This invention relates to the art of dispensing liquids from containers by internally-generated gas pressure, for example to self-propelled sprays and the like, and to apparatus and procedure for effecting such dispensing. In particular, this invention has to do with the provision of a container in which are the liquid to be sprayed and a propellant therefor, said container being gas-tight and being provided with discharge-controlling orifice means, such as a valve nozzle, whereby the liquid may be sprayed out as and when desired.

The liquid composition or product to be dispensed may be any of those which commonly are, or which conveniently can be, dispensed by atomizing or spraying means, such as insecticides, mothproofers and the like; paints, varnishes, and other coating materials; perfumes, deodorants, nasal sprays and other cosmetics and various other liquid pharmaceutical and other drug products; various liquid food-product coating materials, such as syrups and icings; fire extinguishing compositions; and, generally, liquid materials which are to be applied so as to adhere to and/or soak into surfaces and hence are ejected mainly as coarse sprays or jets rather than with fine atomization or vaporization of the spray or jet.

Self-propelled liquid sprays are now commonly made using solutions or emulsions of the propellant liquid and the liquid to be sprayed. The solution or emulsion is sprayed out in the form of a fine particle sized aerosol or mist, rather than the relatively coarse spray featuring droplets possible with the present invention. The spray of the prior art contains not only the desired liquid to be sprayed but also the propellant liquid. Although the latter generally vaporizes at once upon ejection and helps produce this fine spray, it is sometimes of an inflammable nature and hence a fire or explosion hazard, especially in confined spaces. Furthermore, the amount of propellant liquid is necessarily large, being seldom less than 10% and in some cases constituting the entire liquid phase (the material to be sprayed then being a solid dispersed or dissolved in the propellant liquid). The pressure within the container becomes quite high, since higher pressure is required to provide and propel the usual fine sprays now employed. Propellant liquids having very low boiling points are employed to attain these higher pressures, with the fineness of the spray being at least partly due to the volatilization of the propellant-liquid which is present in the spray. The containers therefore must have considerable structural strength—a requirement which demands materials now in critically short supply, such as plastics and metal, commonly metal. Steel containers, when the material to be sprayed is aqueous and/or contains an electrolyte, are also subject to corrosion.

Objects of the present invention include in particular the provision of liquid dispensing containers featured by internal propellant gas pressures, such as self-propellant sprays, using considerably less than the usual amounts of propellant, and lower yet still effective, pressures within the container so that if desired, lighter-weight cans or glass containers may be safely used. Furthermore, the propellants of this invention are, as a practical matter, immiscible with, and are not emulsified with the liquid to be sprayed, and are now non-inflammable and relatively non-corrosive, and of a greater specific gravity when in liquid phase than that of the liquid to be sprayed. Hence fire and explosion hazards may be minimized, and, if metal containers are used, corrosion due to the propellant is greatly reduced. In fact, the preferred propellant of this invention frequently appears, in itself, to inhibit corrosive action of the composition to be dispensed when used in metal containers. This is especially true with respect to the bottoms of such containers, due at least partly to blanketing thereof by pools of the propellants in liquid phase.

The containers filled in accordance with this invention therefore are provided with a three-phase system, two liquid and one gaseous. The liquid phases are the propellant, at the bottom of the container, and the liquid composition or product to be dispensed or sprayed, which floats above the propellant liquid. The gaseous phase is the vaporized propellant together usually with a minor amount of the other volatilized components of the system. The liquid composition or product to be dispensed or sprayed may be a single liquid substance, or a mixture of liquids, or a solution or suspension of solid matter in one or more liquids.

This invention will be more fully understood by reference to the accompanying drawing, which shows a typical container in vertical section. The drawing shows a container 1 having walls of suitable strength for the intended purpose, and provided with a discharge tube or nozzle 2 forming a passage having an intake opening near the bottom of the container but somewhat above the top level of the propellant liquid 3. Tube 2 terminates at the top in a nozzle 4, the fluid flow to which is controlled by valve 5. Nozzle 4 is any suitable low pressure atomizing nozzle or simply an orifice capable of forming a jet; it requires no auxiliary air or gas flow through it to atomize or distribute or eject the escaping liquid. Pressure of one's finger or thumb on valve 5 opens the valve so that the liquid to be sprayed escapes through it and is atomized by nozzle 4. When this pressure on valve 5 is removed, the valve is automatically closed by a spring 9, or by the pressure within the container, or both. The discharge controlling orifice means need not be a valued nozzle since where discharge of the entire contents of the container at one time is to be had, the discharge orifice at the outer end of the passage may be closed by a breakable seal to serve as the sole discharge control.

The body of liquid composition or product to be sprayed is indicated by the numeral 6. As the propellant 3 vaporizes, bubbles 7 of the resulting vapor rise through the body of the liquid composition or product 6 to form gaseous phase 8 which is under pressure. As the liquid composition is sprayed out through nozzle 4, more of propellant 3 vaporizes to fill the additional space above the body of liquid 6. The amount vaporized in any case is sufficient to create gaseous pressure enough to expel the liquid composition 6 from the container through tube 2 and nozzle 4.

The preferred propellant for the purposes of this invention is a fluorinated hydrocarbon, usually also chlorinated, of the types commonly sold under the trade names "Freon" or "Genetron." The compounds of these types which are used herein (aside from any diluents which they may contain) all have the general formula CnH2nFyClz, wherein y is a whole number (usually 1 or 2), x is zero or a whole number, y is zero or a whole number, and z is a whole number, and the sum of x, y, and z is equal to 2n+2. Typical of such compounds...
which are suitable are the following, with their boiling points in degrees centigrade:

<table>
<thead>
<tr>
<th>Compound</th>
<th>Boiling Point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCl₂F₂</td>
<td>-29</td>
</tr>
<tr>
<td>CCl₃F</td>
<td>-82</td>
</tr>
<tr>
<td>CHCl₃F</td>
<td>-41</td>
</tr>
<tr>
<td>CHF₂Cl</td>
<td>4</td>
</tr>
<tr>
<td>CH₃CHF₂</td>
<td>26</td>
</tr>
<tr>
<td>CH₂CCl₂F</td>
<td>10</td>
</tr>
</tbody>
</table>

Mixtures of these compounds may be used. All of the propellant compounds used in this invention have a specific gravity greater than that of the liquid composition or product to be dispensed. If the liquid composition or product to be dispensed has a specific gravity greater than that of water, the propellant liquid selected should have a still greater specific gravity. The boiling point of the propellant, at atmospheric pressure, must be below ordinary room temperature (about 20° C.), in order to insure effective vaporization under all ordinary conditions of operation.

When used in glass containers, the amount and nature of the propellant of this invention should be such as to provide, when entirely in the gaseous state, a volume from about 1.2 to about 5 times that of the container, calculated at "normal" temperature and pressure (0° C. and one atmosphere absolute pressure), e.g. a weight of gas equal to the pressure of the propellant at room temperature (20° C.) of between 1 p. s. i. g. and 100 p. s. i. g. Lesser amounts and pressures are generally inefficient to propel the material to be dispensed or sprayed properly and completely out of the container, while larger amounts and pressures are apt to cause glass fragments to fly forcibly in the event of accidental breakage of the bottle, due to a thoughtless user's failure to take ordinary precautions in handling, such as careful handling and rough toasting into metal trash cans and the like of gas-charged containers after discharge of liquid contents, particularly if, through carelessness, the container is at an elevated temperature.

The particular range to be selected within the above limits will depend among other things upon the size of the glass container and upon the conditions of use. Small bottles, such as would be used for perfumes, can safely withstand the higher pressures within the above range better than larger bottles such as would be used for insecticides, for example. Bottles which would be kept at low temperatures, e.g. bottles of syrups or icings which would be kept in a refrigerator and used cold, could also safely contain propellants capable of producing such higher pressures better than could similar bottles, e.g. of insecticide sprays or aerosols intended for use in tropical climates.

If the containers are formed of materials somewhat stronger than glass, such as metal, but perhaps of appreciably thinner gauge and less strength than that previously used and thus being more prone to rupture at higher pressures, the above figures for volume and vapor pressure may be somewhat higher with the maximum pressure to be generated being dictated by the strength of the container.

The vapor pressure of the propellant at room temperature, when glass containers are used, may for example be around 5 p. s. i. g. or lower. The pressure employed depends also upon the type of delivery desired. For atomizing purposes it cannot be appreciably lower than around 2 p. s. i. g. atomizing suitable nozzle design, whereas for forming a simple jet, without appreciable atomization, the pressure may be as low as about 1 p. s. i. g. In general, the higher the pressure within the container, the greater the degree of atomization and the greater the distance which the spray can travel.

In this invention, as distinguished from those of the usual self-propelled liquid spray systems previously referred to herein, only the small amount of the propellant which dissolves in the liquid composition or product to be dispensed escapes from the container during use until the liquid composition is practically exhausted. For example, when the propellant is a mixture of CCl₂F₂ and balance CCl₃F and CH₃CCl₂F and CCl₃F, 5 grams of the propellant, a mixture of about 70% CH₃CCl₂F and the balance CCl₂F₂ and CCl₃F, is added under pressure through the tube and a nozzle is then fitted to the end of the tube. The quantity of propellant (5% by weight) is such that it will give a volume of gas when vaporized at room temperature and pressure of about ten times the volume of the can. The initial pressure within the container is 30 p. s. i. g. at 70° F.

It is preferable to exclude air from the container, so that the pressure within the container may be maintained...
more nearly constant during spraying and use and also, when metal containers are used, so as to reduce the corrosion which is promoted by the presence of the oxygen of the air. Exclusion of air is accomplished when the container is filled, for example by use of vacuum, or by flushing the container with an inert condensable gas such as "Freon" or steam, before or after introducing the propellant and the liquid to be sprayed.

What is claimed is:

1. A self-propelled liquid dispensing device comprising a gas-tight container having relatively easily rupturable walls, a contained 3-phase fluid system comprising a liquid medium to be dispensed and a propellant present in both gaseous and liquid form and in which said liquid form is substantially immiscible with and of greater specific gravity than said liquid medium, said propellant having a boiling point not greater than about 20°C and being present in an amount such that when entirely in the gaseous state and calculated at 0°C and one atmosphere absolute pressure it will occupy a volume from about 1.2 to about 5 times the volume of the container, the gaseous phase of said propellant being under pressure, above said liquid medium, a conduit having a passage extending from a point outside of said container to a point outside said container, and means for controlling the flow of fluid from within said container through said conduit passage to said discharge orifice.

2. A self-propelled liquid dispensing device in accordance with claim 1 wherein the walls of said container are of glass.

3. A self-propelled liquid dispensing device in accordance with claim 1 wherein the walls of said container are of thin metal.

4. A self-propelled liquid dispensing device as defined in claim 1 in which the propellant is a fluorinated hydrocarbon.

5. A self-propelled liquid dispensing device as defined in claim 1 in which the propellant is a fluorinated and chlorinated hydrocarbon having from one to two carbon atoms per molecule.

6. A self-propelled liquid dispensing device as defined in claim 1 in which the propellant is a fluorinated and chlorinated hydrocarbon and in which the liquid medium to be dispensed contains a silicofluoride as an active ingredient.

7. A self-propelled liquid dispensing device comprising a gas-tight container having relatively easily rupturable walls, a contained 3-phase fluid system comprising a liquid medium to be dispensed and a propellant present in both gaseous and liquid form and in which said liquid form is substantially immiscible with and of greater specific gravity than said liquid medium, said propellant having a boiling point not greater than about 20°C, and being present in an amount such that when entirely in the gaseous state and calculated at 0°C and one atmosphere absolute pressure it will occupy a volume from about 1.2 to about 5 times the volume of the container, the gaseous phase of said propellant being under pressure, above said liquid medium, and means for conveying said liquid medium from a point within the body thereof to a point outside said container for ejection at said latter point, said propellant being selected from the group consisting of fluorinated, and chlorinated and fluorinated, low molecular weight saturated aliphatic hydrocarbons containing not more than two carbon atoms, the quantity and characteristics of said propellant being so adjusted as to be insufficient to cause rupture of the container walls or dangerous propulsion of fragments in the event of accidental breakage.

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