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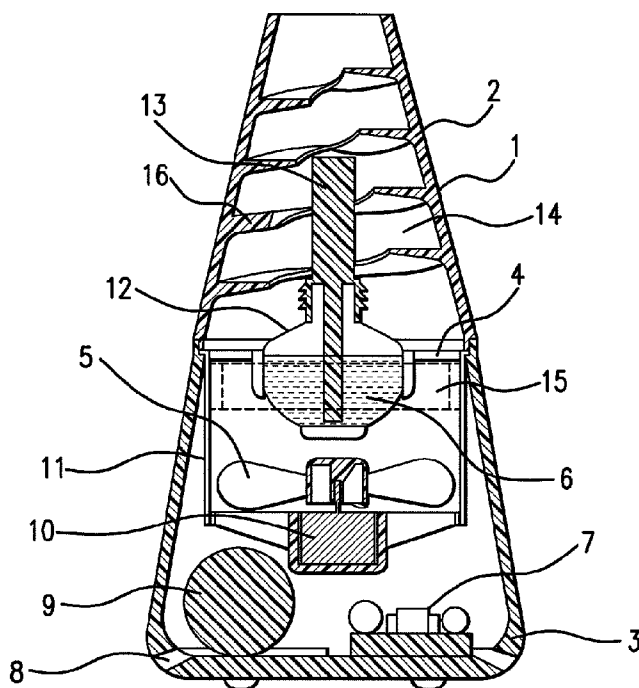


FIG. 2

(57) Abstract: The present application relates to a liquid-evaporate delivery device which relies on the efficient use of air currents to deliver liquid evaporate to airspace around the device. Efficient air currents may be provided by rotating the air currents around the wick, by providing a helical channel for the air to flow around the wick, and/or by aligning a fan with the longitudinal axis of the wick.



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LIQUID-EVAPORATE DELIVERY DEVICE

[0100] The present application claims the benefit of U.S. Application No. 60/947,830, filed July 3, 2007 and U.S. Application No. 60/948,505, filed July 9, 2007, each of which are hereby incorporated by reference in their entirety.

FIELD OF THE INVENTION

[0101] The present application provides a device that delivers evaporated liquids, such as vapors from a liquid fragrance composition, into the surrounding air space (e.g. place of commerce, interior of a car, or room in office or house).

BACKGROUND OF THE INVENTION

[0102] Complex liquid mixtures such as a fragrance or fragrance oils can be delivered to the air by a variety of methods. Exemplary devices which are known to deliver fragrance or fragrance oils include battery or plug-in air freshening devices that contain a fan and/or a heater to accelerate evaporation of the liquid. Such devices, however, have limitations such as inconsistent delivery rates and uneven and inefficient fragrance delivery.

[0103] For example, Fig. 1 illustrates an example of a prior art fragrance delivery device. This figure depicts the top view of a fragrance supply bottle and fan combination, within an enclosure, exhibiting less than ideal air flow. As denoted in letter C in Figure 1, the fan supplies air to the wick without consideration of the air

turbulence that exists in such a device, in which the fan and wick are oriented perpendicular to each other. Notice the excess air turbulence (Fig. 1, C) after the air strikes the wick and how the air flow turbulence continues beyond the wick. Also note that much of the air being supplied by the fan misses the wick, which is the area
5 containing the highest fragrance concentration within the unit. Air deflects off the interior side of the enclosure causing further air flow disturbances (Fig. 1, A and B). This air flow model representative of various prior art devices illustrates an inefficient fragrance delivery pattern because large amounts of fragrance is trapped within the enclosure and does not escape (see Fig. 1, A, B, C). Although weight loss may be
10 significant, fragrance delivery into the surrounding air is marginal at best.

[0104] Without the use of air currents required to efficiently evaporate the liquid, devices have relied upon the application of heat. Unfortunately, certain notes of the fragrance compositions may be skewed by the heating element so that the full “bouquet” of the fragrance is not perceived by the subject, and the hedonic impression
15 is diminished. The inefficient fragrance delivery pattern exhibited by prior art devices thus limits the creativity of the perfumer in selecting fragrances for the device. The perfumers may desire use of unique constituents with variable volatility, yet there are instances where a fragrance cannot be developed because the device requires the application of too much heat in order to deliver the vapors of the
20 fragrance.

SUMMARY OF THE INVENTION

[0105] These design limitations and others are addressed by the liquid-evaporate delivery device of the present application.

[0106] One embodiment of the present invention provides a liquid-evaporate delivery device that includes a container containing a substance to be evaporated (preferably a liquid or gel substance); a wick having a first end, a second end and an exterior surface, the first end disposed within the bottle and the second end and
5 exterior surface disposed exterior to the bottle; a device configured to impart an air flow on the wick (e.g. a fan); the device disposed below the bottle; and a housing, the bottle, heater element disposed within the housing. The air flow rotates around the exterior surface of the wick to provide an efficient means of delivering the liquid evaporate to the surrounding airspace, while avoiding or at least minimizing the
10 requirement of a heating element.

[0107] Liquid that may be employed in the liquid-evaporate delivery device include fragrance compositions, insecticide or insect repellents. In specific embodiments the air flow that rotates around the wick is characterized as laminar, or substantially laminar, as opposed to a turbulent flow regime.

15 [0108] Another embodiment of the present application provides a liquid-evaporate delivery device in which the housing of the device includes at least one continuous baffle that defines a helical channel for directing the air flow around the exterior surface of the wick. The device may contain a single continuous baffle that defines a helical channel or alternatively be configured with multiple baffles that provide one or
20 more helical channels. The size of the baffles may be determined by one of ordinary skill in the art, and may be constant or tapered within the device. The fan may be aligned, or substantially aligned with the longitudinal axis of the wick.

[0109] The present application also provides methods of providing a room with a pleasing fragrance by using the liquid-evaporate device of the present application within that room. The present application also provides methods of providing a pleasing fragrance to car passengers, places of business and office space.

- 5 Alternatively, the liquid-evaporate device of the present application can be used to deliver insect repellents or insecticides to spaces in which nuisance pests are a problem. The device may also be used to provide inhalation therapy to a subject in need thereof, by using, for example, an essential oil, or a therapeutic gel or liquid in the device in close proximity to the person receiving such inhalation therapy.

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BRIEF DESCRIPTION OF THE DRAWINGS

- 15 [0110] **Figure 1** is a comparative embodiment of the present application which shows the relatively inefficient use of air currents to evaporate a liquid from a wick.

[0111] **Figure 2** is an example of a “table-top” embodiment of the device of the present invention that is powered by a battery.

- [0112] **Figure 3** provides a clear view of the air currents within the device, the air
20 currents shown there to rotate around the wick.

[0113] **Figure 4** demonstrates a “table-top” embodiment with a shape that differs slightly from the shape of the table-top embodiment of Figure 2. **Figure 5** provides a clear depiction of the air currents of a device similar to that of Figure 4.

[0114] **Figure 6** demonstrates an alternative embodiment of the present invention, in which a helical channel is provided by a one-piece spiraling baffle design. **Figure 7** provides a birds-eye view of the device shown in Figure 6. **Figure 7** clearly shows that the longitudinal axis of the wick is aligned with the central axis of the fan.

5 [0115] **Figure 8** is a picture of a “plug-in” version of a liquid-evaporate delivery device of the present invention. **Figure 9** is an interior view of a plug-in version having a helical baffle that efficiently provides air flow around the wick.

[0116] **Figure 10** is profile view of a “plug-in” embodiment of the present application. **Figure 11** is a birds’-eye view of this embodiment.

10 [0117] **Figure 12** sets forth the average loss of fragrance over time using delivery devices of the present application.

DETAILED DESCRIPTION

Definitions

[0118] As used herein, the term “wick” refers to entities that absorbs a liquid and provides a surface area for liquid/air interaction to facilitate evaporation. The wick may be comprised of a material selected from, for example, a nylon, a linen, a felt, a rayon, a polyamide, a polymer such as polypropylene or polyethylene, polyester fibers, cellulose acetate fibers, ceramic, sintered glass, a plastic, a cotton, a cellulose or mixtures thereof.

20 [0119] As used herein, the term “substantially laminar air flow” refers to air flow characterized such that it has a Reynolds Number of below about 2500, preferably below about 2000, more preferably below about 1000. Details regarding

determination of Reynolds Numbers can be found, for example, in Perry's Chemical Engineer's Handbook, 7th ed., which is hereby incorporated by reference.

[0120] As used herein, the wick is substantially aligned with the central axis of the fan when the central axis of the fan is within a small amount (e.g., $\pm 10^\circ$ or more preferably $\pm 5^\circ$) of parallel with the central axis of the wick.

[0121] As used herein, a "device configured to impart an air flow on the wick" refers to an entity or structure that provides sufficient air to a moist wick to facilitate evaporation under normal use conditions (e.g. room temperature and pressure). An example of a "device configured to impart an air flow on the wick" is a fan. In some delivery embodiments which, do not require the use of a fan to move air; the presence of an air intake vent is considered a "device configured to impart an air flow on the wick", provided that the air intake vent is positioned to achieve such a result. To one skilled in the art, there are numerous methods to deliver an air stream to the device.

15 [0122] As used herein "air flow rotates around the wick" is defined when the air flows around the exposed portion of the wick in a spiraling fashion. Due to the design of the liquid-evaporate delivery device of the present application, the air makes at least one complete revolution around the wick, preferably at least two or three revolutions around the exposed portion of the wick.

Embodiments of the Liquid-Evaporate Delivery Device

- [0123] One embodiment of the present invention is shown in Figure 2. The liquid-evaporate delivery device shown in Figure 2 has an option of operating by a plug-in power supply (not shown, discussed in detail below), or battery 9 for portable applications. The battery, via the control circuit board 7, supplies power to (impeller item 5 & DC motor item 10) hereafter referred to as fan 10. The fan delivers air flow that rotates around the exterior surface of the wick, 13. In this embodiment, rotating air flow around the exterior surface of the wick is aided by helix or baffle 16 having a slight upgrade that forms a helical air channel 14.
- 10 [0124] The design of the helix or baffle 16 shown in Figure 2 is such that the upper edge is approximately parallel to the base of the device, while the lower edge is slanted upward. Such a design allows air to move toward the center axis of the channel as it rotates around the wick. The baffle is preferably smooth to facilitate laminar air flow.
- 15 [0125] The aero-dynamic shape of liquid-evaporate delivery device, shown in Figure 2 by enclosure items 2 and 3 assist in providing a unique helical channel 14 in the upper portion (Fig. 2, item 2) of the liquid-evaporate delivery device. This air flow model relies on the basic principal of evaporation, which is the process by which a liquid changes to a gas or vapor. The molecules in a liquid are constantly in motion, moving in all directions at different velocities. The molecules near the surface are the molecules that are released from the surface of the liquid into a gaseous state. This happens when those molecules collide into other molecules at high velocities. This
- 20

process occurs more rapidly when temperature is increased because the molecules begin to move at higher velocities.

[0126] The operation of the present invention is unique in that the evaporation of the complex liquid mixture (e.g. fragrance or fragrance oil) off the wick 13, is more efficiently captured by the circulating airflow within the helical channel 14. As a result, more of the evaporation is propelled outward from the top of this aerodynamic enclosure consisting of items 2 & 3 and introduced into the atmosphere, as compared to prior art devices that do not incorporate the helical channel (e.g. the device of Figure 1). In Figure, 2, which may be designed to impart a hedonically pleasing fragrance to an air space (e.g. a room of a house); the fragrance 6 is carried by natural room air currents. It is understood that the device shown in the figures of the present application could deliver other evaporated liquids, such as insect or pest repellents or therapeutic gels and liquids (e.g. aromatherapy and a vaporizer for inhalation therapy for pharmaceutical applications). To one skilled in the art, other applications or configurations of this device could be envisioned.

[0127] The air supply enters the enclosure through air inlet 8 as shown in Fig. 2 and generated by the fan 10 and mounted within item 3 below the air tunnel 11, as illustrated in Fig. 2. The fan 10 is preferably mounted below the fragrance supply bottle 12 so as to provide directed air upward through the enclosure, and is powered by a battery 9 or a plug-in power supply (not shown). In this illustration the battery 9 is shown for portable operation. The fan 10 may have more than one speed, which would permit the amount of fragrance delivered into the atmosphere to be controlled by adjusting the speed of the fan 10.

[0128] The purpose of the helical channel 14 is to direct the air flow, supplied by air inlet 8. Air is introduced into the air tunnel 11 through its lower openings and put into motion by the fan 10 and directionally guided upward by the air tunnel 11 leading into the helical channel 14, whereby developing into a helical air flow pattern around the wick 13, which comes up through the center of the helix, allowing the air flow to more efficiently capture evaporation.

[0129] An example of the air model employed by the liquid-evaporate delivery device of the present application is shown in Fig 3, in which the evaporating liquid is efficiently captured by the circulating airflow within the helical channel 14. The air flow shown in the devices of the present invention capture the evaporated liquid much more efficiently than, for example, the liquid-evaporate delivery device shown in Figure 1, in which the air currently can be seen to go in a multitude of different directions after coming into contact with the wick. Devices like the comparative device of Figure 1 are more likely to require additional amounts of heat to facilitate evaporation.

[0130] As shown in Figure 7, the wick 13 is aligned, or at least substantially aligned with the central axis of the fan impeller, 5. This feature may be combined with a conical shape, shown in the liquid-evaporate delivery devices of Figure 3. For comparison, Figure 4 and 5 demonstrate a liquid-evaporate delivery device in which the shape of the device around the wick is not conical. Nevertheless, the liquid-evaporate delivery device shown in Figures 4 and 5 provide efficient helical air flow by means of helix 16, oriented to provide a helical channel which efficiently delivers the evaporated liquid to the ambient air space surrounding the device.

[0131] As described above, the liquid-evaporate delivery device may contain a baffle (see, for example, Fig. 2 or Figure 6) that provides a helical air channel to efficiently delivery the evaporated liquid to the ambient air. In some embodiments, the liquid-evaporate delivery device contains a plurality of baffles, the baffles

5 preferably oriented at a slight upgrade. For example, the baffles may be spaced about three inches apart . Alternatively, as shown in Figures 2 and 6, the helical air channel may be provided by a one-piece, spiraling baffle design.

[0132] Regardless of whether a plurality of baffles, or a one-piece, spiraling baffle design is employed, it has been found that the size of the outlet aperture, denoted as
10 18 in Figure 2, is important to the functioning of the device. Accordingly, the person of ordinary skill in the art should exercise care in selecting the size of the outlet so that the rate of evaporation (e.g. the extent to which fragrance is released) is optimized based on the particular application for which the liquid-evaporate device is employed.

15 [0133] The liquid-evaporate delivery device of the present invention may be powered by a battery (e.g. battery 9 of Figure 2). In alternative embodiments, the liquid-evaporate delivery device is adapted to be plugged into a wall socket by AC wall outlet, which powers the device and may replace the battery described above. In
20 a further embodiment, the device may be configured for both battery and AC wall outlet plug-in operation.

[0134] An example of a “plug-in” embodiment is shown in Figure 8, which includes AC wall outlet 4 as a power source and contains a power supply mounted on control circuit board 11 to provide safety, control circuit board 11 shown in Fig. 10,

bi-color light emitting diode (LED) 5, fan 6, fragrance supply bottle (bottle can be optionally configured with an orientation key or having a variety of shapes) 8.

Figures 10 and 11 show, respectively, the profile and birds-eye views of a plug-in embodiment of the present application.

5 **[0135]** In preferred embodiments, the liquid-evaporate delivery device may be constructed with an air exchange/liquid collection vent 13 as shown in Fig. 10. In the delivery device shown in Figure 10 the fragrance supply bottle support mount contains a bottle sensor 7, (optionally configured with a mating orientation key or accepting a variety of bottle shapes). Air tunnel 15 is provided within item 3 as
10 shown in Figure 8.

[0136] As explained above and with reference to Figure 10 and 11, the optional strip heater 16, could be configured to operate specific to the fragrance bottle orientation or key. This feature would permit the application of heat to a viscous or semisolid liquid mixture to be pre-determined at the point of manufacture. Hence, the
15 physical properties of the bottle contents would determine the bottle shape or key setting for the application of ambient, warm or hot air to the supply bottle and wick.

[0137] It should be understood by those skilled in the art that the aero-dynamic enclosure, items 2 and 3 can be any of a number of designs and shapes, and is not limited to that which is illustrated in the Figures of this application (e.g. as shown in
20 Figs. 2, 4 and 5). The enclosure may be constructed of any suitable material such as: plastic, glass, metal, ceramic, etc. The device may be configured to provide a helical air flow that provides from about 1 to about 5 wraps around the wick, or from about 2 to 3 wraps around the wick by a one-piece spiral design (e.g. as shown in Figure 6).

[0138] With reference to Figure 10, the construction of the fragrance supply bottle 8 is preferably such that it can be handled without spilling the fragrance 10 contained therein. When the fragrance 10 has dissipated, the fragrance supply bottle 8 is replaced and a new fragrance supply bottle is simply inserted into the fragrance supply bottle support mount 7.

[0139] It is understood that replacement liquid supply bottles (e.g. fragrance supply bottles) that are designed to be used in the liquid-evaporate delivery devices of the present invention are also intended to be included within the inventive subject matter of the present application. Accordingly, one embodiment of the present application provides a kit comprising a liquid supply bottle that may be used in the devices of the present application, the kit further comprising instructions to insert or otherwise employ the liquid supply bottle in any of the devices described in this application.

[0140] The device can also be envisioned to have a variety of delivery rates dependent on the on/off sequence, fan speed, application of heat and additional features controlled by the micro-controller. With reference to Figure 10, a micro-controller, located on the control circuit board 11, is connected to the fan 6 and drives the fan at a predetermined time-on and time-off sequence. Adjusting the predetermined time-on and time-off sequence of the fan 6 permits control of the amount of fragrance delivered into the atmosphere. This feature affords the consumer considerable flexibility with regards to room size and delivery rate preference. In addition, the micro-controller can be optionally configured with trigger devices, such as, infra-red motion entry sensors, light detectors, door opening detectors, malodor

sensors, etc. To one skilled in the art of designing such features, the opportunities are numerous.

[0141] In various embodiments, various pitches of the helix, one of which shown in Figure 2 as 16, may be provided. The helix orientation may be determined by a person of ordinary skill in the art depending on various factors, including the size of the device, the intended space in which the liquid-evaporate delivery device will operate (e.g. the size of the room), and the type and characteristics of the liquid to be employed in the device (e.g. the volatility of the fragrance).

[0142] Referring again to Figure 2, the liquid-evaporate delivery device may be provided with an optional strip heater 15, shown in this embodiment to be in close proximity to fragrance supply bottle 12. The strip heater may optionally be in communication with a circuit board 7 and receive input based on the shape of the fragrance supply bottle, which is also in communication with the circuit board 7. In such an embodiment, the amount of heat to be delivered to the liquid-evaporate delivery device may be optimized based on the liquid (e.g. fragrance) applied, the fragrance being provided in a fragrance supply bottle with a distinct shape that provides the correct amount of heat supplied, based on the characteristics of the fragrance.

[0143] Operating conditions for the fan in both the plug-in and battery operated embodiments can be determined by persons of ordinary skill in the art. In one embodiment the fan operates continuously at, for example a range from about 500 r.p.m. to about 1500 r.p.m. (e.g. about 900 or 1000 r.p.m.). Furthermore, the fan may operate on a timer or motion-detector sensor so that the fan runs intermittently at pre-

selected intervals or when offensive odors are detected by the device (e.g. in bathroom applications). Sensors for detecting odors are known in the art, and can be integrated with the liquid-evaporate delivery device by persons of ordinary skill in the art.

5 **Liquids**

- [0144] In a preferred embodiment, the liquid-evaporate delivery device delivers a fragrance composition. The fragrance compositions that may be used include commercially available fragrances, such as fragrances available from Takasago International Corporation U.S.A., (Rockleigh, NJ) is preferred. Other sources of
- 10 liquid or gel fragrance compositions include S.C. Johnson Company (Racine, WI), Procter & Gamble (Cincinnati, OH), Reckitt Benckiser (Berkshire, UK), Givaudan (Geneva, Switzerland), Firmenich (Geneva, Switzerland), Symrise (Holzminden, Germany), Henkel/Dial (Düsseldorf, Germany) and International Flavors and Fragrances (New York, NY).
- 15 [0145] Also, malodor control compositions may be used in the liquid-evaporate delivery device of the present application, either alone or in combination with a fragrance composition. Accordingly, the liquid-evaporate delivery device may be used to neutralize and/or control odors, instead of, or in addition to, providing a hedonically pleasing odor to the surrounding air space. Use of malodor control
- 20 compositions may find utility in bathroom and kitchen applications, and other areas in which malodors are likely to be present. For example, the malodor control compositions disclosed in U.S. Patent No. 6,660,713 (assigned to Procter & Gamble),

hereby incorporated by reference, could be used in the liquid-evaporate delivery device of the present application.

[0146] An advantage of the liquid-evaporate delivery device is that, by more
5 efficient use of air currents, the performance of the device can be improved. This
could mean that the use of a heater can be optional and contingent on the desired
evaporative delivery. Accordingly, fragrance can be evaporated while minimizing or
eliminating fractionation of individual components, thus providing a wider range of
notes available to the perfumer when selecting liquid fragrance compositions to be
10 used in devices of the present application.

[0147] The liquid-evaporate delivery device may also deliver insecticides or
insect repellents. Insect repellents and insecticides known to those of ordinary skill in
the art may be used, such as the active ingredients described in U.S. Published
Application No. 2006/0083763, which is hereby incorporated by reference in its
15 entirety. Preferred insect repellent compositions include insect repellent compositions
containing para-menthane diol, commercially available from Takasago International
Corporation U.S.A. (Rockleigh, New Jersey).

[0148] As discussed above, the liquid-evaporate delivery device may be
configured to provide specific heat input and/or fan speed inputs based on the shape
20 of the fragrance supply bottle. For example, fragrance compositions having a higher
percentage of lower, more subtle notes may be provided with additional heat supply
and/or increased fan speed. The liquid-evaporate delivery device may recognize use
of a lower note-dominate fragrance based on the particular shape of the fragrance
supply bottle (e.g. by use of a square bottle). Alternatively, more volatile fragrance

compositions that do not require as much heat and/or fan speed may be provided in a different shaped fragrance supply bottle (e.g. a triangular shaped fragrance supply bottle) that is recognized by the device to lower the fan speed and/or lower the amount of applied heat.

- 5 **[0149]** Gels could also be used in the liquid-evaporate delivery device of the present application. The gels could be, for example, fragrance gels or therapeutic gel (e.g. aloe vera gel, essential oil gels).

Uses

[0150] The liquid-evaporate delivery device of the present application may be applied to household rooms and used as an air freshener. Alternatively, the liquid-evaporate delivery device may be used in an office environment (e.g. at reception areas), or a place of business (e.g. a reception area) or a place of recreation (e.g. a casino).

[0151] Alternatively the liquid-evaporate delivery device can be used as a means to control insects and nuisance pests. The liquid applied to the liquid-evaporate delivery device could be an insect repellent composition. Accordingly, the liquid-evaporate delivery device could be used on decks, pavilions, stadiums, outdoor dining facilities and other places where people congregate outdoors or indoors and it is desired to repel insects.

[0152] Another use for the liquid-evaporate delivery device of the present invention is to deliver therapeutic agents (e.g. therapeutic gels) to a human via an inhalation route, including medicinal, holistic and homeopathic compositions that may be vaporized for inhalation. For example, the liquid-evaporate delivery device may deliver essential oils or medicated gels (e.g. Vicks[®] VapoRub[®] Products, commercially available from Procter & Gamble and Co. (Cincinnati, OH)).

[0153] In one therapeutic application of the present invention, the liquid-evaporate delivery device is charged with essential oil(s) and provided in close proximity to a subject such that the subject inhales gas or vapors from the essential oil(s). It has been found that essential oils, such as cinnamon bark, lemongrass and thyme oils, provide antibacterial activity when inhaled and may be used to treat, for

example, respiratory tract infections. See, Journal of Antimicrobial Chemotherapy, 47:565-573 (2001), which is hereby incorporated by reference in its entirety. There it was concluded that the antimicrobial action of essential oils by gaseous inhalation is most efficient at high vapour concentration for a short time, and that a maximal

5 vapour level of 0.1-0.9 mg/L in air may suppress the growth of the bacterial pathogens of respiratory infection (e.g. *Haemophilus influenzae*, *Streptococcus pneumoniae*, *Streptococcus pyogenes* and *Staphylococcus aureus*). The essential oils that may be used in therapeutic applications (e.g. treatment of respiratory tract infections) in the device of the present application may be selected from, for example,

10 cinnamon bark oil, lemongrass oil, thyme oil (wild), thyme oil (red), thyme oil (geraniol), perilla oil, peppermint oil, tea tree oil, coriander oil, lavender (spike) oil, lavender (true) oil, rosemary oil, eucalyptus (radiata) oil, citron oil, and mixtures thereof. Alternatively, the major active constituents of the essential could be used in place of, or in addition to, the essential oil (e.g. cinnamaldehyde, neral, geranial,

15 limonene, perillaldehyde, carvacrol, limonene, γ -terpinene, thymol, geraniol, geranyl acetate, p-menthone, menthol, terpinen-4-ol, linalool, 1,8-cineole, camphor, linalyl acetate, α -pinene, and α -terpineol) .

[0154] It shall be understood that while a fan is described in some embodiments

20 of the present application, the invention is not limited thereto. So long as the device receives sufficient wind flow -- including many if not most embodiments that employ the device outside -- a fan would not be required, or could be provided only as an alternative when ambient air supply is not sufficient. In some embodiments, sufficient wind flow is already provided that totally obviates the fan. The liquid-

25 evaporate delivery device of the present invention can be used without a fan, for

example, in air vents, cars, boats, all-terrain vehicles and outdoor areas that tend to be windy (e.g. tunnels). A person of ordinary skill can determine whether a fan is required when optimizing the liquid-evaporate delivery device for the particular application.

- 5 **[0155]** A person of ordinary skill in the art may modify the liquid-evaporate delivery device to an alternative configuration or size based on the application for which it is used. For example, in car interior applications, the device could be made smaller and adapted to securely fit in the vent within the interior passenger space of the car. The person of ordinary skill can select higher fan speeds and/or provide
- 10 additional heat to formulations when it is required to deliver more evaporate, such as when using the device for insect control purposes or when delivering a more-subtle fragrance.

Example 1

- [0156]** Prototype tabletop units were tested for liquid weight loss to determine the
- 15 technical attributes of the unit while periodic hedonic evaluations were made of the fragrance strength. Tests were performed to estimate the use life of the unit with a fixed amount of fragrance, based on average weight loss of the fragrance.

- [0157]** Testing occurred in a climate controlled room where temperature,
- 20 humidity, air flow and voltage are consistent and monitored. The temperature of the room is controlled at 70 °F +/- 1°, humidity is 50% +/- 10%; air flow is maximum 10 cubic feet per minute face value; and the voltage is 120 +/- 1 volts.

[0158] Both the controls and the inventive liquid-evaporate delivery devices are electrical. The inventive units do not supply heat to the evaporating wick while the controls do increase the evaporating rate by the use of a heating element near the wick in their units.

5 [0159] A device generally depicted in Figure 2 was tested. The reservoir bottles were filled with 12 grams of one of four fragrances (tropical A, tropical B, floral, and fresh fragrance) and testing was complete when there was no visual liquid fragrance remaining even though the wick might contain 2-3 grams of fragrance. The inventive units of the present application were tested in the continuous on mode to determine
10 the weight loss per day and for charting purposes, the units were weighed frequently with 3 readings per week for the first two weeks and then 2 readings per week until the unit was visually empty.

[0160] As controls, a plug-in heated wick with a bottle reservoir and without a fan was tested. An example of such a device include commercial products available S.C.
15 Johnson “Glade® Plug-In® Scented Oil” product, Procter and Gamble “Febreze® Noticeables™” product and Reckitt Benckiser Air Wick® (PISO) unit.

[0161] The weight loss of fragrance per day is set forth below in Table 1.

[0162] Table 1

Device	Fragrance Tested	Average weight loss per day (mg/day)
Device of Present Application	Tropical A	353
Comparative Commercial Embodiment 1	Tropical A	400
Device of Present Application	Fresh	353
Comparative Commercial Embodiment 2	Fresh	547
Device of Present Application	Floral	148
Comparative Commercial Embodiment 3	Floral	665
Device of Present Application	Tropical B	191

[0163] The results are also shown graphically in Figure 12. Based on the average weight loss per day, the devices of the present application are predicted to have a longevity of about 1 to 2 months.

[0164] The results demonstrate that the liquid-evaporate delivery devices of the present application can yield amounts of fragrance comparable to devices that employ heat to help facilitate evaporation. It is understood that so long as the device, depending on room size, delivers about 100 to 800 mg/day, a hedonically pleasing result can be obtained. As shown in Figure 11, and most importantly, the devices of the present application also yield a relatively constant amount of fragrance over a period of about 20 days. Furthermore, the quality and character of the fragrance, i.e. the smell perceived by the user, was substantially the same over the period tested.

Example 2

[0165] The longevity of fragrance emissions over 28 days using a device shown generally in Figure 2 was compared to commercially available units described in Example 1. A tropical fragrance, a fresh fragrance and a floral fragrance were tested. The devices were left on continuously for 28 days or 35 days and the strength of smell was evaluated by evaluators skilled in the fragrance art on a scale of 1 (weak) to 5 (strong). The device of the present application was charged with 12 grams of fragrance and the control devices were charged with between 20 and 26 grams of fragrance.

[0166] The results of the longevity analysis are shown below in Table 2:

[0167] **Table 2**

Device/Fragrance	Initial (Day 0)	Day 7	Day 14	Day 21	Day 28	Day 35
Device of Present Application/ Fresh (12 g)	5	5	5	4.5	4.5	4.5
Comparative Commercial Embodiment 1/ Fresh (20.5 g)	5	5	5	4.5	4	3.5
Comparative Commercial Embodiment 2/ Fresh (26 g)	5	5	5	4.5	4.5	4
Device of Present Application/ Tropical (12 g)	5	5	5	5	5	NA
Comparative Commercial Embodiment 1/ Tropical (20.5 g)	5	5	4.5	4.5	4.5	NA

Comparative Commercial Embodiment 2/ Tropical (26 g)	5	5	5	5	5	NA
Device of Present Application/ Floral (12 g)	5	5	4.5	4.5	4.5	4.5
Comparative Commercial Embodiment 1/ Floral (20.5 g)	5	5	4	3	2.5	3
Comparative Commercial Embodiment 1/ Floral (26 g)	5	5	4	4.5	4	4

[0168] As shown in Table 2, each device tested emitted a strong fragrance for the first 14 days of operation. At day 21 onward, however, the device of the present application performed as well as, or better than commercially available devices that were initially loaded with more fragrance. The example demonstrates that the device of the present application is more efficient at delivering a unit amount of fragrance to the ambient air.

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[0169] The above-mentioned patents, applications, test methods, and publications are hereby incorporated by reference in their entirety.

[0170] Many variations of the present invention will suggest themselves to those skilled in the art in light of the above detailed description. All such obvious variations are within the fully intended scope of the appended claims.

15

CLAIMS

1. A liquid-evaporate delivery device comprising:
 - (a) a container containing a substance or mixture of substances to be evaporated;
 - 5 (b) a wick having a first end, a second end and an exterior surface, the first end disposed within the bottle and the second end and exterior surface disposed exterior to the bottle;
 - (c) a device configured to impart an air flow on the wick;
 - (d) an optional heater element operatively engaged with the bottle; and
 - 10 (e) a housing, the bottle, heater element and device configured to impart an air flow disposed within the housing;wherein the air flow rotates around the exterior surface of the wick.
2. The liquid-evaporate delivery device of claim 1, wherein the substance to be evaporated is selected from a fragrance, an essential oil, a malodor control
- 15 composition, a therapeutic gel, a therapeutic liquid, an insecticide or an insect repellent or pest repellent, or any combination thereof.
3. The liquid-evaporate delivery device of claim 1, wherein the substance to be evaporated is a fragrance.
4. The liquid-evaporate delivery device of claim 1, wherein the device configured to
- 20 impart an air flow on the wick is a fan.
5. The liquid-evaporate delivery device of any one of claims 2, 3, or 4, wherein the air flow is substantially laminar.

6. The liquid-evaporate delivery device of any one of claims 2, 3, or 4, wherein the wick is selected from a nylon, a linen, a felt, a rayon, a polyamide, a polymer such as polypropylene or polyethylene, polyester fibers, cellulose acetate fibers, ceramic, sintered glass, glass fibers, a plastic, a cotton, a cellulose or mixtures thereof.
- 5 7. The liquid-evaporate delivery device of claim 4 wherein the fan is aligned with the central axis of the wick.
8. The liquid-evaporate delivery device of any one of claims 2, 3, or 4, wherein the air flow rotates around the exterior surface of the wick via a helical channel that is
- 10 provided by at least one baffle.
9. The liquid-evaporate delivery device of claim 8, wherein the wick is parallel and concentric to the central axis of the helical channel.
10. The liquid-evaporate delivery device of claim 8, wherein the helical channel is provided by two or more baffles.
- 15 11. The liquid-evaporate delivery device of claim 3, wherein the device delivers a substantially uniform amount, quality and character of fragrance each day over a period of at least about 30 days.
12. A method of providing fragrance to an air space comprising the step of imparting air flow to the liquid-evaporate delivery device of claim 1.
- 20 13. A liquid-evaporate delivery device comprising:
- (a) a retention member containing a substance or mixture of substances to be evaporated;
- 25 (b) an evaporation member operatively engaged with the retention member;

- (c) a device configured to impart air flow on the evaporation member;
 - (d) a housing, the retention member and fan disposed within the housing;
- 5 wherein the housing includes at least one baffle that defines a helical channel for directing the air flow around the exterior surface of the wick.

14. The liquid-evaporate delivery device of claim 13, wherein the evaporation member comprises a wick in communication with a liquid.

- 10 15. The liquid-evaporate delivery device of claim 14, wherein the liquid is a fragrance composition.

16. The liquid-evaporate delivery device of claim 13, wherein the air flow is substantially laminar.

- 15 17. A liquid-evaporate delivery device comprising

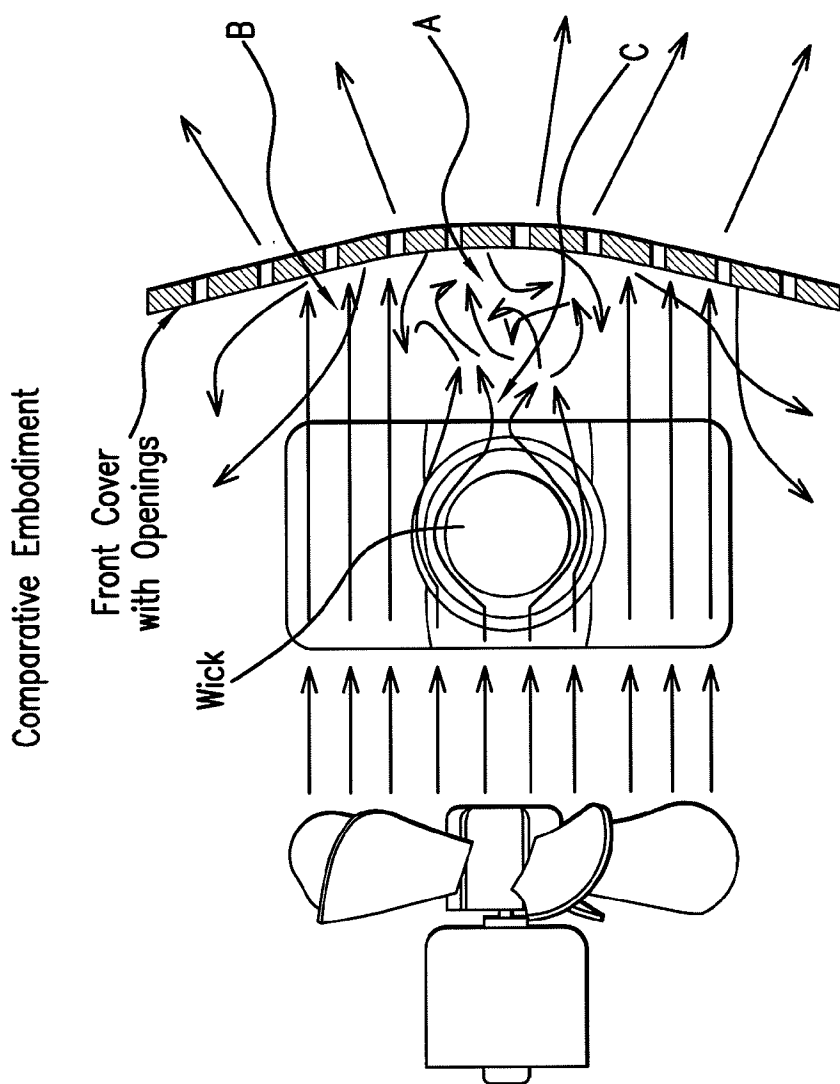
- (a) a bottle containing a substance or mixture of substances to be evaporated;
- (b) a wick, the wick having a longitudinal axis defined by a lower portion
- 20 disposed within the bottle and an upper portion protruding from the bottle, the wick configured to draw the substance to be evaporated from the bottle toward the upper portion of the wick;
- (c) a fan having a central axis; and
- (d) a housing for retaining the bottle and the fan;
- 25 wherein the longitudinal axis of the wick is aligned with the central axis of the fan.

18. The liquid-evaporate delivery device of claim 17, wherein the air rotates around the exterior surface of the wick.
19. The liquid-evaporate delivery device of claim 18, wherein the air rotates around the exterior surface of the wick via a helical channel.
20. The liquid-evaporate delivery device of claim 19, wherein the substance to be evaporated is a liquid fragrance composition.
21. The liquid-evaporate delivery device of claim 20, wherein the device delivers a substantially uniform amount, quality and character of fragrance each day over a period of at least about 30 days.
22. A method of providing fragrance to an air space comprising the step of imparting air flow to the liquid-evaporate delivery device of claim 21.
23. A kit comprising a replacement container containing a substance or mixture of substances to be evaporated and instructions to employ the replacement container in the liquid-evaporate delivery device of any one of claims 1 to 21.
24. A method of providing therapeutic benefit to a subject in need thereof, comprising inserting an essential oil and/or a major constituent of an essential oil, into a liquid-evaporate delivery device of any one of claims 1 to 21.

25. The method of claim 24, wherein the therapeutic benefit is treatment or prevention of a bacterial infection.

26. The method of claim 25, wherein the bacterial infection is a respiratory tract
5 infection.

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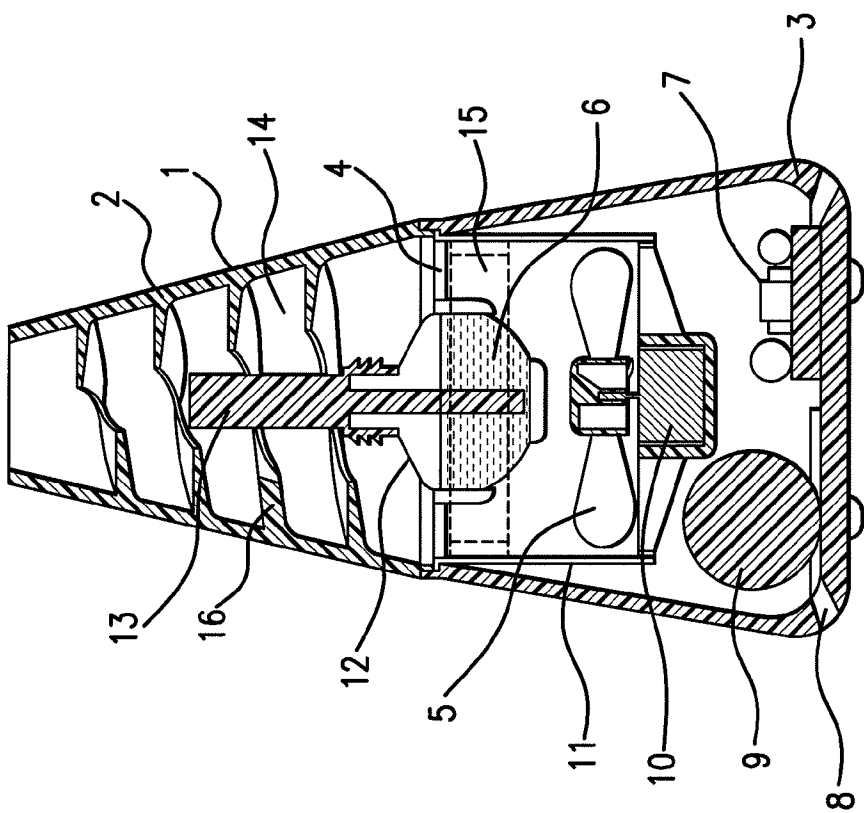


FIG. 2

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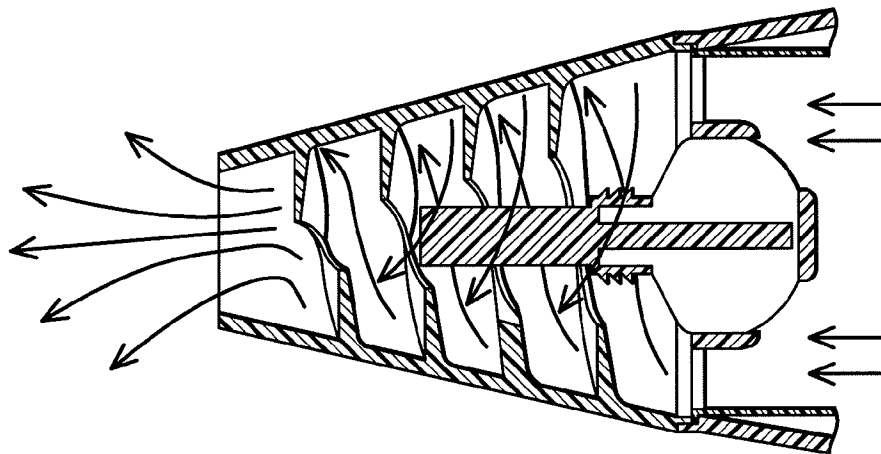


FIG.3

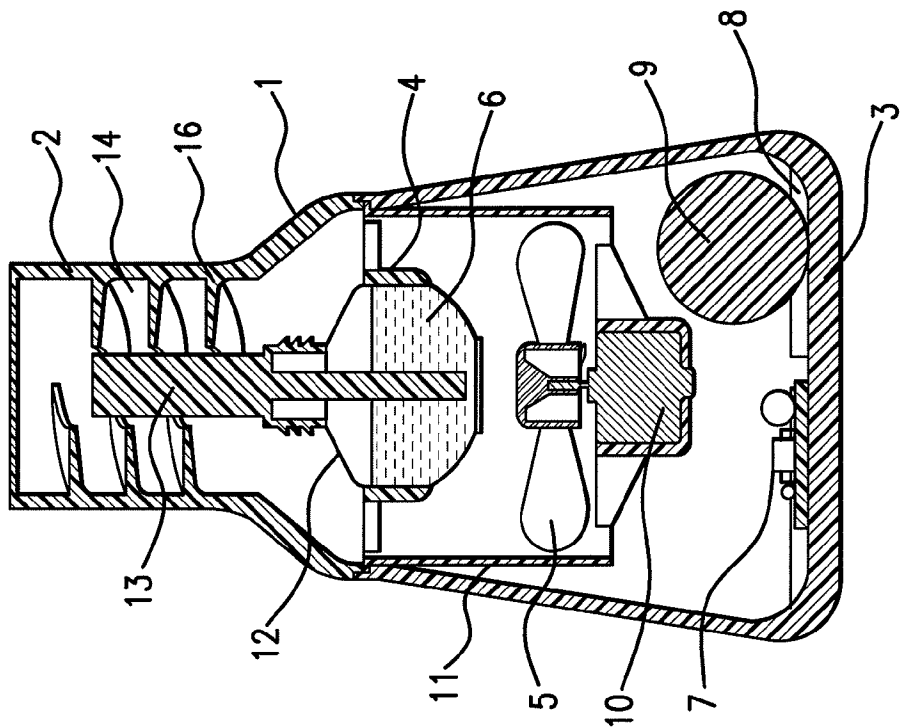


FIG.4

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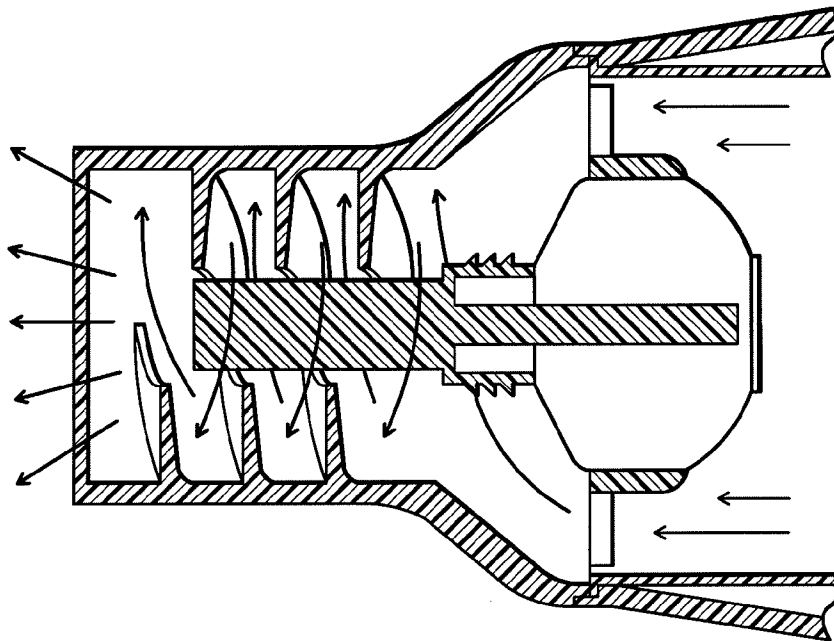


FIG.5

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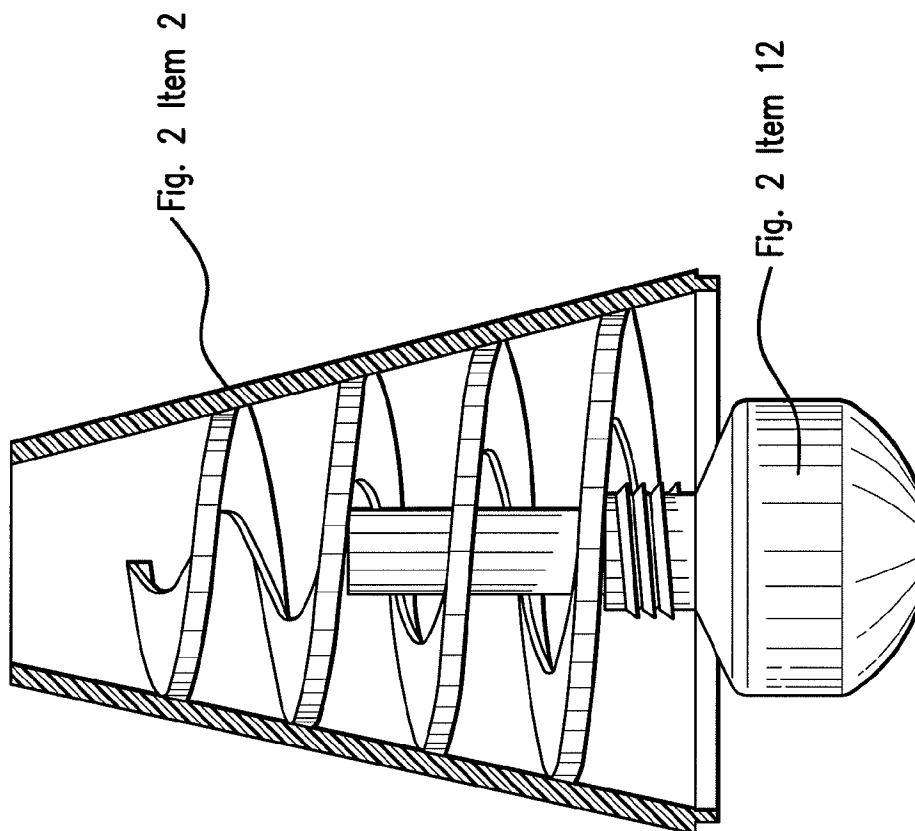


FIG. 6

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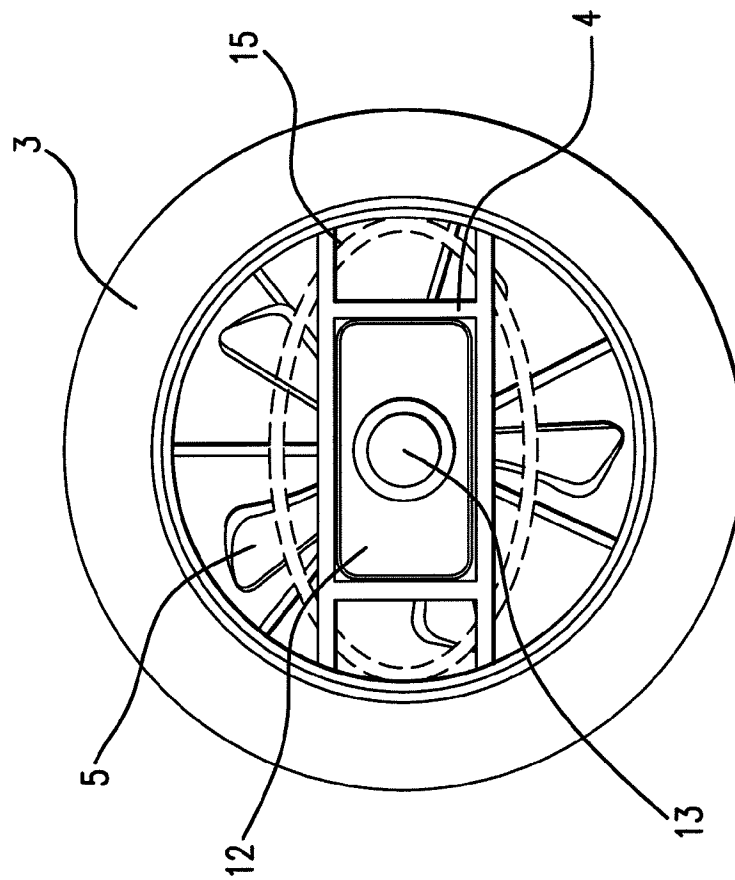


FIG. 7

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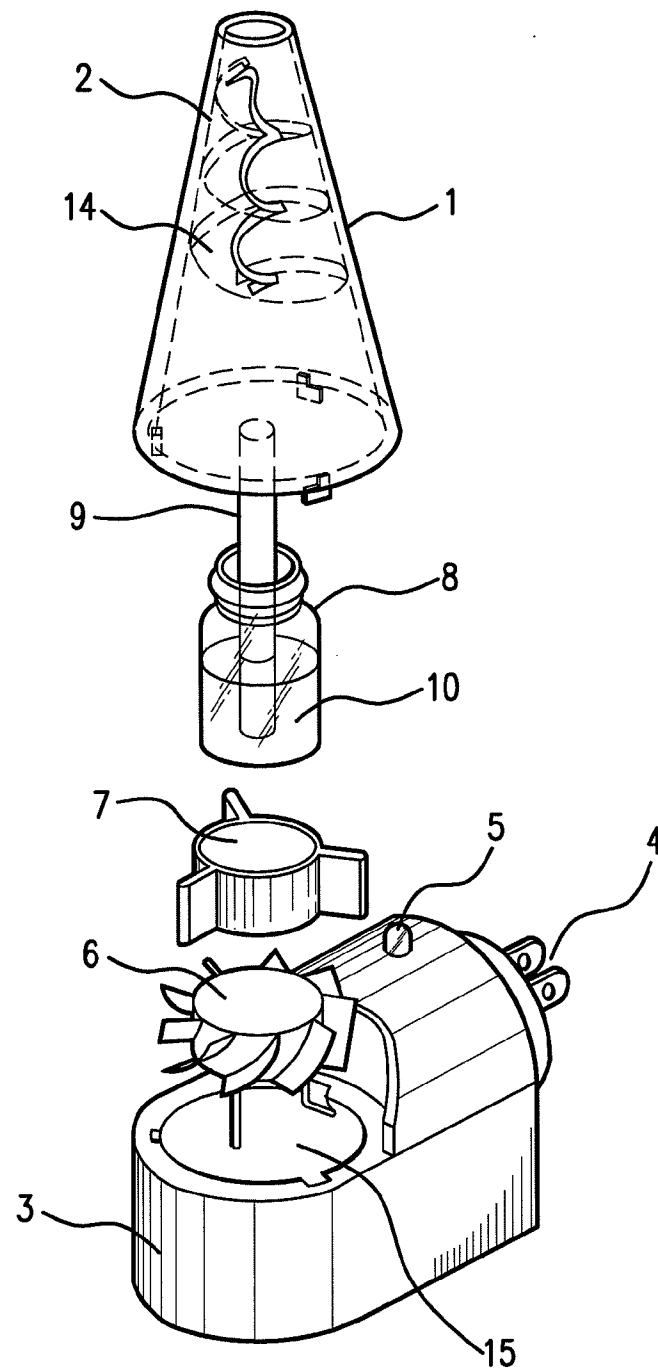


FIG.8

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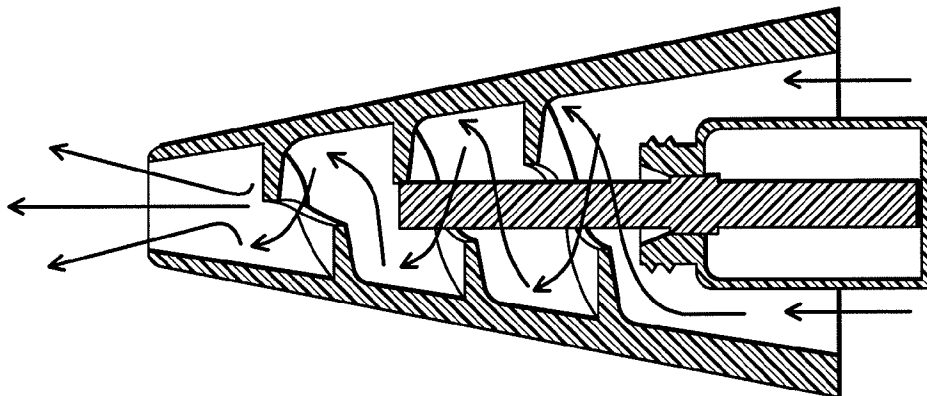


FIG. 9

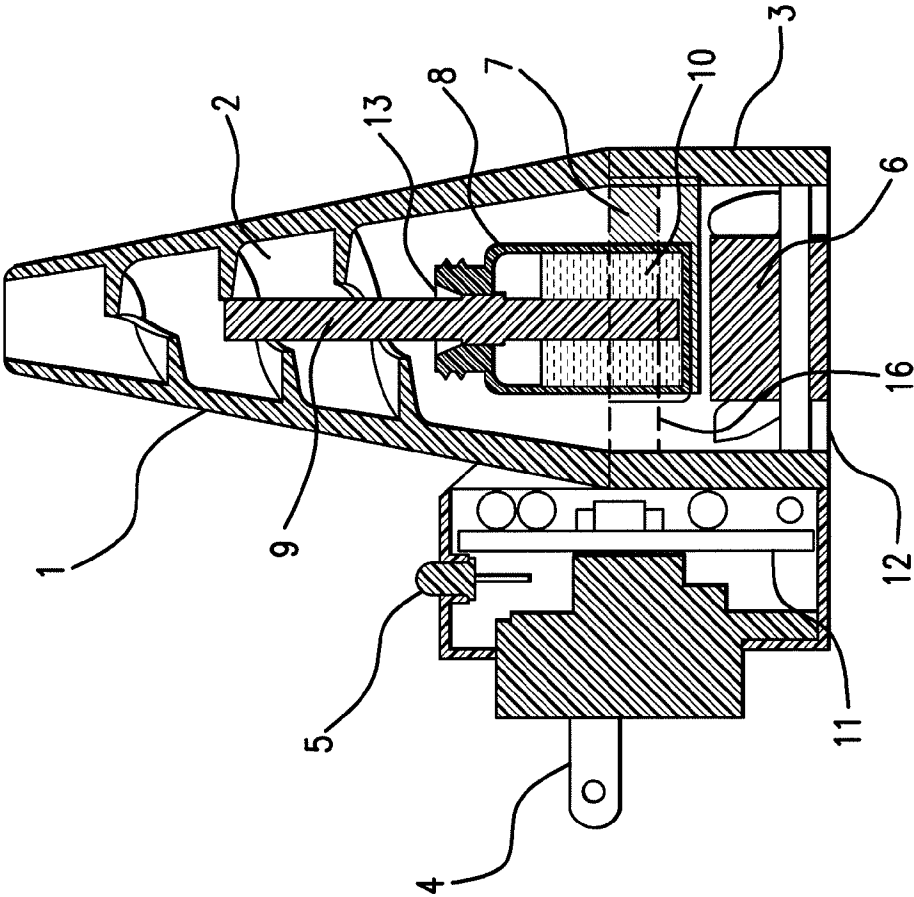


FIG. 10

11/12

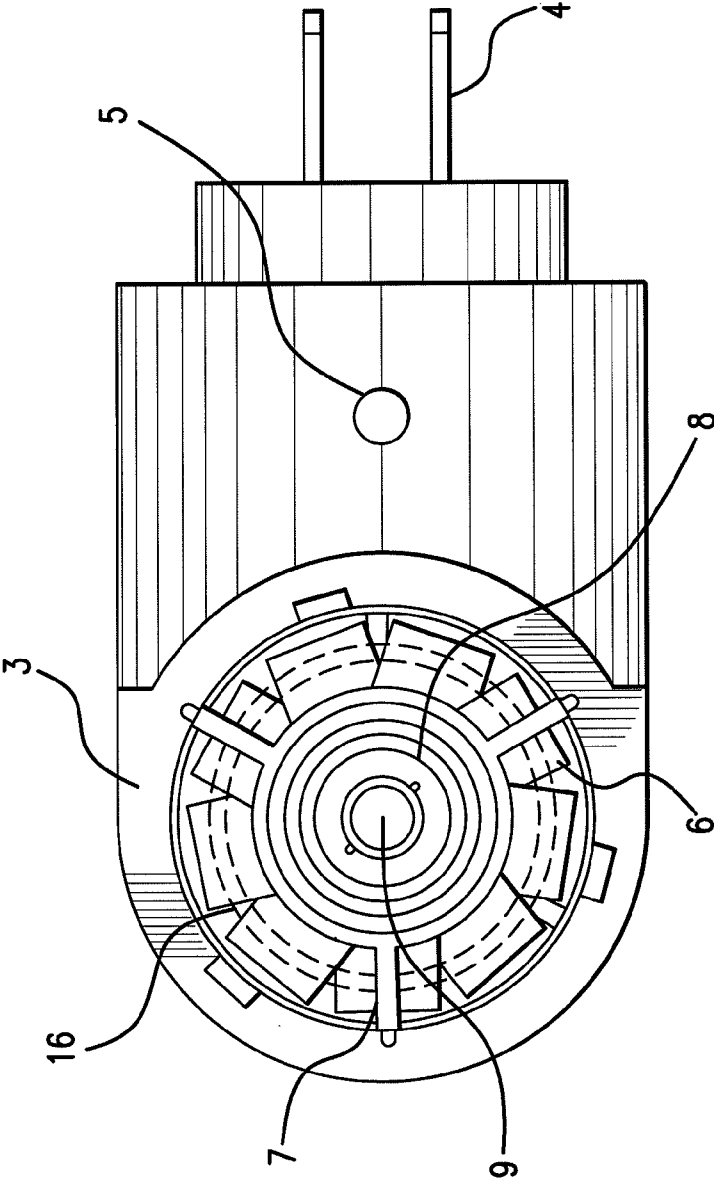


FIG. 11

12/12

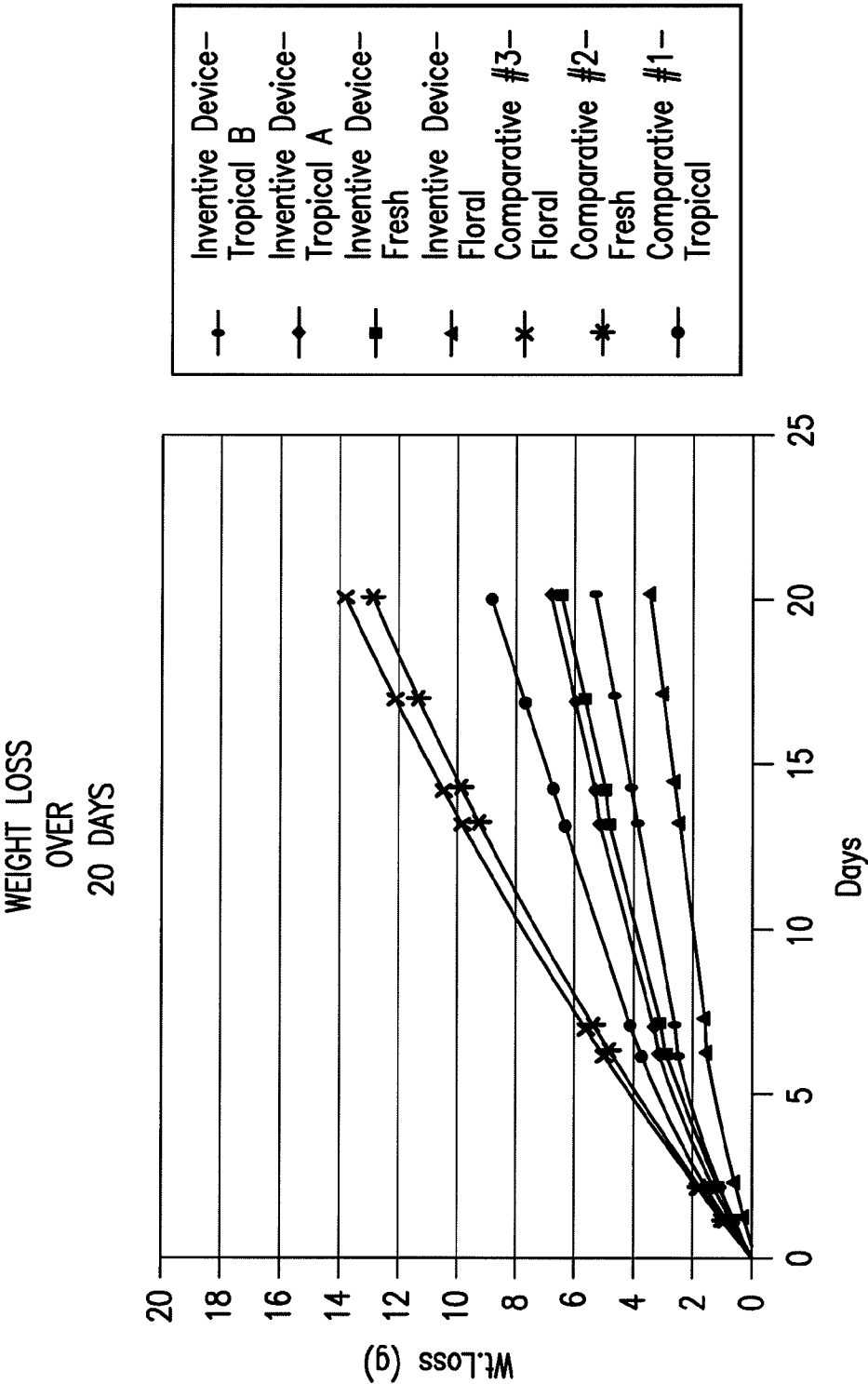


FIG.12

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2008/069176

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A61L 9/04 (2008.04)

USPC - 239/51.5

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - A61L 9/04 (2008.04)

USPC - 239/41, 42, 43, 44, 51.5, 55, 128

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

USPTO West System (US, USPG-PUB, EPO, DERWENT), MicroPatent, IP.com,

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 1,984,055 A (CARTER) 11 December 1934 (11.12.1934) entire document	1-22
Y	US 7,093,949 B2 (HART et al) 22 August 2006 (22.08.2006) entire document	1-22
Y	US 6,371,450 B1 (DAVIS et al) 16 April 2002 (16.04.2002) entire document	8-10 13-16, 19-22

☐ Further documents are listed in the continuation of Box C.


* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

20 September 2008

Date of mailing of the international search report

30 SEP 2008

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Blaine R. Copenheaver

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PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2008/069176

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 23-26
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.