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(54) **FLUID DISPERSION ASSEMBLY**

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(51) **Int. Cl.**
B05B 7/06 (2006.01)
B05B 7/24 (2006.01)
A61L 9/14 (2006.01)
B05B 15/04 (2006.01)
B05B 14/00 (2018.01)

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CPC **B05B 7/2424** (2013.01); **A61L 9/14** (2013.01); **B05B 7/2491** (2013.01); **B05B 7/2494** (2013.01); **B05B 14/00** (2018.02); **B05B 15/0406** (2013.01)

(58) **Field of Classification Search**

CPC B05B 7/2405; B05B 15/00; B05B 7/0425; B05B 7/005; B05B 7/006; B05B 17/0646; B05B 17/04; B05B 7/0012; B05B 7/2494; B05B 7/2491; B05B 15/0406; B05B 11/08; B05B 11/3042; A61M 15/0036; A61M 16/14; A61M 16/201; A61M 11/06; A61L 9/14
USPC 239/427, 310
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,878,418 B2	2/2011	Sevy
7,913,933 B2	3/2011	Van Roemburg
7,930,068 B2	4/2011	Robert et al.
D645,947 S	9/2011	Sevy
9,126,215 B1	9/2015	Levy et al.
9,527,094 B1	12/2016	Levy et al.
2009/0025794 A1	1/2009	Dorendorf et al.
2009/0317504 A1	12/2009	Rajala et al.
2014/0202457 A1*	7/2014	Addington A61M 15/0036 128/200.21

* cited by examiner

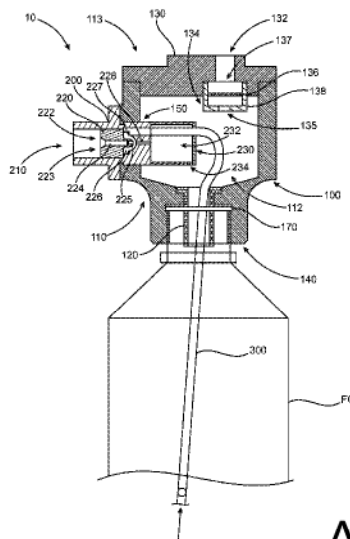
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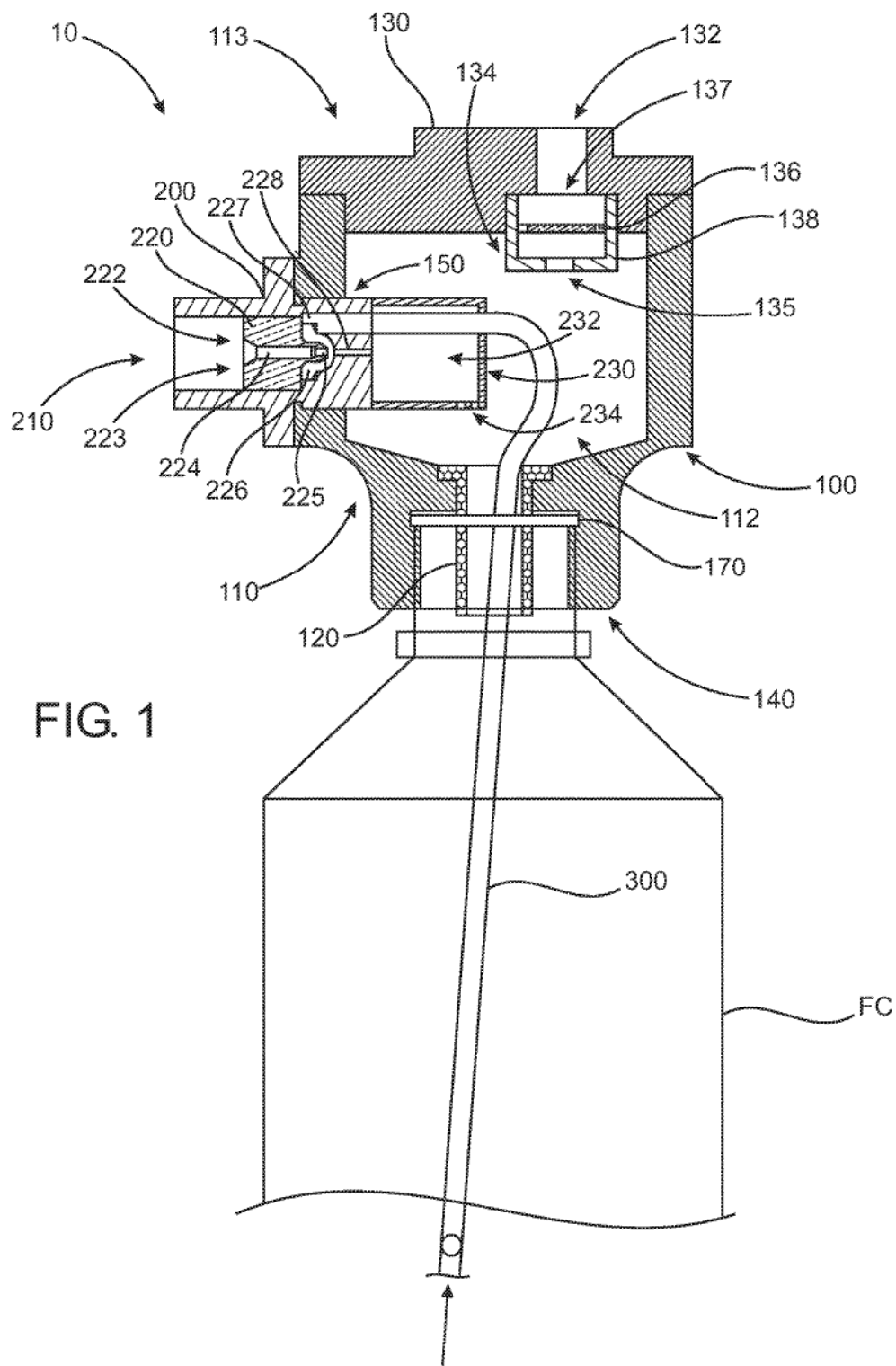
(57) **ABSTRACT**

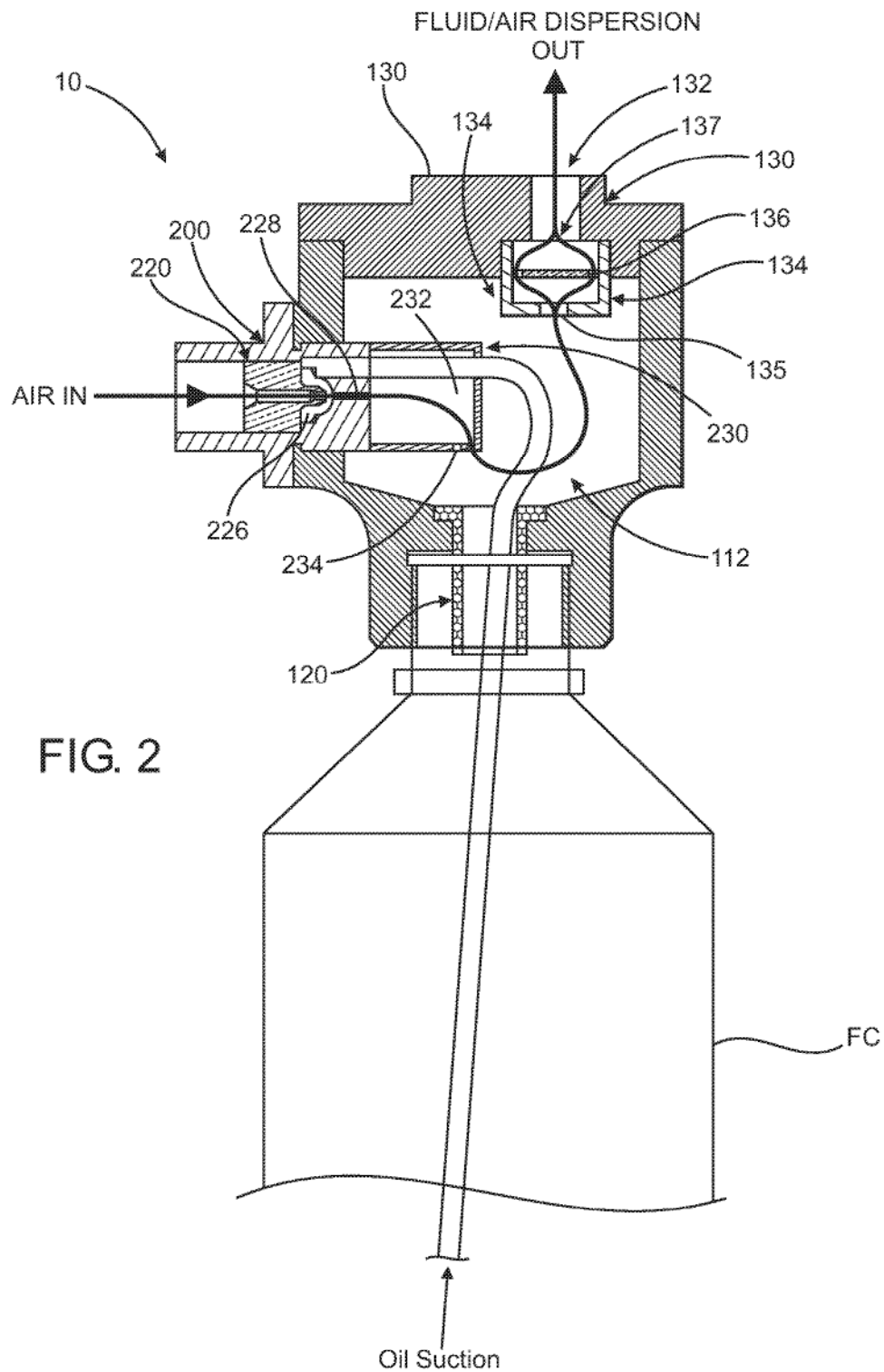
A fluid dispersion assembly comprises a diffusion unit disposed in fluid communication with a fluid container, the assembly being powered by a compressed air source. The diffusion unit at least partially defines a diffusion chamber, and includes a diffusion assembly containing an atomizer assembly which, in combination with the diffusion chamber, generates a fluid dispersion from a mixture of compressed air and an operative fluid, for example, fragrant oils, essential oils, odor neutralizers, disinfectants such as triethylene glycol, air sanitizers, etc.

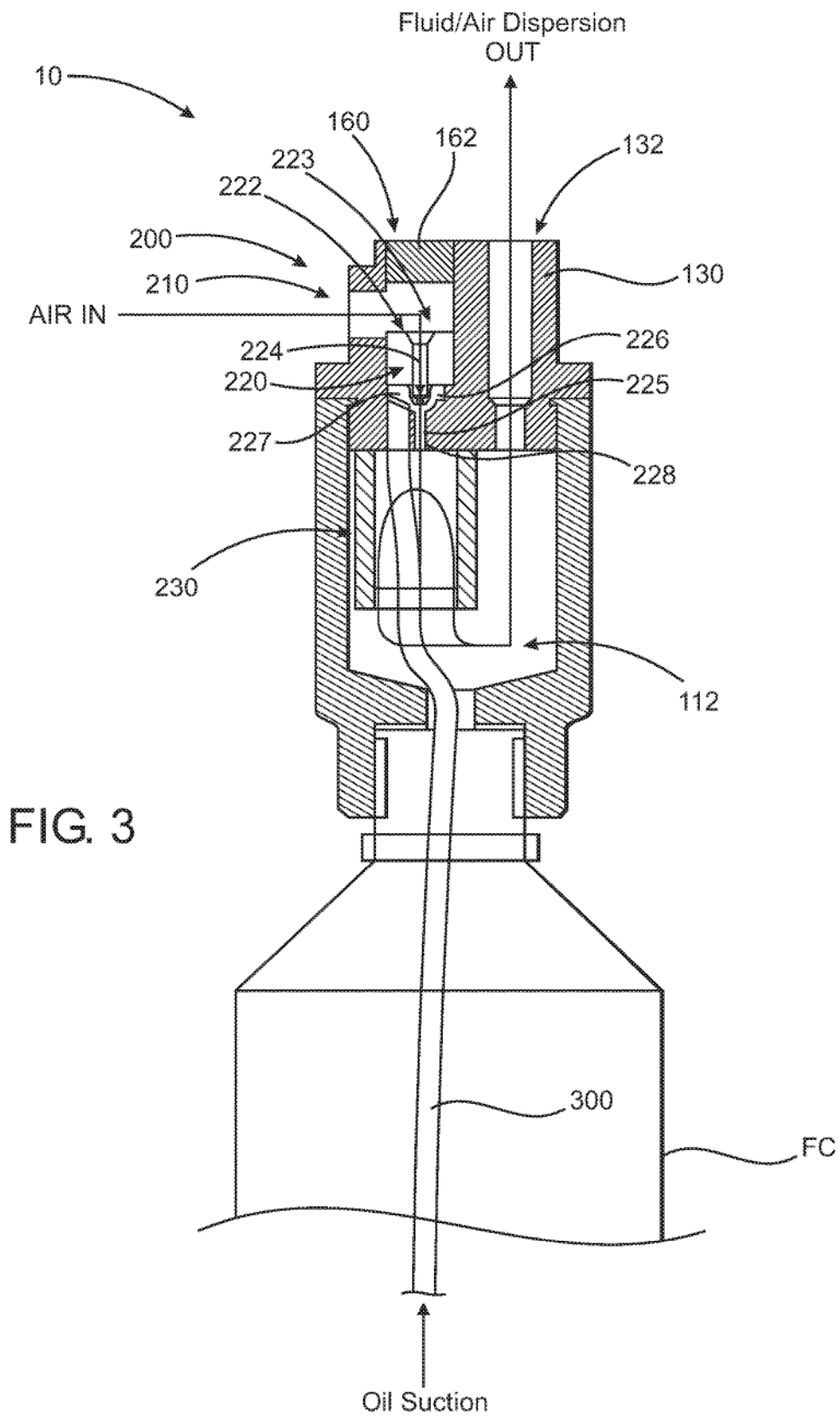
15 Claims, 6 Drawing Sheets



Aroma360 - Exhibit 1001







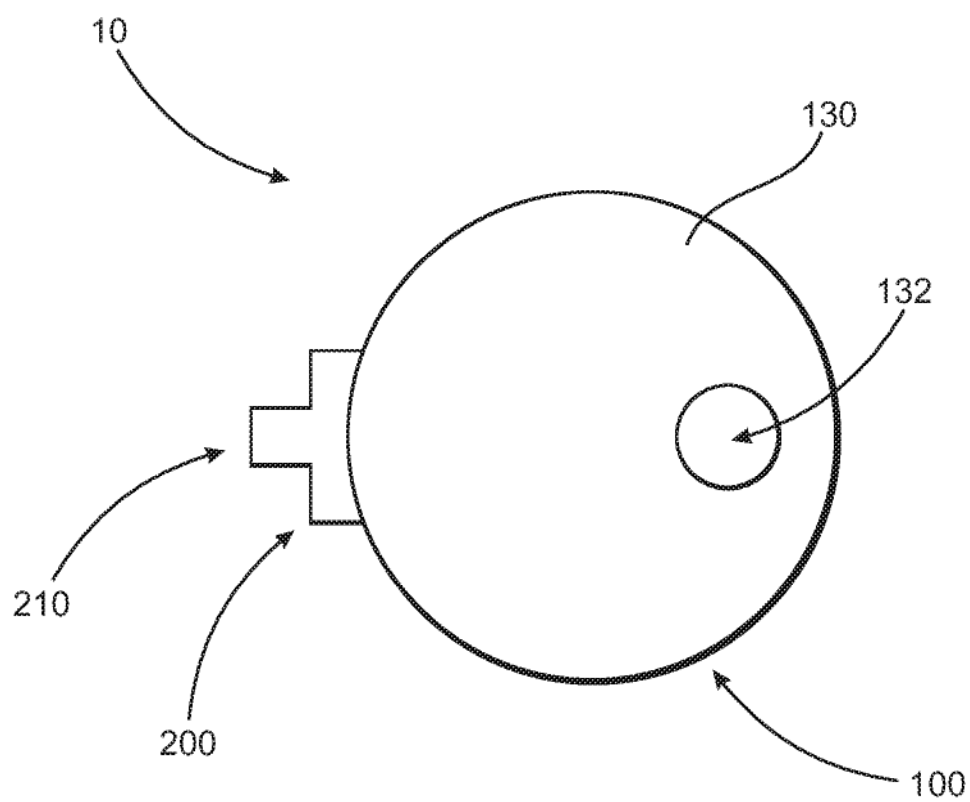


FIG. 4

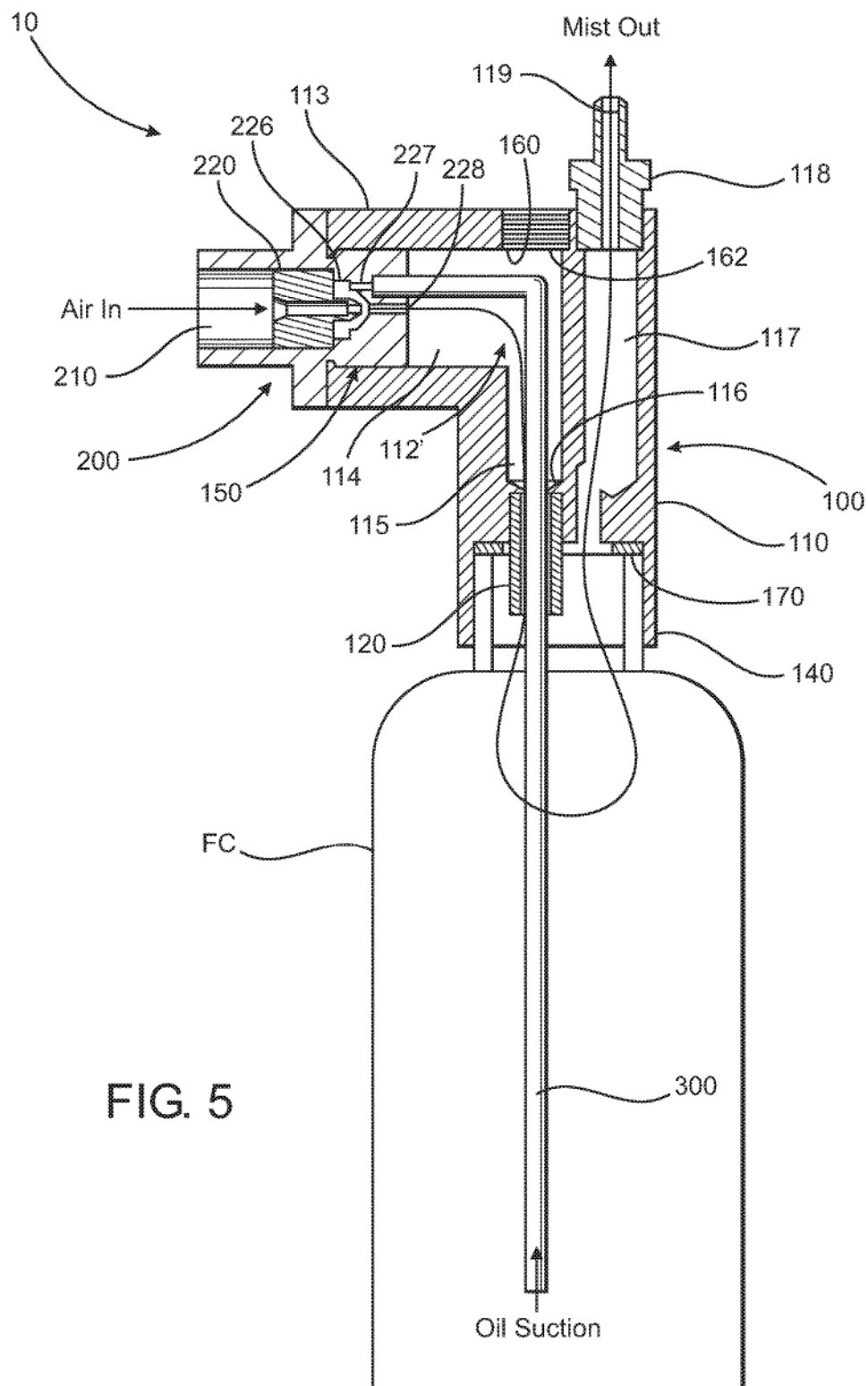
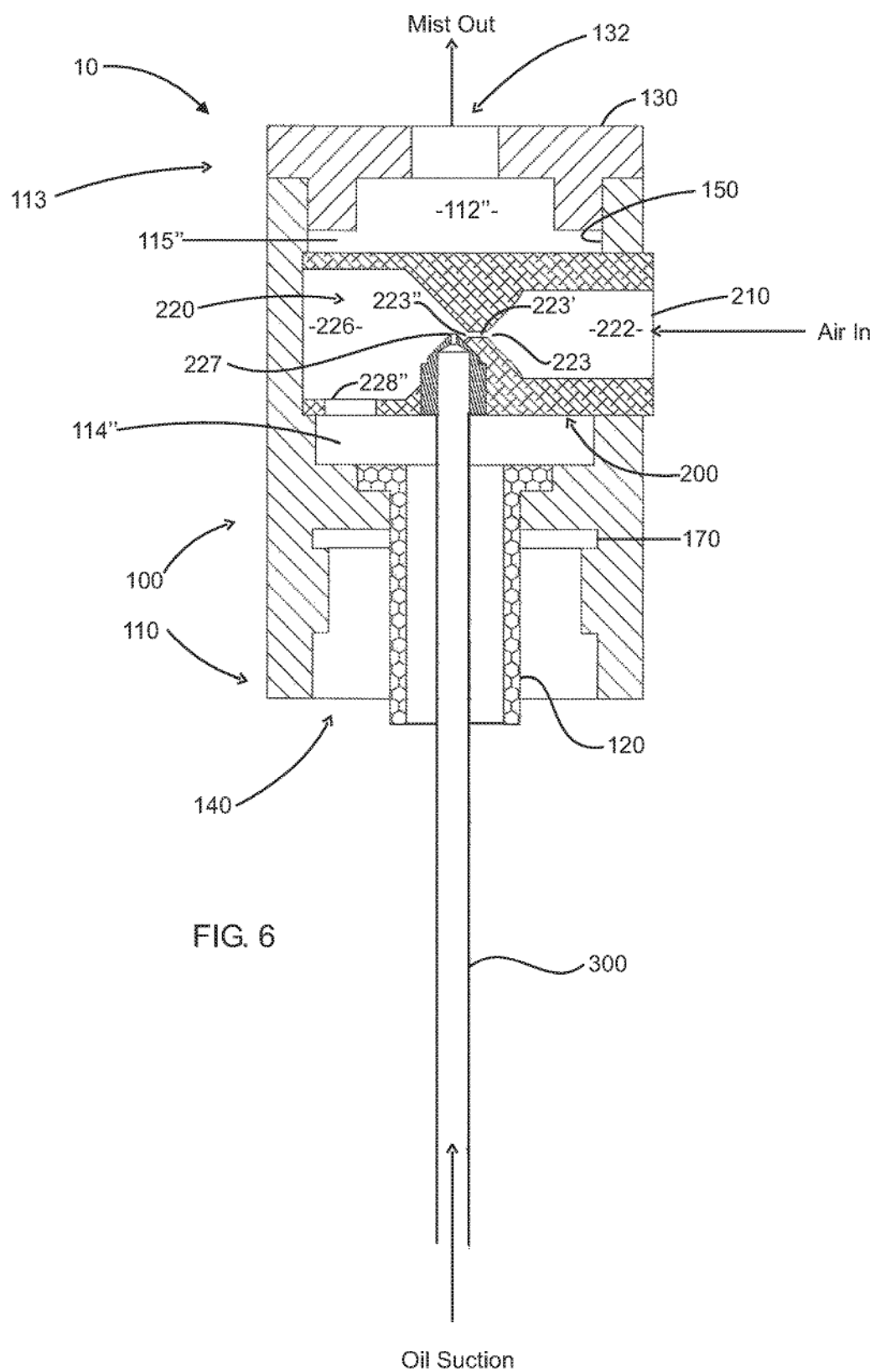


FIG. 5



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FLUID DISPERSION ASSEMBLY**BACKGROUND OF THE INVENTION****Field of the Invention**

This invention relates generally to the field of dispersion of various fluids including, but not limited to, fragrant oils, essential oils, odor neutralizers, disinfectants, e.g., triethyl-ene glycol, air sanitizers, and the like, into a generally enclosed airspace.

Description of the Related Art

There are various devices that can be used to deliver fragrant oils, essential oils, as well as other fluids into the air. Spray cans are commonly used, however, such devices require a user to repeatedly and manually spray when and where necessary. Plug-in devices that heat oils for dispersion into the air are also commonly used, but they require constant heating of the oil via an electrical outlet, which consumes energy and poses a potential fire hazard.

Fluid diffusion devices utilizing forced and/or compressed air for delivery of fragrant oils, essential oils, or other liquids are desirable alternatives to spray cans and plug-in devices since they do not require heating or constant user interaction, however, they have drawbacks as well. One drawback of many known fluid diffusion devices utilizing forced air is that they tend to make an undesirable and often, depending on the location, such as an office or other place of business, a disruptive amount of noise when in operation. In particular, the release of a fluid dispersed in the forced and/or compressed air from such a device is often unacceptably noisy.

As such, there is a need for a fluid dispersion assembly that is designed to significantly reduce the amount of noise generated during operation. A further need exists for such a fluid dispersion assembly to not only operate more quietly, but to operate quietly while generating a fluid dispersion in air having a uniform particle size distribution, such that dosing of an airspace with a particular liquid, whether it be oil, sanitizer, disinfectant, etc., can be predicted within acceptable limits.

SUMMARY OF THE INVENTION

The present invention addresses the need for a forced air diffusion and dispersion assembly for fluids such as fragrant oils, essential oils, odor neutralizers, disinfectants, air sanitizers, etc., that significantly reduces the amount of noise generated during operation. In at least one embodiment, the present invention is directed to a fluid dispersion assembly which operatively engages a fluid container, and is powered by a compressed air source. The fluid dispersion assembly includes a diffusion unit having oppositely disposed ends, which at least partially defines a diffusion chamber. The diffusion chamber is structured so as to facilitate formation of a fluid dispersion comprising a plurality of substantially uniform droplets prior to discharge from the diffusion chamber.

In at least one embodiment, a cap is cooperatively configured in sealing engagement with one of the oppositely disposed ends of the diffusion unit. Furthermore, the cap may be removably attached to the diffusion unit. The cap includes a discharge port disposed in communication with the diffusion chamber such that the fluid dispersion can exit the diffusion chamber and into an airspace surrounding the

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fluid dispersion assembly, while the assembly is in use. In some embodiments, the cap may include a service access port disposed therethrough. The service access port may also include a service access plug removably disposed therein, wherein removal of the service access plug allows for removal, repair, and/or cleaning of the internal components of the fluid dispersion assembly.

The present fluid dispersion assembly, in at least one embodiment, further includes a container interconnect affixed to a different one of the oppositely disposed ends of the diffusion unit which is cooperatively structured to interconnect the diffusion unit to the fluid container in a substantially sealed relationship. In at least one embodiment, a sealing washer is provided to facilitate formation of the substantially sealed relationship, and a drip tube is disposed in an interconnecting relation between the diffusion chamber and the fluid container, in at least one further embodiment, to protect the sealing washer from contact with the operative fluid(s).

In one embodiment, a diffusion assembly is disposed in an operative engagement with the diffusion unit via a cartridge port. The diffusion assembly is removably engaged with the cartridge port, in at least one embodiment. In some embodiments, the cartridge port is disposed directly through the diffusion unit between the oppositely disposed ends. The cartridge port may be oriented on the diffusion unit such that the diffusion assembly is at a substantially perpendicular orientation to the diffusion unit upon engagement therewith. In at least one other embodiment, a cartridge port is disposed through the cap. The diffusion assembly comprises an atomizer assembly, which in one embodiment comprises an inlet channel, a mixing chamber, and an atomizer exhaust channel, wherein the inlet channel is interconnected to the compressed air source and the mixing chamber comprises a fluid inlet disposed in fluid communication with the fluid in the fluid container. Compressed air and fluid are initially mixed together in the mixing chamber to form a fluid dispersion.

These and other objects, features and advantages of the present invention will become clearer when the drawings as well as the detailed description are taken into consideration.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the nature of the present invention, reference should be had to the following detailed description taken in connection with the accompanying drawings in which:

FIG. 1 is a cross-sectional elevation illustrative of one embodiment of a fluid dispersion assembly as disclosed in the present specification.

FIG. 2 is a cross-sectional elevation illustrative of another embodiment of a fluid dispersion assembly as disclosed in the present specification.

FIG. 3 is a cross-sectional view illustrative of yet another embodiment of a fluid dispersion assembly as disclosed in the present specification.

FIG. 4 is a plan view illustrative of an embodiment of a fluid dispersion assembly as disclosed in the present invention.

FIG. 5 is a cross-sectional elevation illustrative of one further embodiment of a fluid dispersion assembly in accordance with the present specification.

FIG. 6 is a cross-sectional elevation illustrative of yet another further embodiment of a fluid dispersion assembly in accordance with the present specification.

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Like reference numerals refer to like parts throughout the several views of the drawings.

DETAILED DESCRIPTION

As illustrated in the accompanying figures, and with initial reference to FIGS. 1 and 2, the present invention is directed to a fluid dispersion assembly, generally indicated as **10**, powered by a compressed air source. In at least one embodiment, the fluid dispersion assembly **10** is further structured to operatively engage a fluid container (FC). The fluid dispersion assembly **10** is structured to combine an amount of an operative fluid with compressed air to generate a fluid dispersion.

More in particular, a “fluid dispersion” in accordance with the present specification shall mean a mixture of an operative fluid in air comprising a plurality of substantially uniform droplets of the operative fluid dispersed throughout the air. Further, and once again, as used in the present specification, “substantially uniform droplets” shall mean droplets having substantially the same diameter. In at least one embodiment, the plurality of “substantially uniform droplets” each have a diameter in the range of about one micron (1 μm), in another embodiment, the diameter of the droplets is in the range of about three microns (3 μm), and, in one further embodiment, droplet diameter is in the range of about five microns (5 μm).

The fluid dispersion assembly **10** includes a diffusion unit **100** having oppositely disposed ends, as at **110** and **113**, in at least one embodiment. The diffusion unit **100** at least partially defines a diffusion chamber **112**, and in at least one embodiment, the diffusion chamber **112** is substantially enclosed within diffusion unit **100**. The diffusion unit **100** may be constructed of any rigid material or materials which are chemically inert, or at least chemically resistant to the intended operative fluid(s) which include, but once again are not limited to, fragrant oils, essential oils, essential oil extracts, odor neutralizers, disinfectants, e.g., triethylene glycol, air sanitizers, etc. Further, the material of construction selected for the diffusion unit **100** must be capable of withstanding compressed air at operative pressures, which may range anywhere from about 5 to 50 psig, in most embodiments of the present fluid dispersion assembly **10**. In one lower pressure embodiment, the operating pressure of the present fluid dispersion assembly **10** is in the range of about 5 to 10 psig, and in one further embodiment, the operating pressure is in a range of between about 5 to 7 psig. Conversely, a higher pressure embodiment of the present fluid dispersion assembly **10** operates at pressures in the range of about 20 to 25 psig, and in the range of between about 23 to 24 psig in yet one further embodiment. As such, the material or materials of construction of a diffusion unit **100** in accordance with the present invention may include metals, engineered plastic materials, e.g., polyvinyl chloride, high-density polyethylene, etc., and/or composite materials, just to name a few.

In one embodiment, a cap **130** is cooperatively configured and disposed in a sealing engagement with one of the oppositely disposed ends **110**, **113** of the diffusion unit **100**. The cap **130** includes a discharge port **132** therethrough in communication with the diffusion chamber **112**, and provides a point of release of the fluid dispersion from the diffusion chamber **112** into the airspace surrounding the fluid dispersion assembly **10**. In at least one embodiment, the cap **130** is removably attached in a sealing engagement to the diffusion unit **100**. FIG. 4 is a plan view of the embodiment of the fluid dispersion assembly **10** as shown in FIGS. 1 and

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2, and shows the cap **130** having a discharge port **132** disposed therethrough. As shown in the embodiment of FIG. 3, the cap **130** may include a service access port **160** disposed therethrough. The service access port **160** includes a service access plug **162** removably disposed therein, wherein removal of the service access plug **162** allows access for removal and cleaning or repair of a diffusion assembly **200**, as disclosed in greater detail below.

The fluid dispersion assembly **10**, in at least one embodiment, includes a container interconnect **140** which is cooperatively structured to interconnect the diffusion unit **100** to the fluid container (FC) in a substantially sealed relationship. In one embodiment, the container interconnect **140** is disposed at a different one of the oppositely disposed ends **110**, **113**, opposite of cap **130** of the diffusion unit **100**. A sealing washer **170** is disposed between the diffusion unit **100** and the fluid container (FC), in at least one embodiment, so as to provide a substantially sealed relationship between the diffusion unit **100** and the fluid container (FC). The sealing washer **170** may be constructed from any of a variety of materials such as, but not limited to, rubber, nylon, plastic, PVC, TEFLON, or a composite material, once again, provided the material of construction is chemically inert or at least chemically resistant to the operative fluid(s).

In one further embodiment of a fluid dispersion assembly **10** in accordance with the present invention, a drip tube **120** is disposed in an interconnecting relation between the diffusion unit **100** and the fluid container (FC). As shown in FIGS. 1 and 2, the drip tube **120** is disposed through a sealing washer **170**, and thus, the drip tube **120** serves to minimize contact between the sealing washer **170** and the operative fluid, by essentially preventing the operative fluid from making contact in and around the sealing washer **170** disposed between the fluid container (FC) and the container interconnect **140**. More in particular, the drip tube **120** channels any operative fluid which may agglomerate and/or accumulate in the diffusion chamber **112** through the drip tube **120** directly back into the fluid container (FC) without contacting the sealing washer **170**, once again, as shown in FIGS. 1 and 2.

The container interconnect **140** may be structured in a variety of ways to allow interconnection to the fluid container (FC). As one example, the container interconnect **140** may be threaded, internally or externally, such that the diffusion unit **100** is interconnected to the fluid container (FC) by screwing the container interconnect **140** into place onto corresponding threads on the neck of the fluid container (FC). In at least one other embodiment, the container interconnect **140** comprises one portion of a quick-connect type fitting and the fluid container (FC) comprises a complementary portion of such a quick-connect type fitting whereby once operatively engaged, a substantially sealed relationship is created between the diffusion unit **100** and the fluid container (FC). In at least some embodiments, the substantially sealed relationship is further enhanced by a sealing washer **170**, as disclosed above.

In at least one embodiment, a cartridge port **150** is provided into the diffusion chamber **112** to facilitate operative engagement of a diffusion assembly **200** with the diffusion chamber **112**. The diffusion assembly **200** may be removably engaged with the cartridge port **150** to aid in removal and replacement and/or cleaning of the diffusion assembly **200** and/or components thereof. In some embodiments, the cartridge port **150** is disposed directly through the diffusion unit **100** and into the diffusion chamber **112**, and is positioned between the oppositely disposed ends **110**, **113**. In at least one embodiment, the cartridge port **150** is

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disposed on the diffusion unit 100 such that the diffusion assembly 200 is disposed in a substantially perpendicular orientation relative to the diffusion unit 100 when operatively engaging the cartridge port 150, such as is shown in the illustrative embodiment of FIG. 1. The diffusion assembly 200 is also shown disposed substantially perpendicular to the diffusion unit 100 in the plan view of FIG. 4. In at least one other embodiment, the cartridge port 150 is disposed through the cap 130. In yet another embodiment, the diffusion assembly 200 comprises an integral component of the cap 130 itself, such as in the embodiment of FIG. 3.

As illustrated in FIGS. 1 and 3, the diffusion assembly 200 comprises an air inlet 210 and an atomizer assembly 220. The atomizer assembly 220 comprises an atomizer air inlet channel 222, a mixing chamber 226, and an atomizer exhaust channel 228. The atomizer air inlet channel 222 is interconnected to the compressed air source via the air inlet 210. Moreover, the atomizer air inlet channel 222 may also include an inlet aperture 223, a first portion 224 and a second portion 225. The first portion 224 and the second portion 225 are collectively structured to facilitate delivery of compressed air into the mixing chamber 226. The first portion 224 of the atomizer air inlet channel 222 may comprise a larger diameter than the second portion 225, such as is shown in the illustrative embodiment of FIG. 1. Of course, it is within the scope and intent of the present invention for the atomizer air inlet channel 222 to comprise a constant diameter along its entire length, i.e., a diameter of a first portion 224 is substantially equal to a diameter of a second portion 225.

Further, the mixing chamber 226 comprises a fluid inlet 227 disposed in fluid communication with an operative fluid in the fluid container (FC) via a fluid delivery tube 300. The fluid delivery tube 300 is disposed in a fluid communicating relation between the atomizer assembly 220 and the fluid container (FC) to facilitate delivery of an amount of the operative fluid into the atomizer assembly 220. In at least one embodiment, the fluid delivery tube 300 connects to the atomizer assembly 220 via the fluid inlet 227 into the mixing chamber 226.

As shown in FIGS. 1 and 2, the fluid inlet 227 is substantially perpendicular to a compressed air flowpath through the atomizer assembly 200. More in particular, and with reference to FIG. 1, the compressed air flowpath extends horizontally through the air inlet 210, atomizer air inlet channel 222, mixing chamber 226, and out through the atomizer exhaust 228.

As such, when compressed air is supplied to the diffusion assembly 200, a corresponding amount of operative fluid is drawn into the mixing chamber 226 through the fluid delivery tube 300 as a result of the venturi effect of the compressed air flowing past the opening of the fluid inlet 227 into the mixing chamber 226. More in particular, at each different compressed air flowrate, i.e., each "predetermined amount" of compressed air which is dictated and fixed by a compressed air operating pressure supplied to diffusion assembly 200, a different corresponding and substantially constant amount, i.e., a "preselected amount" of an operative fluid corresponding to each different predetermined amount of compressed air, will be drawn into the mixing chamber 226. More importantly, the "predetermined amount" of compressed air and the "preselected amount" of the operable fluid are initially mixed together in the mixing chamber 226 to form a fluid dispersion. The diffusion chamber 112 is further structured to facilitate the formation of a plurality of

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substantially uniform droplets, as defined herein, in the fluid dispersion prior to discharge from the diffusion chamber 112 through discharge port 132.

As illustrated in FIGS. 1 and 2, the fluid dispersion assembly 10 also includes a suppressor assembly 230 disposed in communication with the diffusion assembly 200. The suppressor assembly 230 comprises a suppression chamber 232, disposed in a communicating relation with the atomizer exhaust channel 228 of the atomizer assembly 220. More in particular, the suppression chamber 232 receives the fluid dispersion from the mixing chamber 226. The suppressor assembly 230 helps to suppress the noise generated during operation of the fluid dispersion assembly 10 as it disrupts the path of flow of the fluid dispersion out of the atomizer assembly 200 and into diffusion chamber 112, and therefore, disrupts and dampens the sound waves associated therewith. Further, the walls of the suppressor assembly 230 itself serve to absorb and dampen the sound waves generated by the flow of the fluid dispersion out of the mixing chamber 236 through atomizer exhaust channel 238.

The suppressor assembly 230 may also include a suppressor discharge port 234 to facilitate transfer of the fluid dispersion from the suppressor chamber 232 into the diffusion chamber 112. In at least one embodiment, such as is shown in FIG. 1, the suppressor discharge port 234 is located through a low point in the suppressor chamber 232. Of course, as shown in the alternative embodiment of FIG. 2, the suppressor discharge port 234 is located through the sides of the suppressor chamber 232.

FIG. 5 is illustrative of an alternative embodiment of a fluid dispersion assembly 10, wherein a modified diffusion chamber 112' is configured to suppress and/or dampen sound waves generated during operation, similar to the suppressor assembly 230 disclosed above. However, as will be appreciated from the following disclosure, the diffusion chamber 112' of the embodiment of FIG. 5 serves to suppress sound waves generated during operation without the need for a separate suppression chamber, as in previously disclosed embodiments.

Before addressing the modified diffusion chamber 112' of the embodiment of FIG. 5, it is noted that, in many respects, the fluid dispersion assembly 10 of FIG. 5 is similar to the previously disclosed embodiments herein. To begin, the fluid dispersion assembly 10 of FIG. 5 comprises a diffusion unit 100 having oppositely disposed ends 110, 113, and a diffusion chamber 112' disposed therebetween. Unlike previously disclosed embodiments, however, the fluid dispersion assembly 10 of FIG. 5 includes a service access port 160 having a removable service access plug 162 disposed directly through one end 113 of the diffusion unit 100, rather than through a separate cap disposed at one end of the unit 100.

The fluid dispersion assembly 10 of FIG. 5 further comprises a container interconnect 140 cooperatively structured to interconnect the diffusion unit 100 to a fluid container (FC) in a substantially sealed relationship and, as before, a sealing washer 170 is provided to maintain a substantially sealed relationship.

A cartridge port 150 is disposed through one side of the diffusion unit 100, in the illustrative embodiment of FIG. 5, and a diffusion assembly 200 is operatively positioned therethrough and into fluid communication with diffusion chamber 112', as in previously disclosed embodiments. The diffusion cartridge 200 includes an air inlet 210 disposed in communication with an atomizer assembly 220. Further, and as in previously disclosed embodiments, when compressed air is supplied to the diffusion assembly 200, and more in

particular, atomizer assembly 220, through air inlet 210, a corresponding amount of fluid is drawn into a mixing chamber 226 from the fluid container (FC) through a fluid delivery tube 300, as a result of the venturi effect of compressed air flowing past the opening of a fluid inlet 227 into the mixing chamber 226. As a result, a fluid dispersion is formed and discharged from the atomizer assembly 220 through atomizer exhaust channel 228, and directly into diffusion chamber 112'.

As noted above, and as may be seen with reference to FIG. 5, the diffusion chamber 112' of the present embodiment comprises a modified configuration. Specifically, the modified diffusion chamber 112' comprises an upside down L-shaped configuration, wherein a first axial portion 114 of the diffusion chamber 112' is disposed in a substantially axial orientation adjacent and relative to the discharge of the atomizer exhaust channel 228. A second transverse portion 115 of the diffusion chamber 112' is disposed in a substantially downwardly directed orientation, as shown in FIG. 5, substantially transverse or perpendicular to the direction of flow from atomizer exhaust channel 228.

The second or transverse portion 115 of the modified diffusion chamber 112', in at least one embodiment, comprises a fluid return lip 116 disposed at a lower end thereof in a surrounding relation to incoming fluid delivery tube 300. The fluid return lip 116, in at least one embodiment, extends downwardly and outwardly from the walls of the second portion 115 of the diffusion chamber 112', such that any liquid which coalesces in the diffusion chamber 112' along the walls thereof, will be directed into drip tube 120, disposed in an abutting relation along the underside of the fluid return lip 116, and back into fluid container (FC).

More importantly, the fluid dispersion discharged from the atomizer assembly 220 through atomizer exhaust channel 228 into diffusion chamber 112' is interrupted and redirected by virtue of axial portion 114 and transverse portion 115 therein. The interruption and redirection of flow in the modified diffusion chamber 112' during operation of the fluid dispersion assembly 10 in accordance with the present embodiment, serves to suppress or dampen sound waves generated therein, in a similar manner as the suppression chamber 232 of previously disclosed embodiments. Further, the restricted discharge from the transverse portion 115 of the modified diffusion chamber 112' may serve to further suppress or dampen sound waves, thus reducing the noise generated during operation to an even greater extent.

After being discharged from the diffusion chamber 112', the fluid dispersion enters the freeboard above the liquid in the fluid container (FC), the freeboard serving as a quasi-diffusion chamber prior to final discharge of the fluid dispersion from the diffusion unit 100. A discharge chamber 117 is disposed in fluid communication with the freeboard of the fluid container (FC), such that the fluid dispersion can pass therethrough, into a discharge head 118 and out through discharge channel 119 into the airspace surrounding the fluid dispersion assembly 10, as shown in the illustrative embodiment of FIG. 5.

Turning next to the illustrative embodiment of FIG. 6, the present invention is directed to yet another embodiment of a diffusion unit 100 of a fluid dispersion assembly 10 which is also powered by a compressed air source (not shown). In at least one embodiment, the fluid dispersion assembly 10 is further structured to operatively engage a fluid container, and to combine an amount of an operative fluid with compressed air to generate a fluid dispersion.

As before, a "fluid dispersion" in accordance with the present invention shall mean a mixture of an operative fluid

in air comprising a plurality of substantially uniform droplets of the operative fluid dispersed throughout the air. Further, and once again, as used in the present specification, "substantially uniform droplets" shall mean droplets having substantially the same diameter. In at least one embodiment, the plurality of "substantially uniform droplets" each have a diameter in the range of about one micron (1 μm), in another embodiment, the diameter of the "substantially uniform droplets" is in the range of about three microns (3 μm), and, in one further embodiment, the plurality of "substantially uniform droplets" each have a diameter in the range of about five microns (5 μm). In another embodiment, the plurality of "substantially uniform droplets" comprise a diameter in a range of about 2 to 3 microns, and in yet one further embodiment, the plurality of "substantially uniform droplets" comprise a diameter in a range of about 2.3 to 3 microns.

In at least one embodiment, a diffusion unit 100 comprises oppositely disposed ends, as at 110 and 113. Further, a diffusion unit 100 at least partially defines a diffusion chamber 112", and in at least one embodiment, the diffusion chamber 112" is substantially enclosed within diffusion unit 100. As before, the diffusion unit 100 may be constructed of any rigid material or materials which are chemically inert, or at least chemically resistant to the intended operative fluid(s) which include, but once again are not limited to, fragrant oils, essential oils, essential oil extracts, odor neutralizers, disinfectants, e.g., triethylene glycol, air sanitizers, etc.

Further, the material of construction selected for the diffusion unit 100 must be capable of withstanding compressed air at operative pressures, which may range anywhere from about 5 to 50 psig, in most embodiments of the present fluid dispersion assembly 10. In one lower pressure embodiment, the operating pressure of the present fluid dispersion assembly 10 is in the range of about 5 to 10 psig, and in one further embodiment, the operating pressure is in a range of about 5 to 7 psig. Conversely, a higher pressure embodiment of the present fluid dispersion assembly 10 operates at pressures in the range of about 20 to 25 psig, and in the range of about 23 to 24 psig in yet one further embodiment. As such, the material or materials of construction of a diffusion unit 100 in accordance with the present invention may include metals, engineered plastic materials, e.g., polyvinyl chloride, high-density polyethylene, etc., and/or composite materials, just to name a few.

In one embodiment, a cap 130 is cooperatively configured and disposed in a sealing engagement with one of the oppositely disposed ends 110, 113 of the diffusion unit 100. The cap 130 includes a discharge port 132 therethrough in communication with the diffusion chamber 112", and provides a point of release of a fluid dispersion from the diffusion chamber 112" into the airspace surrounding the fluid dispersion assembly 10. In at least one embodiment, the cap 130 is removably attached in a sealing engagement to the diffusion unit 100.

The fluid dispersion assembly 10, in at least one embodiment, includes a container interconnect 140 which is cooperatively structured to interconnect the diffusion unit 100 to a fluid container in a substantially sealed relationship. In one embodiment, the container interconnect 140 is disposed at a different one of the oppositely disposed ends 110, 113, opposite of the cap 130 of the diffusion unit 100. A sealing washer 170 is disposed between the diffusion unit 100 and the fluid container, in at least one embodiment, so as to provide a substantially sealed relationship between the diffusion unit 100 and the fluid container (not shown). The sealing washer 170 may be constructed from any of a variety

of materials such as, but not limited to, rubber, nylon, plastic, PVC, TEFLON, or a composite material, once again, provided the material of construction is chemically inert or at least chemically resistant to the operative fluid(s).

In one further embodiment of a fluid dispersion assembly **10** in accordance with the present invention, a drip tube **120** is disposed in an interconnecting relation between the diffusion unit **100** and the fluid container. As shown in FIG. 6, the drip tube **120** is disposed through a sealing washer **170**, and thus, the drip tube **120** serves to minimize contact between the sealing washer **170** and the operative fluid, by essentially preventing the operative fluid from making contact in and around the sealing washer **170** disposed between the fluid container (not shown) and the container interconnect **140**. More in particular, the drip tube **120** channels any operative fluid which may agglomerate and/or accumulate in the diffusion chamber **112"** through the drip tube **120** directly back into the fluid container (not shown) without contacting the sealing washer **170**, once again, as shown in FIG. 6.

As before, the container interconnect **140** may be structured in a variety of ways to allow interconnection to the fluid container. As one example, the container interconnect **140** may be threaded, internally or externally, such that the diffusion unit **100** is interconnected to the fluid container by screwing the container interconnect **140** into place onto corresponding threads on the neck of the fluid container. In at least one other embodiment, the container interconnect **140** comprises one portion of a quick-connect type fitting and the fluid container comprises a complimentary portion of such a quick-connect type fitting whereby once operatively engaged, a substantially sealed relationship is created between the diffusion unit **100** and the fluid container. In at least some embodiments, the substantially sealed relationship is further enhanced by a sealing washer **170**, as disclosed above.

In at least one embodiment, a cartridge port **150** is provided into the diffusion chamber **112"** to facilitate operative engagement of a diffusion assembly **200** with the diffusion chamber **112"**. The diffusion assembly **200** may be removably engaged with the cartridge port **150** to aid in removal and replacement and/or cleaning of the diffusion assembly **200** and/or components thereof. As shown in the illustrative embodiment of FIG. 6, the cartridge port **150** is disposed directly through the diffusion unit **100** and into the diffusion chamber **112"**, and is positioned between the oppositely disposed ends **110**, **113**. In accordance with the illustrative embodiment of FIG. 6, the cartridge port **150** is disposed on the diffusion unit **100** such that the diffusion assembly **200** is disposed in a substantially perpendicular orientation relative to the diffusion unit **100** when operatively engaging the cartridge port **150**. As further illustrated in the embodiment of FIG. 6, while operatively disposed in the diffusion chamber **112"**, the diffusion assembly **200** is disposed between the upper chamber **115"** and the lower chamber **114"** of the diffusion chamber **112"**. In at least one other embodiment, the cartridge port **150** is disposed through the cap **130**. In yet another embodiment, the diffusion assembly **200** comprises an integral component of the cap **130** itself.

As illustrated in FIG. 6, the diffusion assembly **200** comprises an air inlet **210** and an atomizer assembly **220**. The atomizer assembly **220** comprises an atomizer air inlet channel **222**, a mixing chamber **226**, and an atomizer exhaust aperture **228"**. The atomizer air inlet channel **222** is interconnected to the compressed air source via the air inlet **210**. Moreover, the atomizer air inlet channel **222** includes

an inlet aperture **223** and an outlet aperture **223"**, as may be seen in FIG. 6. As may also be seen in the illustrative embodiment of FIG. 6, the inlet aperture **223** and outlet aperture **223"** are substantially equal in diameter, as is the channel **223'** disposed therebetween.

Further, the mixing chamber **226** comprises a fluid inlet **227** disposed in fluid communication with an operative fluid in the fluid container via a fluid delivery tube **300**. The fluid delivery tube **300** is disposed in a fluid communicating relation between the atomizer assembly **220** and the fluid container to facilitate delivery of an amount of the operative fluid into the atomizer assembly **220**. In at least one embodiment, the fluid delivery tube **300** connects to the atomizer assembly **220** via the fluid inlet **227** into the mixing chamber **226**.

As shown in FIG. 6, the fluid inlet **227** is substantially perpendicular to a compressed air flowpath through the atomizer assembly **200**. More in particular, and with reference to FIG. 6, the compressed air flowpath extends horizontally through the air inlet **210**, atomizer air inlet channel **222**, inlet aperture **223**, channel **223'**, and outlet aperture **223"**, into mixing chamber **226**, and out through the atomizer exhaust aperture **228"**.

As such, when compressed air is supplied to the diffusion assembly **200**, a corresponding amount of operative fluid is drawn into the mixing chamber **226** through the fluid delivery tube **300** as a result of the venturi effect of the compressed air flowing over the opening of the fluid inlet **227** into the mixing chamber **226**. More in particular, at each different compressed air flowrate, i.e., each "predetermined amount" of compressed air which is dictated and fixed by a compressed air operating pressure supplied to diffusion assembly **200**, a different corresponding and substantially constant amount, i.e., a "preselected amount" of an operative fluid corresponding to each different predetermined amount of compressed air, will be drawn into the mixing chamber **226**. More importantly, the "predetermined amount" of compressed air and the "preselected amount" of the operable fluid are initially mixed together in the mixing chamber **226** to form a fluid dispersion. The diffusion chamber **112"** is further structured to facilitate the formation of a plurality of substantially uniform droplets, as defined hereinabove, in the fluid dispersion prior to discharge from the diffusion chamber **112"** through discharge port **132**.

FIG. 6 is illustrative of an alternative embodiment of a diffusion unit **100** having a modified diffusion chamber **112"**. More in particular, the modified diffusion chamber **112"** is configured to suppress and/or dampen sound waves generated during operation, similar to the suppressor assembly **230** disclosed above. However, as will be appreciated from the following, the modified diffusion chamber **112"** of the embodiment of FIG. 6 serves to suppress sound waves generated during operation without the need for a separate suppression chamber, as in previously disclosed embodiments.

As noted above, and as may be seen with reference to FIG. 6, the diffusion chamber **112"** of the present embodiment comprises a modified configuration. Specifically, the modified diffusion chamber **112"** comprises a lower chamber **114"** which is disposed below and adjacent to the discharge of a fluid dispersion through the atomizer exhaust aperture **228"**. An upper chamber **115"** of the diffusion chamber **112"** is disposed above the diffusion assembly **200**, as shown in FIG. 6, substantially opposite to the direction of flow of a fluid dispersion from atomizer exhaust aperture **228"**.

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More importantly, the fluid dispersion discharged from the atomizer assembly 220 through atomizer exhaust aperture 228" into diffusion chamber 112" is interrupted and redirected by virtue of lower chamber 114" and upper chamber 115" therein. The interruption and redirection of flow in the modified diffusion chamber 112" during operation of the fluid dispersion assembly 10 in accordance with the present embodiment, serves to suppress or dampen sound waves generated therein, much like the suppression chamber 232 of previously disclosed embodiments. Further, the restricted discharge from the upper chamber 115" of the modified diffusion chamber 112" serves to further suppress or dampen sound waves, thus reducing the noise generated during operation to an even greater extent.

After being discharged from the mixing chamber 226 through the atomizer exhaust aperture 228", the fluid dispersion is at least partially deflected into the freeboard above the liquid in the fluid container, the freeboard serving as a quasi-diffusion chamber prior to final discharge of the fluid dispersion from the diffusion unit 100 through discharge port 132 and into the airspace surrounding the fluid dispersion assembly 10. A portion of the fluid dispersion is also deflected against the bottom surface of the lower chamber 114" of the modified diffusion chamber 112" and upwardly into the upper chamber 115" of the modified diffusion chamber 112" before being discharged through discharge port 132 into the airspace surrounding the fluid dispersion assembly 10.

It is further envisioned that at least one embodiment of the fluid dispersion assembly 10 of the present invention is operated via a programmable timer to control a fragrance intensity and character in an airspace by metering the fragrance delivered in an enclosed environment. The fluid dispersion assembly 10 delivers a specific amount of a fragrance, i.e., the delivery rate, based upon such factors as the specific physical configuration of the atomizer assembly 220 and the fluid container (FC)/fluid delivery tube 300, the pressure and volume of the compressed air supplied into air inlet 210, as well as the physical properties of the fragrance itself, such as, viscosity, surface tension, vapor pressure, etc., wherein the delivery rate is measured in grams per minute of a fragrance dispersed. The perceived fragrance intensity in a specific airspace is measured from a sensory point of view using a labeled magnitude scale. The data is directly correlated to the amount of fragrance delivered and may be measured in either grams per liter or grams per cubic meter. Since the delivery rate is fixed, fragrance intensity is controlled by cycling the fluid dispersion assembly 10 through an on/off programming cycle every minute to deliver the intensity and character levels that are desired by a user. The optimization process is a function of dosing time per minute and a user's desired fragrance experience.

Since many modifications, variations and changes in detail can be made to the described preferred embodiment of the invention, it is intended that all matters in the foregoing description and shown in the accompanying drawings be interpreted as illustrative and not in a limiting sense. Thus, the scope of the invention should be determined by the appended claims and their legal equivalents.

Now that the invention has been described,

What is claimed is:

1. A fluid dispersion assembly operatively engages a container of an operative fluid and a compressed air source and generates and discharges a fluid dispersion into a surrounding airspace, said fluid dispersion assembly comprising:

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a diffusion unit at least partially defining an enclosed diffusion chamber, wherein said diffusion chamber comprises an upper chamber and a lower chamber, a discharge port disposed in fluid communication between said diffusion chamber and the surrounding airspace, a diffusion assembly disposed in an operative engagement with said diffusion unit, wherein said diffusion assembly comprises an atomizer assembly, said diffusion assembly is disposed between said upper chamber and said lower chamber, said atomizer assembly comprising an atomizer air inlet channel, a fluid inlet, a mixing chamber, and an atomizer exhaust aperture, and said atomizer air inlet channel interconnected to the compressed air source and said fluid inlet disposed in fluid communication with the operative fluid in the container, wherein the compressed air and the operative fluid are mixed together in said mixing chamber to form the fluid dispersion.

2. The fluid dispersion assembly as recited in claim 1 further comprising a cap cooperatively configured and disposed in a sealing engagement with said diffusion unit.

3. The fluid dispersion assembly as recited in claim 1 wherein said atomizer exhaust aperture is disposed in a communicating relation between said mixing chamber and said lower chamber to facilitate transfer of the fluid dispersion therebetween.

4. The fluid dispersion assembly as recited in claim 1 wherein said diffusion chamber facilitates formation of the fluid dispersion prior to discharge of the fluid dispersion from said diffusion chamber through said discharge port and into the surrounding airspace.

5. A fluid dispersion assembly is operatively interconnected to a container of an operative fluid and a compressed air source to generate and discharge a fluid dispersion into a surrounding airspace, said fluid dispersion assembly comprising:

a diffusion unit at least partially defining a diffusion chamber, wherein said diffusion chamber comprises an upper chamber and a lower chamber,

a discharge port disposed in fluid communication between said diffusion chamber and the surrounding airspace, and

a diffusion assembly disposed in an operative engagement with said diffusion unit, wherein said diffusion assembly comprises an atomizer assembly, said diffusion assembly is disposed between said upper chamber and said lower chamber.

6. The fluid dispersion assembly as recited in claim 5 wherein said atomizer assembly comprising an atomizer air inlet channel, a fluid inlet, a mixing chamber, and an atomizer exhaust aperture.

7. The fluid dispersion assembly as recited in claim 6 wherein said atomizer air inlet channel is interconnected to the compressed air source and said fluid inlet disposed in fluid communication with the operative fluid in the container, wherein the compressed air and the operative fluid are mixed together in said mixing chamber to form the fluid dispersion.

8. The fluid dispersion assembly as recited in claim 7 wherein said diffusion chamber facilitates formation of the fluid dispersion prior to discharge of the fluid dispersion from said diffusion chamber through said discharge port and into the surrounding airspace.

9. The fluid dispersion assembly as recited in claim 5 further comprising a container interconnect operatively interconnecting said diffusion unit to the container, wherein

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said container interconnect comprises a sealing washer disposed between said diffusion unit and the container.

10. The fluid dispersion assembly as recited in claim **9** further comprising a drip tube, said drip tube disposed in an interconnecting relation between said diffusion chamber and the container through said sealing washer, wherein said drip tube minimizes contact between said sealing washer and the operative fluid.

11. A fluid dispersion assembly interconnects to a container of an operative fluid and a compressed air source and generates and discharges a fluid dispersion into a surrounding airspace, said fluid dispersion assembly comprising:

a diffusion unit having an enclosed diffusion chamber, said diffusion chamber comprising oppositely disposed portions therein,

said diffusion chamber comprises an upper chamber and a lower chamber,

a diffusion assembly disposed in an operative engagement with said diffusion unit between said upper chamber and said lower chamber,

said diffusion assembly comprises an atomizer assembly having an atomizer exhaust aperture,

said lower chamber disposed below and adjacent said atomizer exhaust aperture, and

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said diffusion chamber structured to facilitate formation of the fluid dispersion prior to discharge of the fluid dispersion from said diffusion chamber, wherein the fluid dispersion discharged from said atomizer exhaust aperture into said diffusion chamber is interrupted and redirected in said lower chamber, thereby dampening sound waves generated during operation of said fluid dispersion assembly.

12. The fluid dispersion assembly as recited in claim **11** wherein said atomizer assembly further comprises an atomizer air inlet channel, a fluid inlet, and a mixing chamber.

13. The fluid dispersion assembly as recited in claim **12** wherein said atomizer air inlet channel is interconnected to the compressed air source and said fluid inlet is disposed in fluid communication with the preselected fluid in the container, wherein the compressed air and the preselected fluid are mixed together in said mixing chamber to form the fluid dispersion.

14. The fluid dispersion assembly as recited in claim **11** further comprising a drip tube.

15. The a fluid dispersion assembly as recited in claim **14** wherein said drip tube is disposed to direct coalesced fluid from the diffusion chamber back into the container of operative fluid.

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