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J. FRANGOS ETAL
AEROSOL SPRAYER

3,069,098

Filed June 20, 1960

FIG. 1

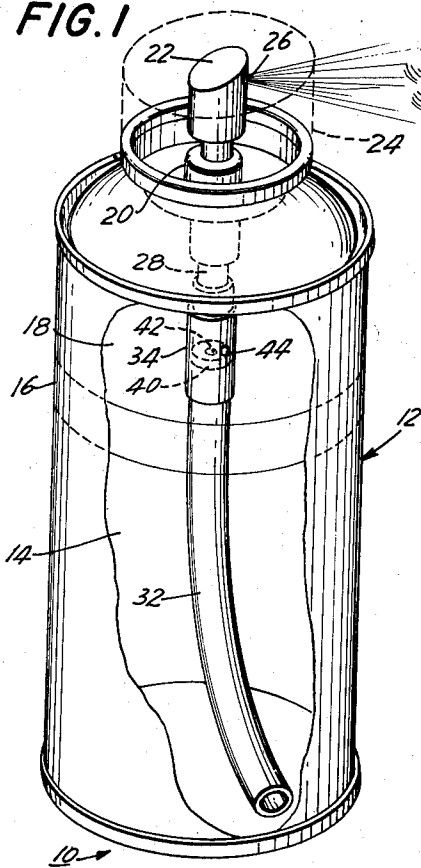


FIG. 2 FIG. 3 FIG. 4

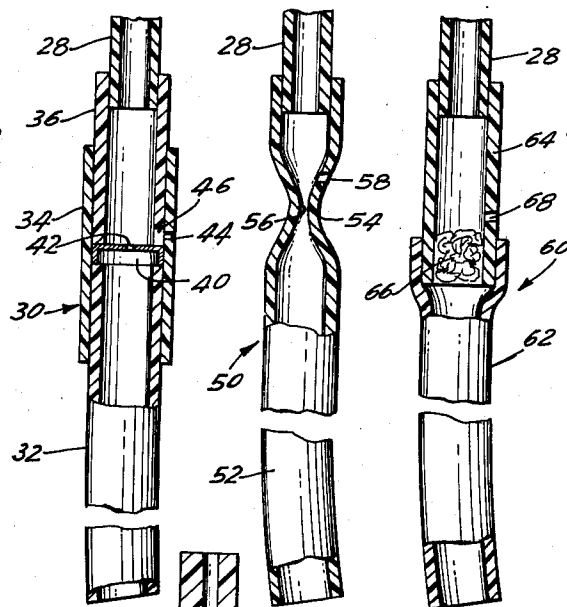


FIG. 5

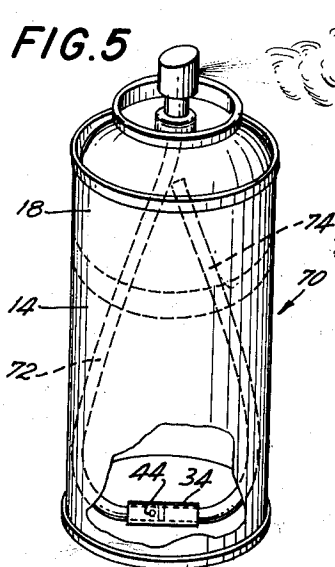
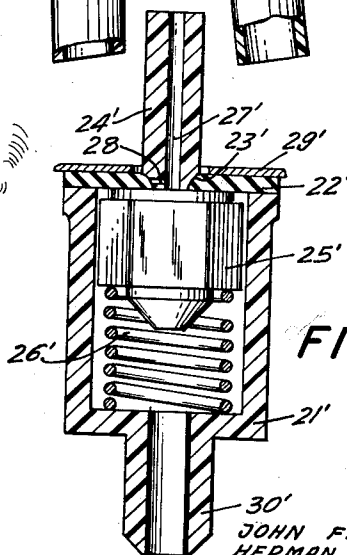


FIG. 6



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1

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AEROSOL SPRAYER

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This invention relates to an aerosol sprayer.

An object of the invention is to provide an aerosol sprayer which is capable of dispensing, as a fine spray or mist, a liquid product which includes a liquefied propellant gas that is immiscible with the product.

Another object is to provide an aerosol sprayer which is capable of handling, effectively, any of a number of different products which cannot be dispensed satisfactorily in previously available aerosol sprayers.

Another object is to provide a sprayer of the type described herein which is simple and reliable and yet inexpensive to produce.

These and other objects will in part be understood from and in part pointed out in the description given hereinafter.

Aerosol-type sprayers are widely used at the present time to dispense various products such as insecticides, perfumes, air-deodorants, under conditions where a fine "non-spitting" spray or mist is desired.

A typical aerosol dispenser of this type comprises a container in which is placed the product, usually in liquid form, to be dispensed as a spray or mist. To this product is added the propellant gas which is liquefied.

Because of the limitations in the effectiveness of previously known aerosol sprayers, it has not been possible, as a practical matter, to use a product fill in which there is immiscibility between the product and the propellant because of the resultant "spitting" of the dispensed material. This has been particularly so when the product fill has been water which is immiscible with the propellant except, of course, in those instances where a "wet" spray is desired in contradistinction to a fine spray or mist.

While this invention contemplates the use of product fills and propellants of many types that are immiscible, it is particularly useful when water-base fills are employed and so a water-base fill is chosen to disclose the applicability of the invention.

When miscible base fills and propellants are used, certain objections arise. For instance, alcohols, which are often used to promote the propellant miscibility with the base fill, are inflammable. To overcome these objections such propellants as certain hydrocarbons have been used because of their non-flammable nature. The cost of such propellants is often greater than the cost of the active material of the base fill. When a fluorinated and chlorinated hydrocarbon is used, it produces, under certain conditions, a chemical reaction with the attendant possibility of breaking down of the base fill into highly toxic or corrosive components which, of course, makes it impracticable for use in many medical products or in food products. However, when an aqueous base fill is used these disadvantages are not present.

Another difficulty with a non-aqueous fill, particularly when it includes alcohol, is that it is not as suitable a solvent as water for certain materials. Thus, in the case of a hair grooming product, an alcohol base tends to dry the hair and chill the skin, whereas a water base would have less tendency to do this; additionally water promotes desirable curling of the hair. Because of these limitations inherent in non-aqueous fills, a number of products which could very advantageously be dispensed by an aerosol sprayer have never reached the market.

2

The present invention contemplates the use of a pressurized container in which the base fill and the propellant are immiscible and in which the fill may be principally water. The container is provided with a valve control spray head of known types, one of which is illustrated in the drawing and which may include an extended tube section.

A tube section is connected with this spray head and extends into and communicates with the liquid fill.

Thus, when the valve is opened the propellant in the container will force the fill through the tube and out of the spraying orifice of the spray head.

To make it possible to use a propellant-immiscible fill such as a water-base fill which may be ejected from the orifice of the spray head as a spray or mist, this invention contemplates the creation of a drop in pressure in the tube and the injection of the propellant into the fill within the tube, preferably adjacent the area of the greatest pressure drop. The resultant turbulence will cause the admixture of the fill and the propellant and the diffusion of the propellant in the fill. While the optimum point of injection of the propellant into the fill is, as stated above, in the area of greatest drop in pressure, the injection may occur in other areas of the pressure drop in the fill.

This pressure drop may be created in a number of ways as, for instance, restricting the inside diameter of the tube or placing an obstruction in the tube.

In the illustrative embodiments of the invention disclosed in the drawing and described in this specification, we have shown a restricted cross-sectional area in the tube as well as an obstruction therein which will result in a drop in pressure and in connection with these forms we have shown an aspirator hole closely adjacent the restriction or obstruction for the passage of the propellant into the liquid fill at or near the point of greatest pressure drop.

A better understanding of the invention together with a fuller appreciation of its many advantages will best be gained from the following description given in connection with the accompanying drawings wherein:

FIGURE 1 is a perspective view of an aerosol sprayer embodying features of the invention;

FIGURE 2 is a substantially enlarged view partly in cross-section of the dip or siphon tube in the sprayer of FIGURE 1;

FIGURE 3 is similar to FIGURE 2 but shows a somewhat different dip tube, also embodying features of the invention;

FIGURE 4 illustrates still another embodiment of the invention;

FIGURE 5 is a perspective view of an aerosol sprayer shown somewhat smaller in scale than FIGURE 1 and showing a different arrangement according to the invention; and

FIGURE 6 is a cross-sectional view of a conventional valve-control spray head showing a depending tube section.

The aerosol sprayer 10 shown in FIGURE 1 comprises a sealed container 12 charged with a quantity of liquid material or fill 14 to be dispensed as a spray. The container is pressurized by a suitable propellant, such as liquefied isobutane, which floats as a layer 16 upon the active material 14. The space 18 above the liquid fractions contains some of the propellant in its gaseous phase. The top of the container is sealed by a valve head of conventional construction, such as shown in FIGURE 6.

This conventional valve head comprises a casing 21' having an upper end closed by a flexible disc 22' through an opening 23' in which a valve stem 24' extends. This opening is normally closed by a valve head 25' which is pressed into its closing position by a spring 26'. The valve stem is provided with a longitudinal bore 27' which

communicates with the interior of the casing 21' through a port 28' when the valve is unseated.

The valve head is secured to the container by a suitable cap 29' and is provided at its lower end with a tube section 30' to which is attached another dip tube section later to be described. The outer end of the valve stem is capped by a spray head 22, also standard, which serves as a manual button to actuate the valve. When not in use, the top of the can may be covered by a cap 24 shown in dotted outline. With this cap removed, and when spray head 22 is depressed, the valve is opened and a vaporized jet of the liquid material in the can is sprayed outward as indicated at 25 through a small orifice 26 in the spray head.

This assembly includes a lower portion 32 of the dip tube extending to the bottom of container 12 and through which the liquid to be sprayed is forced upward to the valve head when the valve in the latter is opened. Near the top of assembly and, in this embodiment, above liquid propellant layer 16 is located a sleeve 34, the lower end of which surrounds, with a snug fit, the top of tube portion 32. The upper end of sleeve 34 similarly surrounds a short length of tubing 36 which in turn fits snugly around the tube section 30'.

Within sleeve 34 midway between its upper and lower ends is securely fitted a flanged disc 40 having a very small axial hole 42 through its wall. Above this disc and laterally through the side of the sleeve 34 is another hole 44 preferably of similar size, and preferably adjacent the hole 42, there being a larger opening or cut-away portion 46 through tubing 36 so that it does not obstruct this hole. It has been found that disc 40, with its hole 42 in combination with hole 44 gives the desired spray or mist, as indicated at 25, when a water-base fill and an immiscible propellant are used. Of course, with alcohol or other non-aqueous materials excellent results are also obtained.

FIGURE 3 shows a different dip tube assembly 50. Here, a continuous tube section 52 just below where it joins the tube section 30 is necked-down at 54 to provide a small axial opening 56, comparable to hole 42 in disc 40. This necked-down portion 54 is laterally pierced by a small hole 58 through the wall of tube 52.

FIGURE 4 shows still another dip tube assembly 60 wherein a length of tubing section 62, comparable to tube portion 32 in FIGURE 2, is fitted onto a short sleeve 64. The top of this sleeve connects with the tube section 30' and its lower end is plugged with a wad of glass wool 66. This material provides a number of very small axial openings or pores inside sleeve 64. These pores together give an effect similar to the single hole 42 in disc 40. Preferably just above material 66 and laterally through the wall of sleeve 64 is placed a small hole 68.

FIGURE 5 shows a sprayer 70, identical to sprayer 10, except that the dip tube sleeve 34, with its disc 40 and lateral hole 44 are positioned near the bottom of the container within liquid fill 14. Accordingly, the portion 72 of the dip tube, comparable to tubing 36 in FIGURE 2, is much longer, and the open end of tube 74, comparable to tube 32, is in gas space 18 rather than in liquid 14. Thus, hole 44 now handles liquid while hole 42 in disc 40 handles gas. An arrangement similar to this would be obtained in FIGURE 1 by turning can 12 upside down. Sprayer 70 will also work satisfactorily when turned upside down.

The drawings herein were made from actual units which have been built and successfully operated to produce a fine mist or spray. One such sprayer comprised a conventional seven ounce aerosol can and a standard valve and spray head such as above referred to. The can was charged with one hundred and sixty-eight grams of water as a base-fill, two grams of perfume, and thirty grams of isobutane as a propellant. The dip assembly included a section 32 of polyethylene tubing of approximately one-eighth inch internal diameter and one thirty-second inch wall thickness, and about five and one-fourth

inches long. Sleeve 34 had a slightly larger inside diameter, a similar wall thickness and a length of about five-eighths inch. Tube 36 was the same inside diameter as tube 32 but only about one-half inch long. Disc 40 was formed from sheet metal about five-thousandths of an inch thick and hole 42 was about one sixty-fourth inch in diameter. Hole 44 was about the same in size and was closely adjacent the top of the disc.

Thus, it will be seen that we have created an aerosol sprayer which comprises a container which may be, if desired, of the rigid can form or other form and which includes a base-fill and a liquefied gas propellant which are immiscible with each other. It includes also a spray head of a conventional type, such as a valve-controlled head for dispensing the contents of the container in the form of a fine spray or mist. The base-fill in the container is conveyed to the spray head in a column, in which column a drop in pressure is created. A portion of the propellant is injected into the column of liquid preferably adjacent the area of the greatest drop in pressure but which may be in an area more remote. The injection of the portion of the propellant into the column of liquid creates a turbulence in the liquid with the result that the propellant is thoroughly distributed throughout the adjacent portion of the liquid of the column. Thus when the content of the container is sprayed from the spray head it will be in a finely divided condition forming a fine spray or mist and this is true even when the propellant and the base-fill are immiscible with each other.

While we have illustrated and described the particular embodiments of our invention, this has been for the purpose of illustrating its principle and we will not be limited to these particular embodiments except insofar as the claims require such limitation. Many changes in construction will be obvious to those skilled in the art upon examination of the disclosure in this application.

What we claim is:

1. In an aerosol type sprayer which includes a closed container having a valved spray head at one end thereof, and a dip tube located in said container and connected to the spray head for conveying a liquid fill in the container to the spray head, means in the dip tube and spaced from the spray head restricting the effective lateral inside dimensions of the dip tube to create a drop in pressure in the liquid as it is forced through the tube, and means adjacent the said first-mentioned means but on the lower pressure side thereof to convey pressurized gas into said tube to admix with the liquid as it passes from the first-mentioned means to the spray head.

2. In an aerosol type sprayer which includes a closed container having a valved spray head at one end thereof, and a dip tube located in said container and connected to the spray head for conveying a liquid fill in the container to the spray head, means in the dip tube and spaced from the spray head restricting the effective lateral inside dimensions of the dip tube to create a drop in pressure in the liquid as it is forced through the tube, and means adjacent the said first-mentioned means but on the lower pressure side thereof to convey pressurized gas into said tube to admix with the liquid as it passes from the first-mentioned means to the spray head, said first-mentioned means including a perforated plate in said tube.

3. In an aerosol type sprayer which includes a closed container having a valved spray head at one end thereof, and a dip tube located in said container and connected to the spray head for conveying a liquid fill in the container to the spray head, means in the dip tube and spaced from the spray head restricting the effective lateral inside dimensions of the dip tube to create a drop in pressure in the liquid as it is forced through the tube, and means adjacent the said first-mentioned means but on the lower pressure side thereof to convey pressurized gas into said tube to admix with the liquid as it passes from the

5

first-mentioned means to the spray head, said first-mentioned means including a restriction of the inside diameter of the tube.

4. In an aerosol type sprayer which includes a closed container having a valved spray head at one end thereof, and a dip tube located in said container and connected to the spray head for conveying a liquid fill in the container to the spray head, means in the dip tube and spaced from the spray head restricting the effective lateral inside dimensions of the dip tube to create a drop in pressure in the liquid as it is forced through the tube, and means adjacent the said first-mentioned means but on the lower pressure side thereof to convey pressurized gas into said tube to admix with the liquid as it passes from the first-mentioned means to the spray head, said first-mentioned means including a wad of glass wool within the tube.

5. In an aerosol type sprayer which includes a closed container having a valved spray head at one end thereof, and a dip tube located in said container and connected to the spray head for conveying a liquid fill in the container to the spray head, means in the dip tube and spaced from the spray head restricting the effective lateral inside dimensions of the dip tube to create a drop in pressure in the liquid as it is forced through the tube, and means adjacent the said first-mentioned means but on the lower pressure side thereof to convey pressurized gas into said tube to admix with the liquid as it passes from the first-mentioned means to the spray head, said second-mentioned means including an aspirator establishing communication between the inside of the container and the inside of the tube.

6. An aerosol sprayer suitable for use with a water-base fill to give a substantially droplet-free spray, said sprayer comprising a pressure-tight container having a valved spray head with a spray orifice, a liquid fill partially filling said container, a compressed and liquefied propellant in said container, and a dip tube in said container extending down from said spray head into said fill, said tube having a flow-restricting obstruction below said spray head, the internal flow area of said tube between said spray head and said obstruction being relatively large, said obstruction having a flow area much smaller than the upper part of said tube and approximately equal to that of a hole $\frac{1}{64}$ inch in diameter, said tube having a small aspirator hole through it above said obstruction within about $\frac{1}{8}$ inch thereof.

7. The sprayer in claim 6 wherein said fill is a water-base material, and said propellant material has propellant characteristics like those of isobutane.

8. An aerosol sprayer suitable for use upright with a water-base fill to give a substantially droplet-free spray, said sprayer comprising a pressure-tight container having a valved spray head with a right-angle spray orifice, a liquid fill partially filling said container, a compressed and liquefied propellant in said container, and a dip tube in said container extending down from said spray head into said fill, said tube having a flow-restricting obstruction a short distance below said spray head, the internal flow area of said tube between said spray head and said obstruction being of the order of $\frac{1}{8}$ inch in diameter, said obstruction comprising a thin diaphragm having a hole of the order of $\frac{1}{64}$ inch in diameter through it, said tube having a small aspirator hole through it above said obstruction within about $\frac{1}{8}$ inch thereof, said hole being above said liquid fill.

9. An aerosol sprayer suitable for use upright with a water-base fill to give a substantially droplet-free spray, said sprayer comprising a pressure-tight container having a valved spray head with a right-angle spray orifice, a water-base fill partially filling said container, a compressed and liquefied propellant in said container, and a dip tube in said container extending down from said spray head

6

into said fill, said tube having a flow-restricting obstruction a short distance below said spray head, the internal flow area of the upper part of said tube between said spray head and said obstruction being relatively large, said obstruction comprising a short length restriction having a flow area much smaller than the upper part of said tube and approximately equal to that of a hole $\frac{1}{64}$ inch in diameter, said tube having a small aspirator hole through it above said water-base fill closely above said obstruction so that said fill is sprayed from said container in a substantially droplet-free mist.

10. An improved aerosol sprayer comprising a container for a liquid to be sprayed as a spray or mist, a water-base fill partly filling said container, a layer of liquefied gas propellant immiscible with the water located on the surface of said water fill, a portion of said propellant being in gaseous phase and located above said layer, a valve controlled spray head closing said container, a dip tube having a relatively large flow area and extending from said spray head into said liquid, flow restricting means in the dip tube below said spray head to cause a sudden drop in pressure in the water-base fill as it passes through said tube, and injection means on the low pressure side of said flow restricting means to introduce propellant into said tube within the area of said pressure drop and to admix and distribute propellant and fill into an atomized mix.

11. In an aerosol-type sprayer suitable for use with a water-base fill and which comprises a pressure-tight container with a valved spray head, a dip tube for carrying the fill to the spray head, said tube having a relatively large internal diameter and having at a place intermediate its ends an internal flow restricting obstruction, said obstruction having a flow area many times less than the flow area of said tube and producing a sudden pressure drop in the flow through said tube, and an aspirator hole through said tube above said obstruction, said hole lying in close proximity to said obstruction, said obstruction serving to produce a pressure drop within said tube in the vicinity of said aspirator hole.

12. An improved, self-pressurized sprayer suitable for use with a water-base fill, said sprayer comprising a pressure-tight container having a push-button valved spray head with a right-angle spray orifice, a quantity of liquid material partially filling said container, a compressed and liquefied hydrocarbon propellant lying as a separate layer against said material, the region of said container above said layer being gas filled, and a dip tube in said container extending down from said spray head into said liquid material, the internal diameter and effective flow area of said tube for most of its length being relatively large, a flow restricting obstruction in said tube at a point below said spray head, said obstruction having a flow area much smaller than the flow area of said tube and producing a pressure drop in said tube, and a small aspirator hole through said tube, said hole being located above said obstruction a distance less than approximately the internal diameter of said tube.

13. An aerosol sprayer suitable for use with a water-base fill to give a substantially droplet-free spray, said sprayer comprising a pressure-tight container having a valved spray head with a spray orifice, a liquid fill partially filling said container, a compressed and liquefied propellant in said container, and a dip tube in said container extending down from said spray head into said fill, said tube having a flow-restricting obstruction below said spray head, the internal flow area of said tube between said spray head and said obstruction being relatively large, said obstruction having a flow area much smaller than the upper part of said tube and approximately equal to that of a packed wad of glass wool, said tube having a small aspirator hole through it above said obstruction within about $\frac{1}{8}$ inch thereof.

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