to the volatile material 128, and to thus control the volatile material concentration in an environment to achieve the desired fragrance experience or to reduce a number of pests in the environment.

[00150] Further, the systems and methods disclosed herein provide for the visual indicator 126 that improves communication between the user and the dispenser 100 and the refill unit 124, 862. In addition, the present disclosure provides the user with easily accessible and relevant information about the refill unit 124, 862, or contents thereof, which can establish trust with the user. By providing information to the user device 148, the information is readily available to the user and can be provided with aesthetically appealing visuals or graphics via the GUI 200 for enhancing the user's understanding. Further, the system and methods disclosed herein offer the user simplified solutions for achieving sophisticated outcomes, such as maintaining a cohesive fragrance experience in the floor plan 500 while realizing energy savings.

[00151] Unless otherwise limited or defined, the terms "about" and "approximately," as used herein with respect to a reference value, refer to variations from the reference value of $\pm$

20% or less (*e.g.*, ± 15 , $\pm 10\%$, $\pm 5\%$, etc.), inclusive of the endpoints of the range. Similarly, as used herein with respect to a reference value, the term “substantially equal” (and the like) refers to variations from the reference value of less than $\pm 5\%$ (*e.g.*, $\pm 2\%$, $\pm 1\%$, $\pm 0.5\%$) inclusive.

[00152] Unless otherwise limited or defined, “substantially parallel” indicates a direction that is within ± 12 degrees of a reference direction (*e.g.*, within ± 6 degrees or ± 3 degrees), inclusive. Correspondingly, “substantially vertical” indicates a direction that is substantially parallel to the vertical direction, as defined relative to gravity, with a similarly derived meaning for “substantially horizontal” (relative to the horizontal direction). Likewise, unless otherwise limited or defined, “substantially perpendicular” indicates a direction that is within ± 12 degrees of perpendicular a reference direction (*e.g.*, within ± 6 degrees or ± 3 degrees), inclusive.

[00153] Any of the embodiments described herein may be modified to include any of the structures or methodologies disclosed in connection with different embodiments. Further, the present disclosure is not limited to the dispensing systems of the type specifically shown. Still further, the methods and systems of any of the embodiments disclosed herein may be modified to work with any type of volatile material dispenser.

INDUSTRIAL APPLICABILITY

[00154] Numerous modifications to the present disclosure will be apparent to those skilled in the art in view of the foregoing description. Accordingly, this description is to be construed as illustrative only and is presented for the purpose of enabling those skilled in the art to make and use the disclosure. The exclusive rights to all modifications which come within the scope of the appended claims are reserved.

We claim:

1. A method of dispensing a volatile material using a dispenser having a diffuser assembly, a controller, a temperature detection device, and a power source, the method comprising:

receiving a refill unit including a wick and the volatile material, wherein the refill unit is recognized by the controller;

activating the diffuser assembly to a first heat setting for a first interval; and

activating the diffuser assembly to a second heat setting for a second interval, wherein the first heat setting is different from the second heat setting, and wherein the first heat setting corresponds to a first fragrance characteristic of the volatile material and the second heat setting corresponds to a second fragrance characteristic of the volatile material.

2. The method of claim 1, wherein the first interval is different from the second interval, and

wherein, upon the controller receiving a signal, the second heat setting occurs before completion of the first interval.

3. The method of claim 1, wherein the first interval and the second interval are the same, and

wherein, upon the controller receiving a signal, the second heat setting occurs before completion of the first interval.

4. The method of claim 1, wherein a third interval and a third heat setting correspond to a third fragrance characteristic of the volatile material.

5. The method of claim 4, wherein the third heat setting occurs after the second interval is completed.

6. The method of claim 1, wherein the first heat setting includes the diffuser assembly operating at a first temperature and being located a first distance from a distal end of the wick, the second heat setting includes the diffuser assembly operating at a second

temperature and being located a second distance from the distal end of the wick, and wherein the first temperature and the second temperature are equal.

7. The method of claim 6, wherein the first distance and the second distance are different.

8. The method of claim 1, wherein the first heat setting includes the diffuser assembly operating at a first temperature and being located a first distance from a distal end of the wick, the second heat setting includes the diffuser assembly operating at a second temperature and being located a second distance from the distal end of the wick, and wherein the first temperature and the second temperature are different.

9. The method of claim 8, wherein the first distance and the second distance are equal.

10. The method of claim 1, wherein the temperature detection device is in thermal communication with at least one of the diffuser assembly or the wick.

11. The method of claim 10, wherein the temperature detection device includes a first sensor and a second sensor, the refill unit carries the first sensor and the dispenser carries the second sensor.

12. The method of claim 1, wherein the controller is configured to receive a signal indicating a time of day, an ambient temperature, an ambient humidity, a room use, a room size, or a weather condition.

13. The method of claim 1, wherein the controller is configured to detect a refill unit identifier provided by the refill unit.

14. The method of claim 13, wherein the refill unit identifier is associated with an operating profile corresponding to the volatile material of the refill unit.

15. The method of claim 14, wherein the refill unit includes at least one of a tag or a code.
16. The method of claim 15, wherein the tag includes one of a NFC chip or a RFID chip.
17. The method of claim 15, wherein the code is a computer-readable code.
18. The method of claim 14, wherein, upon detecting the refill unit identifier, the controller retrieves the operating profile from a local memory.
19. The method of claim 18, wherein the operating profile includes the first interval and the first heat setting, the second interval and the second heat setting, and the first and second fragrance characteristics.
20. The method of claim 19, wherein the controller is in communication with a user device that displays a graphical user interface associated with the operating profile of the dispenser.
21. A volatile material dispenser, comprising:
a diffuser assembly, a controller, and a temperature detection device; and
a visual indicator, wherein the dispenser is configured to removably receive a refill unit having a volatile material and a wick, wherein the diffuser assembly is configured to be activated by the controller to dispense the volatile material from the refill unit, the diffuser assembly being adjustable between a first heat setting and a second heat setting, and wherein the visual indicator is configured to display a color that corresponds with a first fragrance characteristic of a plurality of fragrance characteristics of the volatile material during operation of the dispenser.

22. The volatile material dispenser of claim 21, wherein the diffuser assembly changes in temperature when adjusted from the first heat setting to the second heat setting.

23. The volatile material dispenser of claim 22, wherein the visual indicator changes in brightness intensity from first heat setting to the second heat setting.

24. The volatile material dispenser of claim 23, wherein the visual indicator changes color from the first heat setting to the second heat setting.

25. The volatile material dispenser of claim 24, wherein the visual indicator changes a light sequence from the first heat setting to the second heat setting.

26. The volatile material dispenser of claim 21, wherein the visual indicator is a light ring including at least one LED.

27. The volatile material dispenser of claim 21, wherein the controller is configured to receive a signal from a user device to cause the diffuser assembly to adjust from the first heat setting to the second heat setting.

28. A volatile material dispenser system, comprising:
a volatile material dispenser having a controller and a diffuser assembly; and
a refill unit including a wick, a volatile material, and a refill unit identifier that is configured to be detected by the controller, wherein the refill unit is configured to be removably received by the volatile material dispenser, and wherein the controller is configured to adjust the diffuser assembly based on a refill data profile associated with the refill unit identifier.

29. The system of claim 28, wherein the refill unit identifier is detected by the dispenser upon being located within a proximity of the dispenser.

30. The system of claim 29, wherein the refill unit identifier is detected by a user device that is in communication with the dispenser.

31. The system of claim 30, wherein the refill data profile includes at least one of a fragrance profile, a volatile material composition, a quantity, a mood setting, a purity score, a sustainability score, or a refill status.

32. The system of claim 31, wherein, after the dispenser detects the refill unit identifier, a notification is sent to the user device.

33. The system of claim 32, wherein the notification includes the refill status and an interactive menu comprising at least one of a start option, a schedule option, and a link.

34. The system of claim 33, wherein the link is associated with a web application or mobile application.

35. The system of claim 34, wherein the link is associated with a third-party website or third-party mobile application.

36. The system of claim 34, wherein the link is associated with an online marketplace.

37. The system of claim 33, wherein the schedule option includes fields for inputting a date, a start time, a stop time, a reoccurrence frequency, and an operation setting.

38. A method of dispensing a volatile material, the method comprising:
providing a volatile material dispenser having a controller and a diffuser assembly;
providing a single refill unit including a volatile material and a wick that is configured to be received by the volatile material dispenser; and
providing a visual indicator in communication with the controller of the volatile material dispenser, wherein the dispenser is configured to automatically adjust a characteristic of the visual indicator based on a fragrance characteristic of the volatile material.

39. The method of claim 38, wherein the visual indicator is provided on the volatile material dispenser and, upon detection of the refill unit, the visual indicator is configured to perform a recognition light sequence.

40. The method of claim 39, wherein the visual indicator displays a color that corresponds to a fragrance note of the refill unit.

41. The method of claim 40, wherein the visual indicator displays the color at a brightness intensity that corresponds to a heater setting.

42. The method of claim 38, wherein, upon detecting an unauthorized refill unit, the visual indicator is configured to perform an error light sequence.

43. The method of claim 38, wherein the controller of the volatile material dispenser is in communication with a user device that is configured to detect a refill unit identifier of the refill unit.

44. The method of claim 43, wherein, subsequent to detection of the refill unit identifier, the user device displays a plurality of options associated with operating the volatile material dispenser to dispense the volatile material of the refill unit.

45. The method of claim 44, wherein the plurality of options includes a plurality of fragrances that are selectable.

46. The method of claim 45, wherein, after selection of one fragrance of the plurality of fragrances, the user device communicates with the controller of the volatile material dispenser to activate the diffuser assembly and the visual indicator according to an operational profile associated with the selected fragrance and the detected refill unit.

47. The method of claim 46, wherein the operational profile includes a temperature and a color corresponding to the selected fragrance.

48. The method of claim 47, wherein, upon selection of two fragrances of the plurality of fragrances, the user device displays a prompt including a plurality of pre-set modes.

49. A volatile material delivery system, comprising:

a plurality of volatile material dispensers, each of the volatile material dispensers including a diffuser assembly, a controller, and a temperature detection device, wherein a refill unit including a wick is removably mounted to each volatile material dispenser;

a communication network to which the plurality of volatile material dispensers are operably connected; and

a user device that is configured to communicate with the plurality of volatile material dispensers via the communication network, wherein the plurality of volatile material dispensers are configured to communicate with one another via the communication network.

50. The system of claim 49, wherein the user device is configured to select a multi-unit operational setting that includes operation parameters for at least two dispensers of the plurality of volatile material dispensers.

51. The system of claim 50, wherein the at least two dispensers are located in different rooms relative to one another.

52. The system of claim 50, wherein the multi-unit operational setting includes a heater setting and a setpoint for each of the at least two dispensers.

53. The system of claim 50, wherein the communication network is a mesh network topology having a plurality of nodes corresponding to the plurality of volatile material dispensers.

54. The system of claim 53, wherein each node of the plurality of nodes includes a sensor that is configured to detect a location of the user device within a predetermined range.

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55. The system of claim 54, wherein, upon detection of the user device within the predetermined range of one node of the plurality of nodes, at least one other node of the plurality of nodes switches to a low duty cycle.

56. The system of claim 54, wherein, upon entry of the user device within the predetermined range of one node of the plurality of nodes, at least one other node of the plurality of nodes switches to a high duty cycle.

57. A volatile material dispenser system, comprising:
a diffuser assembly that is in communication with a refill unit including a wick;
a controller that is in communication with a sensor that defines a predetermined range;
and

a user device that is configured to be detected by the sensor, the controller adjusting an operation of a dispenser between a first duty cycle and a second duty cycle based on a location of the user device relative to the predetermined range defined of the sensor.

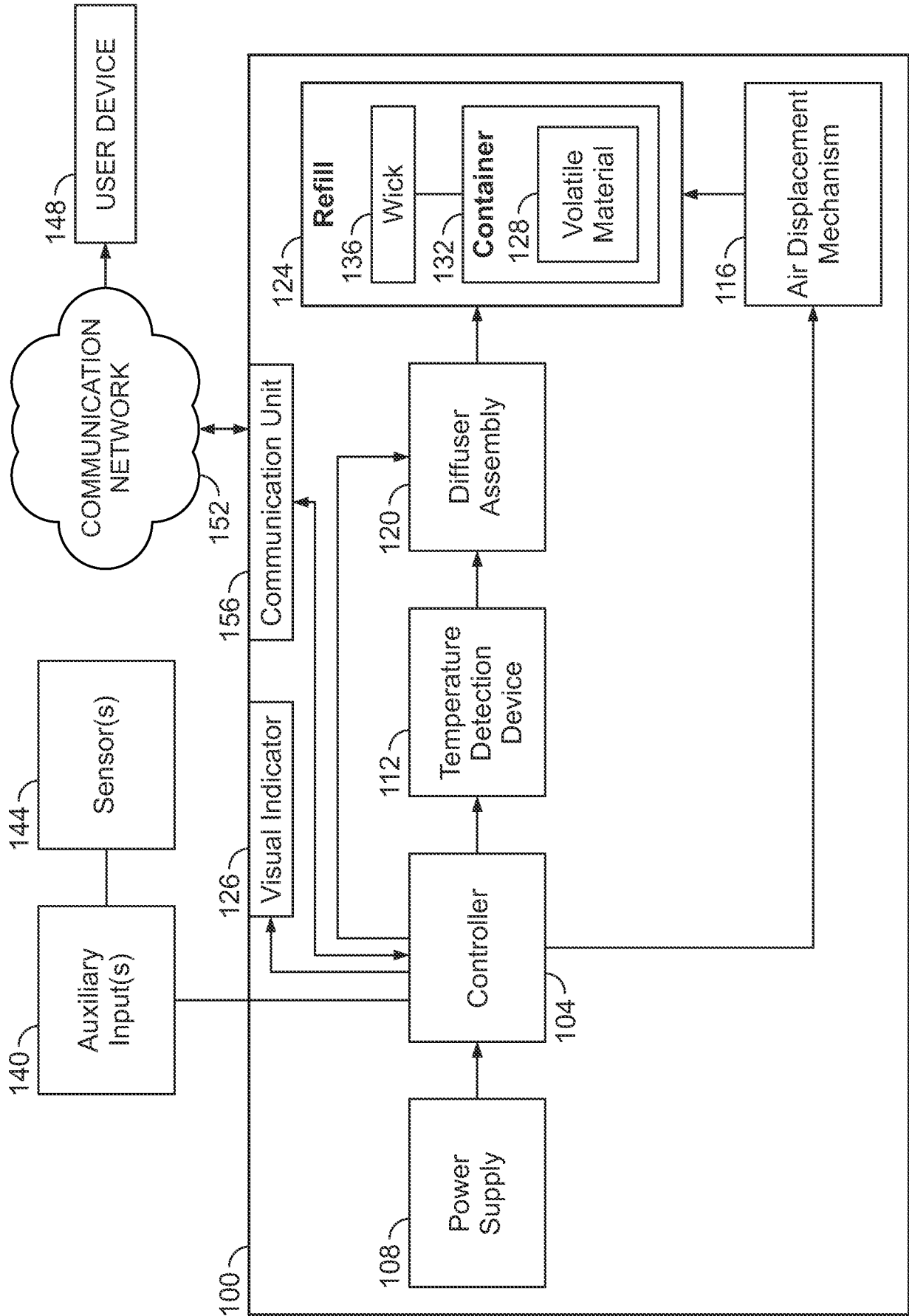


FIG. 1

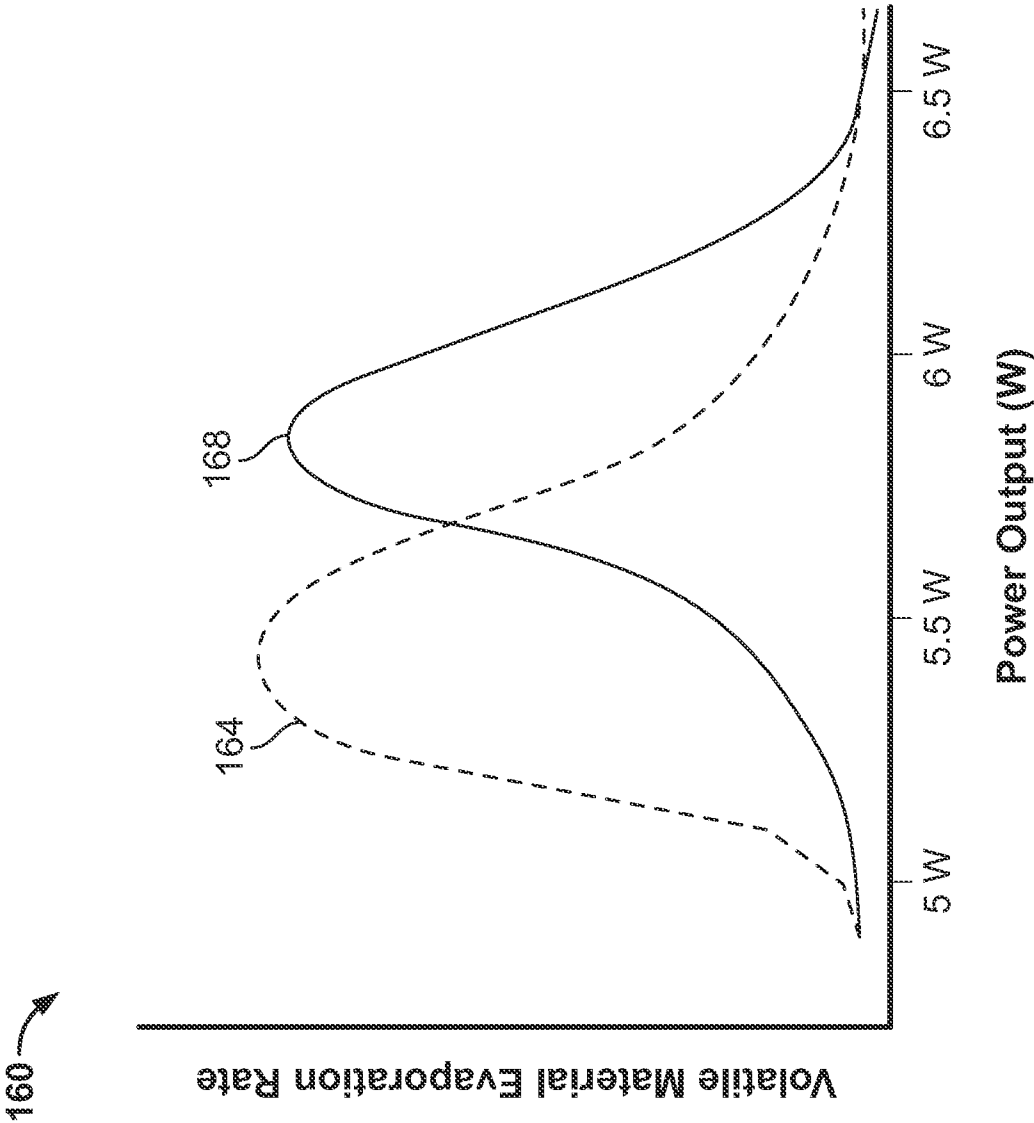


FIG. 2

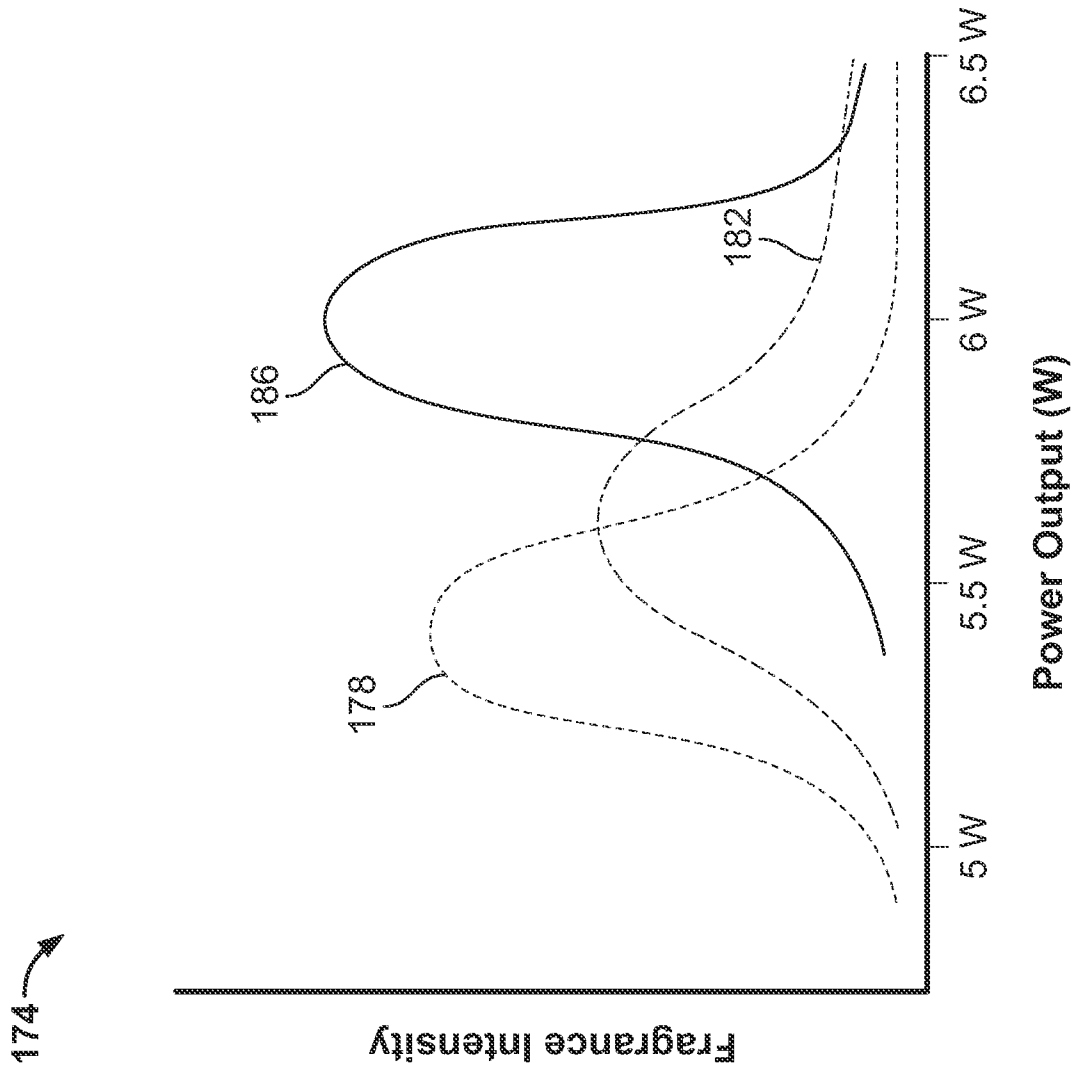


FIG. 3

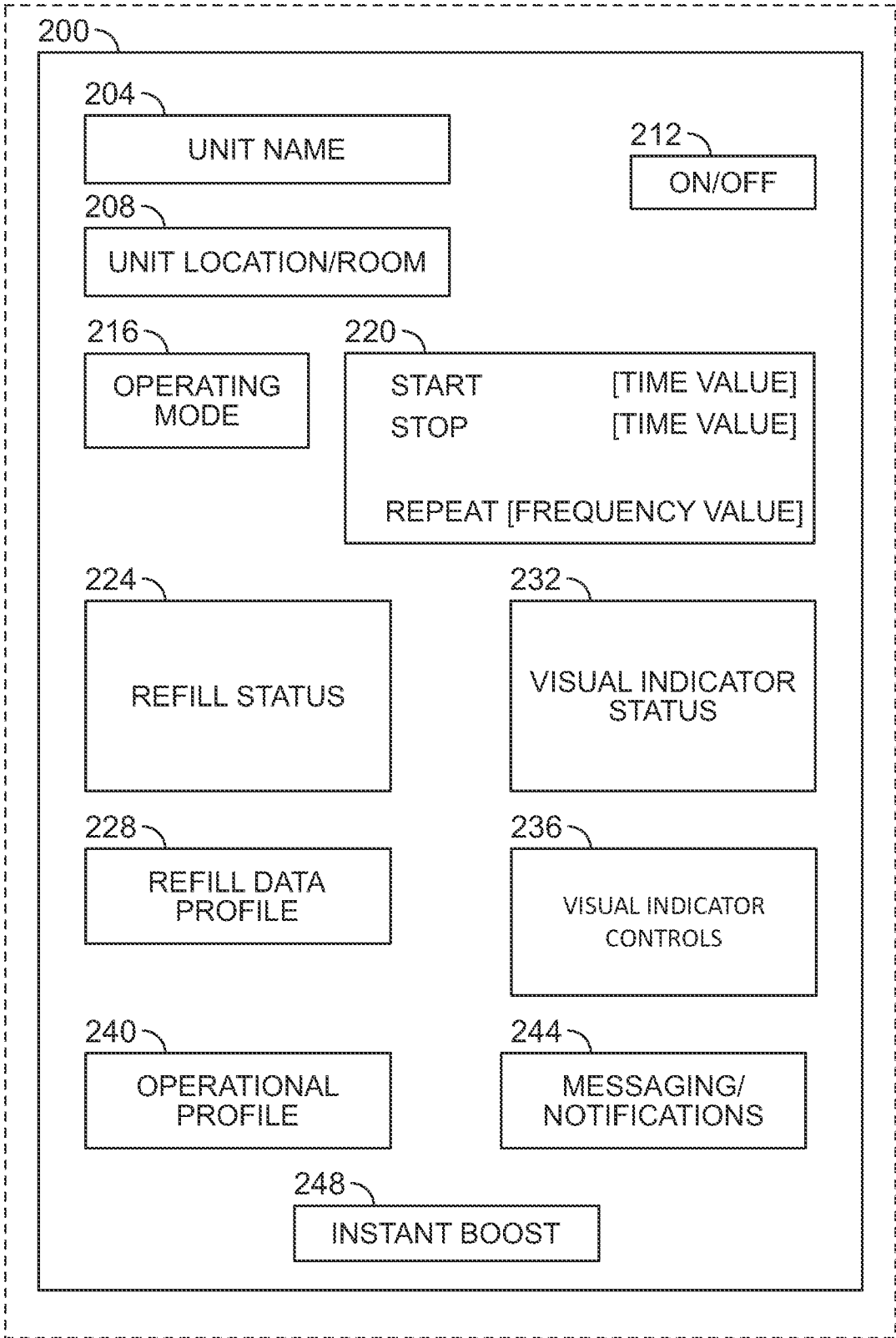


FIG. 4

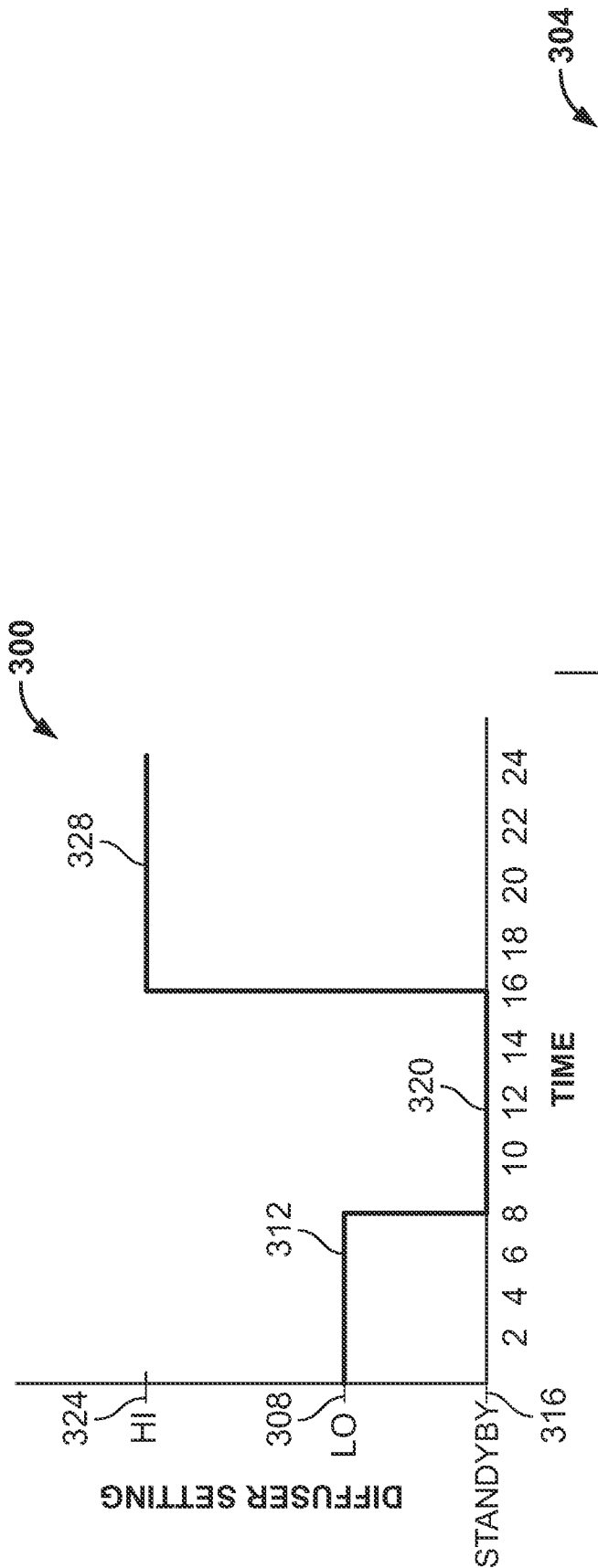


FIG. 5

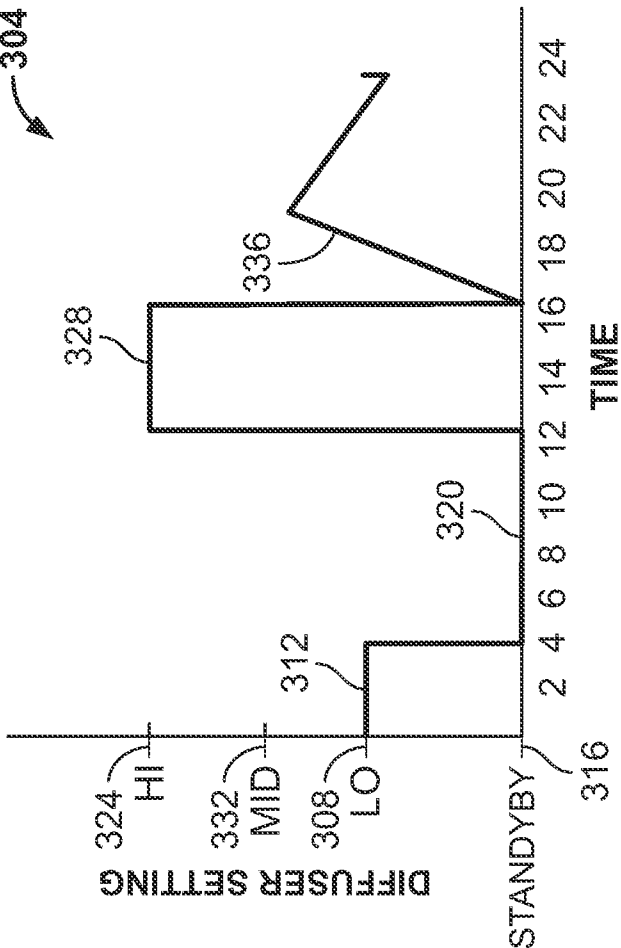


FIG. 6

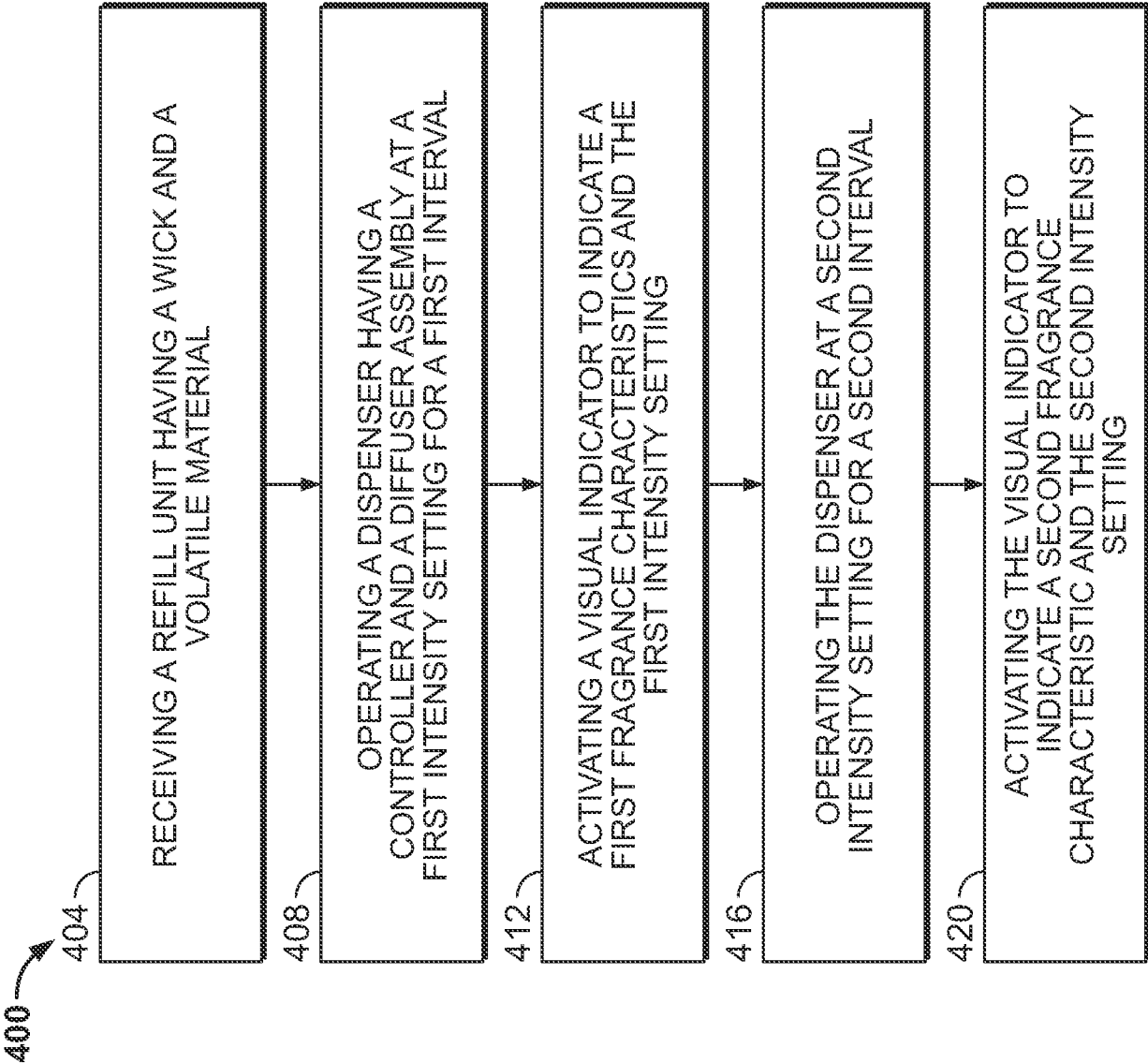


FIG. 7

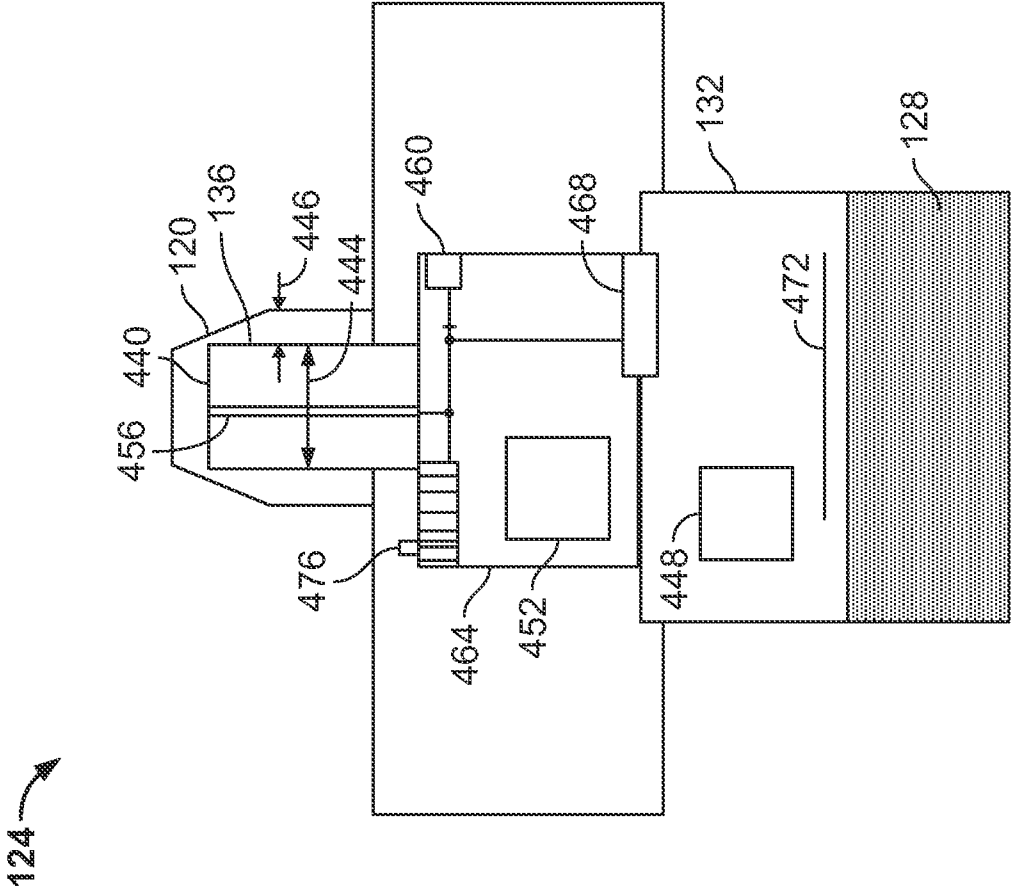


FIG. 8

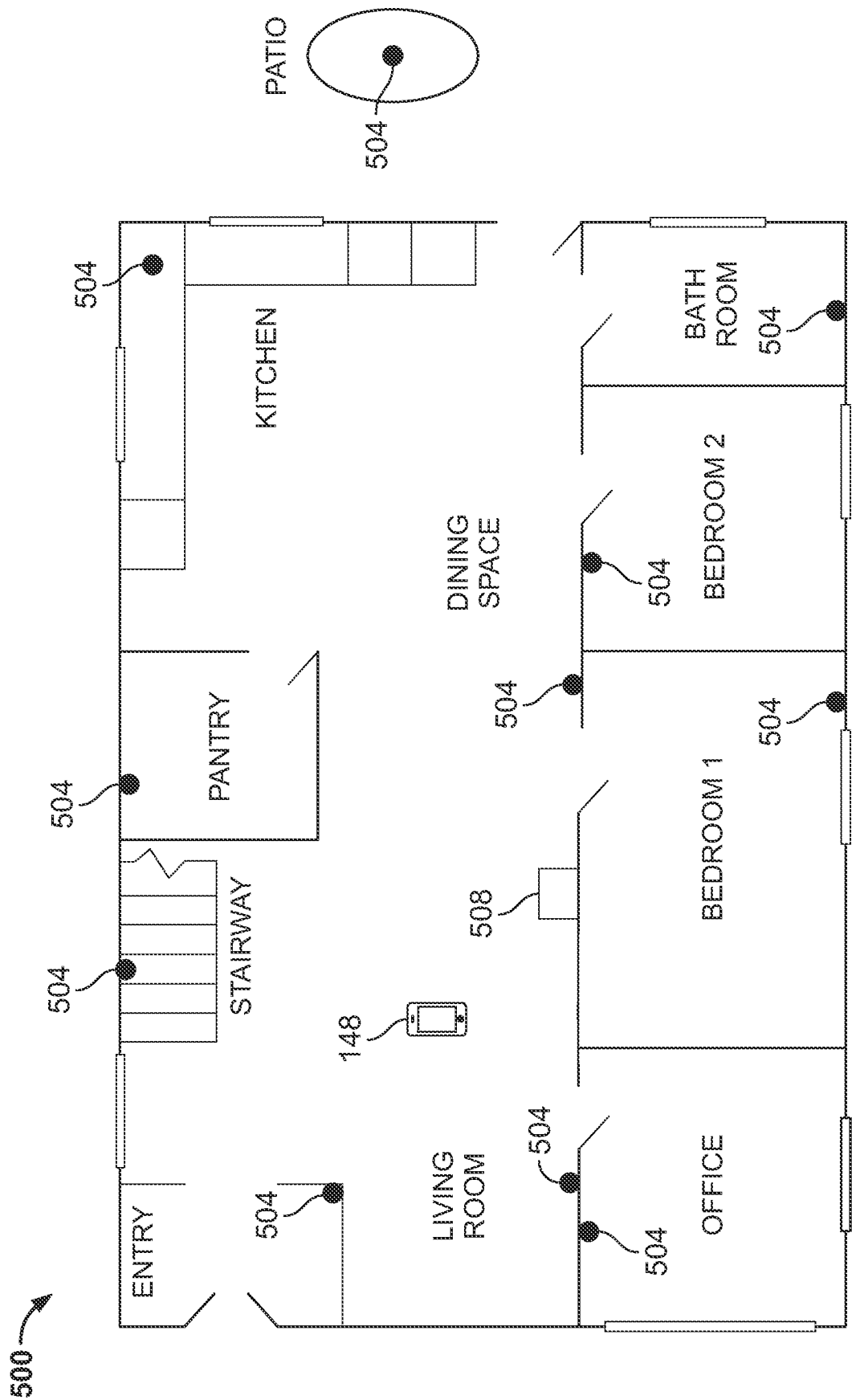


FIG. 9

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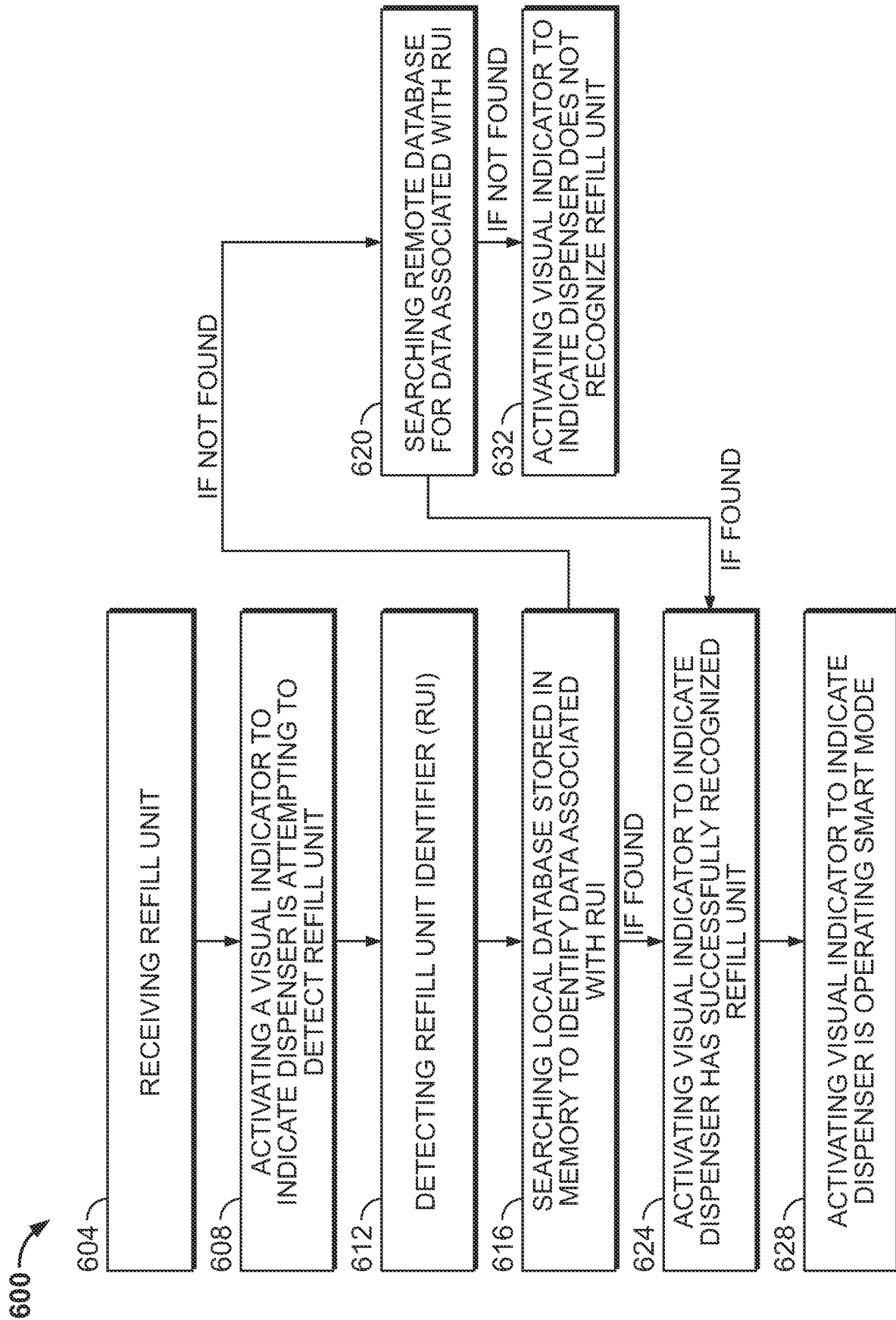


FIG. 10

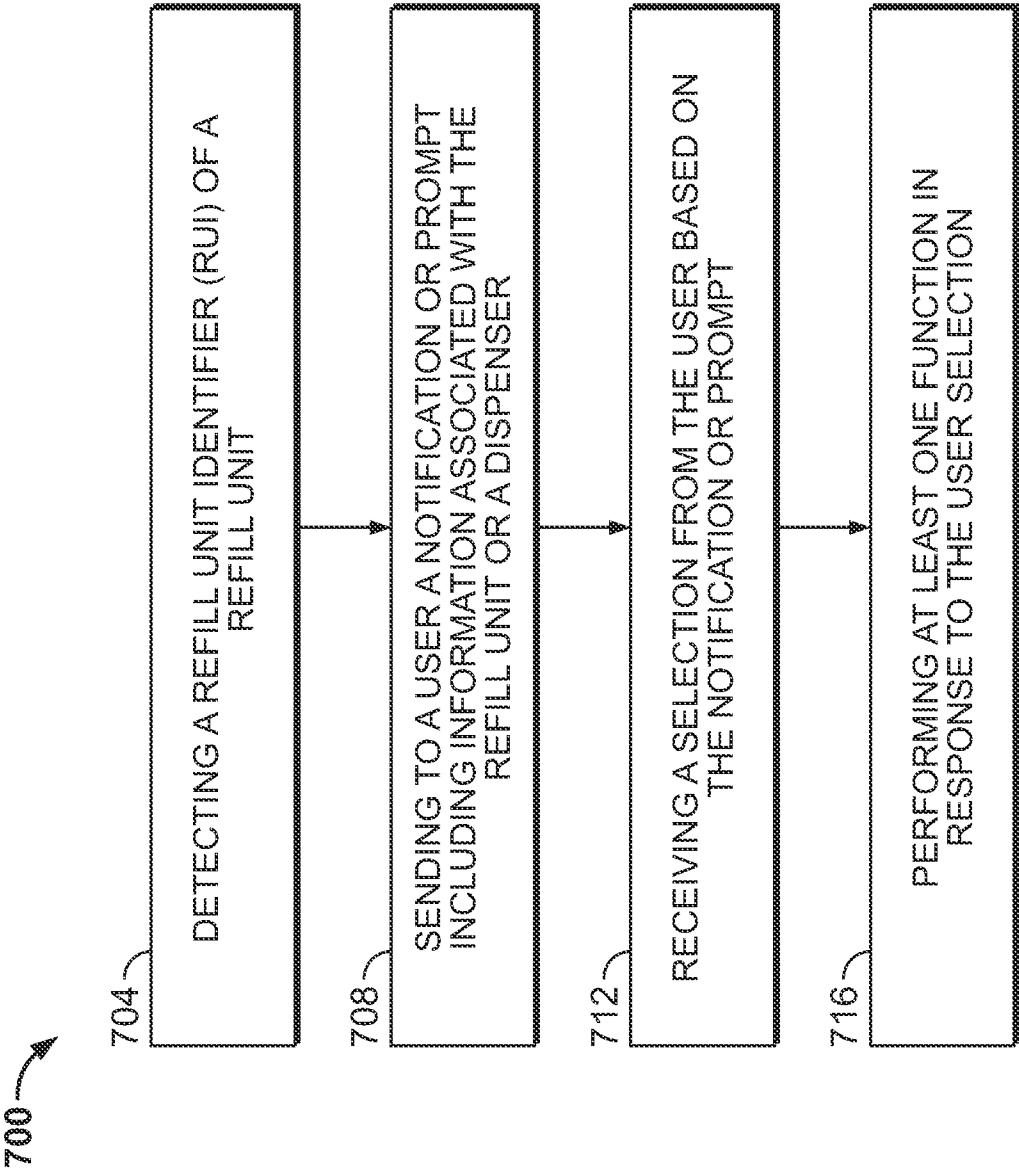


FIG. 11

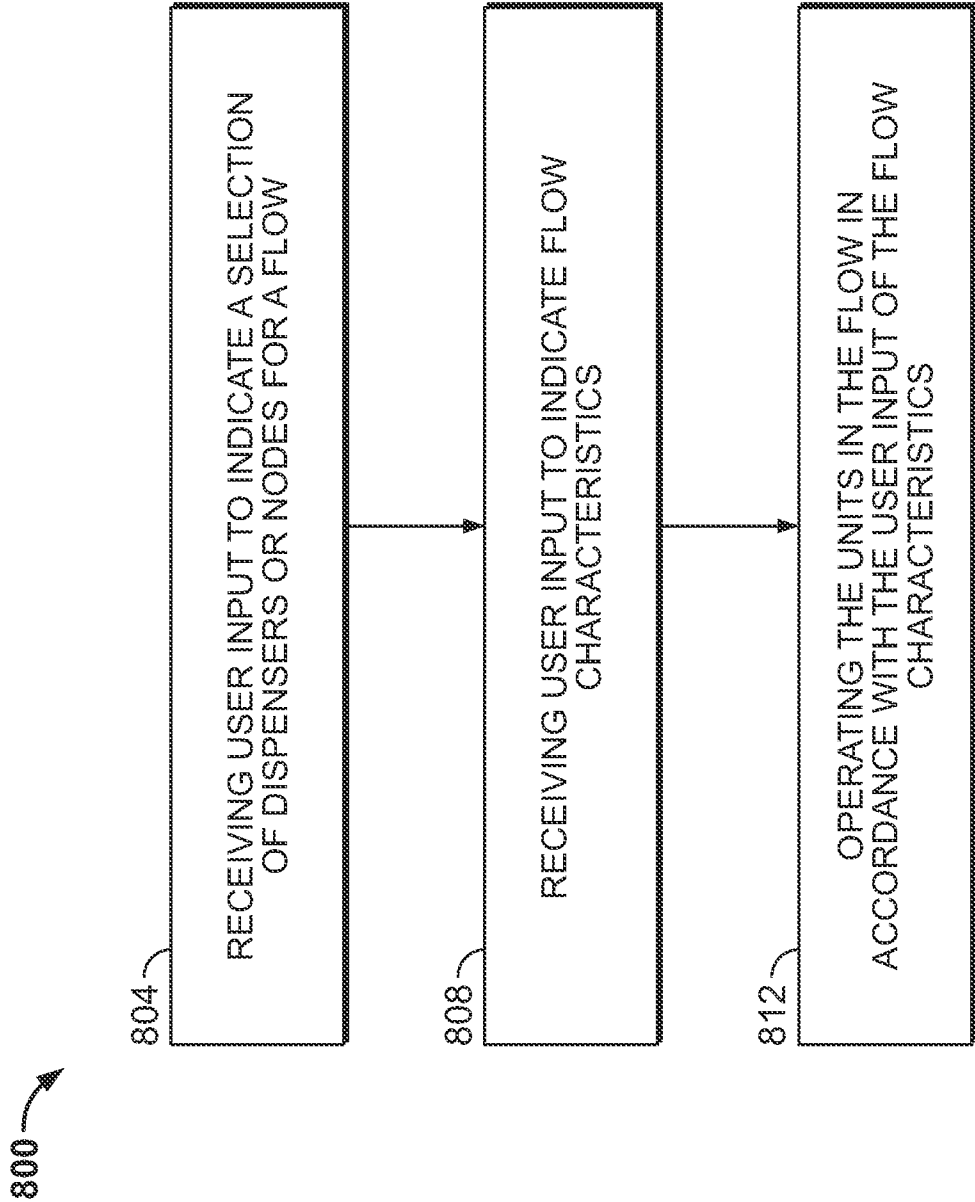


FIG. 12

