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A foam-generating device for a pump sprayer

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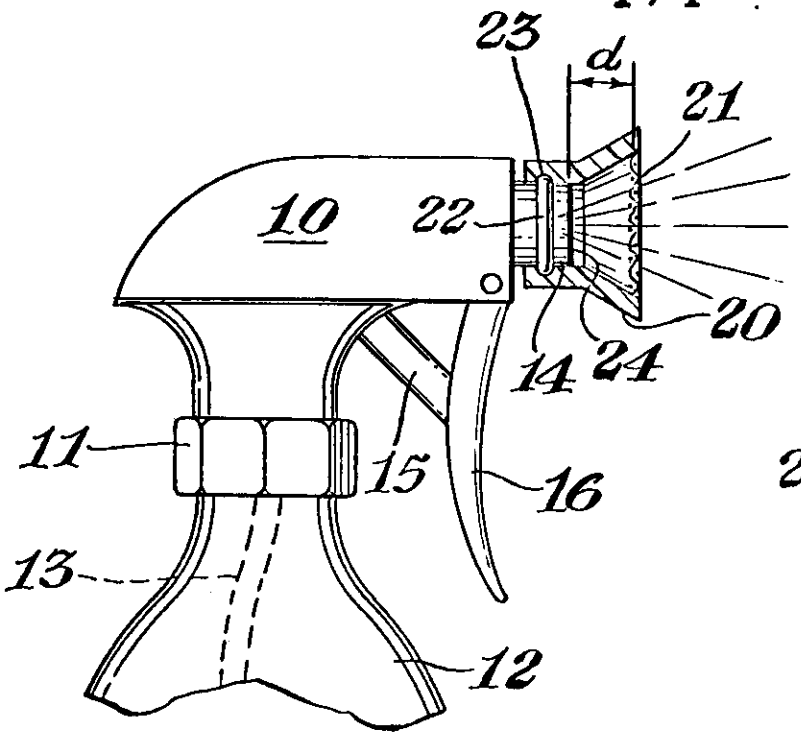

FIG. 1

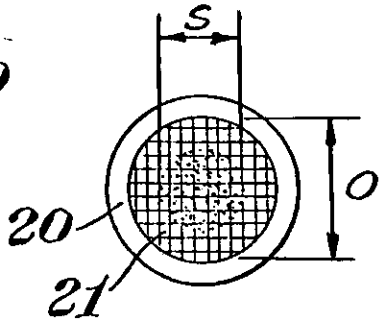

FIG. 2

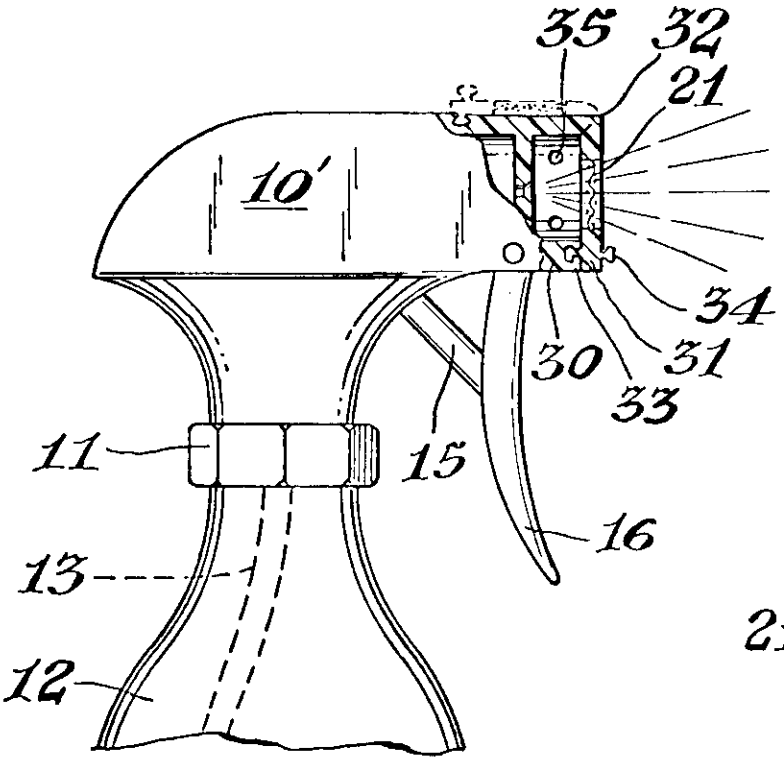

FIG. 4

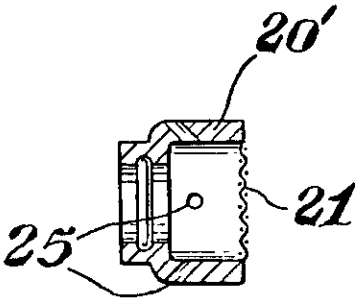

FIG. 3

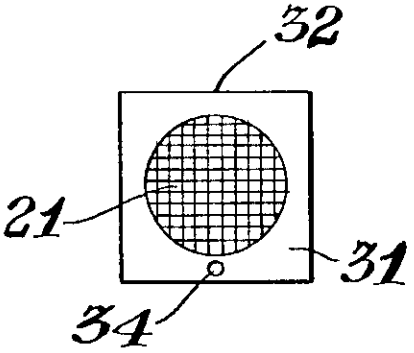

FIG. 5

SPECIFICATION

A foam generating device for a pump sprayer

The present invention resides in a foam generating and dispensing device and, more particularly, to a foam generating device for a manually operated atomizing dispenser having the capacity to spray a foamable liquid as a foam.

Foam generating and dispensing devices are well known in the art. The demand for these devices has heretofore been satisfied almost exclusively by the disposable, self-contained aerosol dispensers, due to their convenience and adaptability to a wide variety of products and foaming conditions. However, the continued use of such self-container aerosol dispensers is presently being re-evaluated, due in part to recently espoused environmental concerns over the effects of some of the chemical propellants used therein and in part to changing economic conditions. Accordingly, workers in the art have embarked upon a search for an acceptable replacement for the aerosol foam dispensers.

Generally, those replacement devices which have been proposed are of the type which include a collapsible bottle and a foam-forming cap assembly. The foam-forming cap assembly typically includes a homogenizing element of sponge-like material providing minute tortuous passages in which a flow of foamable liquid and air from the container is mixed to provide foam. Exemplary devices of this type are described in US Patent No. 3,985,271; US Patent No. 3,973,701; US Patent No. 3,937,364; and US Patent No. 3,572,590. In such devices, the mixture of air and liquid loses considerable velocity as it passes through the homogenizing element. Consequently, such devices undesirably have only limited "reach", i.e., they require the user to dispense the foam in near proximity to the surface upon which the foam will be deposited. Furthermore, because the user must apply his efforts to expel both liquid and air simultaneously, appreciable energy is wasted in forming and dispensing the foam. Still further, such devices are uneconomical inasmuch as they require that the bottle be only partially filled with a foamable liquid so that the necessary internal air supply is available for foam formation.

Consequently, attempts have been made to convert a conventional manually-operated atomizing dispenser (or "pump sprayer" as they are often called) to a foam-forming device, thereby overcoming some of the disadvantages of the "collapsible bottle" foamers. Specifically, it has been appreciated that (a) a pump sprayer is highly efficient, i.e., the user's efforts are directed to expelling only liquid, thereby minimizing the labor involved in its operation, and (b) it has considerable "reach", i.e., the liquid can be projected over a considerable distance. Nevertheless, it is believed that foam-generating pump sprayers have heretofore not met with success. For whatever reason, it would appear that pump sprayers (which have replaced the aerosol dispenser in numerous other applications) have not been made adaptable to the generation and dispensation of a foam of commercially acceptable quality.

Accordingly, it is an object of the present invention to provide a foam generating device operatively associated with a dispensing pump which requires only minimal effort to operate, which has considerable reach, which can spray a foam of commercially acceptable quality, and which can be economically produced by conventional fabrication techniques. It is also an object of this invention to provide a dispensing pump having the capacity to spray a foamable liquid as a foam.

The present invention provides a foam generating device, being operatively associated with a dispensing pump, including an atomizing nozzle, for drawing a foamable liquid from a container and ejecting it as a spray into the atmosphere through the atomizing nozzle, the association being capable of producing foam from the spray without substantially modifying the spray pattern thereof, said device comprising a screen retained in the path of the spray, which screen has a size in the range of from 60 to 200 mesh (U.S. Sieve Series) and is spaced at a distance of from 0.8 to 4mm from the atomizing nozzle, and means for introducing air into the spray so that, in use, the spray is permitted to foam upon contact with the screen and said device is such as to permit the passage of substantially all the spray therethrough without contact except by the screen.

The device generates foam on the surface of the screen using air external to the dispensing pump. Consequently, the user's labor is minimized since the amount of liquid expelled in the form of a foam is directly proportional to the effort contributed, there being no wasted energy due to the compression of air as in the "collapsible bottle" foamers.

Additionally, minimal velocity is lost by the spray as it is converted to foam in the device since substantially all the spray passes through the foam generating device without contact except by the surface of the screen. Accordingly the reach of the spraying apparatus utilizing the present foam generating device is considerably increased compared to the "collapsible bottle" foamers.

Furthermore, the foam generating device of the present invention provides a foam of commercially acceptable quality, i.e. it is relatively dry and stable and has little tendency to drip when deposited on a vertical surface. Consequently, the device is eminently suited for spray-

foaming household cleaners and the like.

Still further, the foam generator of the present invention is very economical to produce since, in some instances, it can be readily constructed with only minimal modification for use on a pre-existing pump sprayer.

Figure 1 is a side elevation view, showing the foam generating device in cross-section attached to a conventional manually operated foam-spraying apparatus.

Figure 2 is a front elevation view of the foam generating device of Fig. 1.

Figure 3 is a cross-sectional side elevation view of another embodiment of a foam generating device.

Figure 4 is a side elevation view, partially in cross-section, of another embodiment of a foam generating device attached to a conventional hand-held dispensing pump.

Figure 5 is a front elevation view of the foam generating device of Fig. 4.

Referring to Figs. 1 and 2, a manually operated dispensing pump 10 is detachably connected by a conventional threaded coupling 11 to a container 12 for receiving a foamable liquid therein. It is not a requirement of this invention that the dispensing pump be connected to the container, though such is desirable to enhance mobility. Generally, a conventional hand-held dispensing pump/container combination, such as is currently marketed for household use, is preferred. Regardless of the particular form chosen, it is understood that fluid communication will be provided between the dispensing pump and the foamable liquid, e.g., through a dip tube 13 (shown in phantom), so that the dispensing pump is able to draw liquid from the container.

As used herein, the term "foamable liquid" is meant to include any liquid having the capacity to form a foam when dispensed by the foam-spraying apparatus of the present invention. Generally, such liquids will exhibit the following properties: surface tension in the range of 20 to 45 dyne/cm, preferably 25 to 35 dyne/cm; density in the range of 0.8 to 1.2 g/cc, preferably 0.98 to 1.05 g/cc; and viscosity in the range of 0.9 to 1 7 centistokes, preferably 1.1 to 1.4 centistokes.

The dispensing pump may generally be of any conventional construction, so long as it includes an atomizing nozzle 14. The term "atomizing nozzle" as used herein is intended to be generic to a mechanism for providing a fine spray of liquid through a single or a plurality of orifices. Such dispensing pumps are generally provided with a compression mechanism, e.g., a piston 15 and an actuator 16, to force the liquid from the container through the atomizing nozzle with sufficient velocity to form the spray. Suitable dispensing pumps will preferably provide a spray having a velocity in the range of 15 to 21 metres/sec. through an orifice having a diameter in the range of from 0.3 to 0.65 mm and a land length in the range of from 0.25 to 0.6 mm. Exemplary dispensing pumps which may be used in the present invention include the AFA 7510 sprayer manufactured by the AFA Corporation and the Canyon CS sprayer manufactured by the Canyon Corporation.

The foam dispensing device of the present invention includes a bell-shaped housing 20 which is provided with a screen 21. The housing is operatively attached to the dispensing pump by a suitable mechanism such as a snap-fit mechanism which consists of a peripheral projection 22 which extends from the atomizing nozzle and a complimentary annular groove 23 defined by the inner surface of the housing 20. The housing 20 functions to retain the screen 21 in the path of the spray at a predetermined distance *d* from the atomizing nozzle, i.e., the distance from the point at which the spray is ejected from the dispensing pump into the atmosphere (which point will typically coincide with the location of the nozzle face 24). In order to generate a high quality foam, distance *d* will be in the range of from 0.8 to 4 mm, preferably in the range of from 2 to 3 mm. Furthermore, the screen size will be in the range of from 60 to 200 mesh (U.S. Sieve Series), preferably in the range of from 100 to 180 mesh. Screens having a smaller mesh size than that indicated will severely reduce spray velocity and cause excessive dribbling, whereas screens having a larger mesh size will permit spray to pass therethrough without sufficient foaming. The screen can be made of any material which is inert to the foamable liquid which will be dispensed. Because of their low cost and characteristically flat surface conformations, plastic screens, such as those made from polyethylene or polypropylene, are preferred. Furthermore, such plastic screens are eminently suited for sonic or electronic welding, thus providing a convenient method of attaching the screen to housing 20, should the housing be constructed of a similar plastic material. Other methods of attachment, such as by a suitable adhesive or press-fit mechanism, can also be used.

The foam generating device also includes means for introducing air into the spray so that the spray is permitted to foam upon contact with the screen. One method of accomplishing this is to construct housing 20 so that the diameter of the opening therein is larger than the diameter of the spray pattern at the point which it intercepts the screen, whereby air is permitted to enter the foam generating device from the front. This will be better understood by referring to Fig. 2, which shows the screen diameter *s* of the spray pattern as it intercepts the screen 21 (depicted by shading) and the diameter *o* of the opening of housing 20. Another method is exemplified by Fig. 3, wherein housing 20′ defines passageways 25 which permit air to flow into the spray

through the wall of the foam-forming means. Either of these methods, or a combination thereof, may be used. In either method, however, the foam generating device should be constructed so as to provide the proper amount of air for good foam formation. Specifically, if too little air is available, some of the spray will pass through the screen without foaming, thereby resulting in an undesirably wet foam being ejected from the foam-spraying apparatus.

It is a requirement of the foam generating device of the present invention that substantially all the spray pass therethrough without contacting any surface except the surface of the screen. Mechanical breakup of the spray, such as by impinging upon the walls of housing 20, should be minimized, since such will cause the reduction of spray velocity and result in undesirable dribbling from the foam-spraying apparatus.

It will be appreciated that the foam generating device of the present invention is capable of numerous embodiments. For example, it may be constructed so as to be detachable from the dispensing pump, as exemplified by Figs. 1 to 3, or it may be permanently integrated with the dispensing pump, as exemplified by Figs. 4 and 5. In Fig. 4, the foam generating device comprises an integral box-like member 30, which protrudes outwardly from a dispensing pump 10′ adjacent to the atomizing nozzle. The box-like member includes a flap 31, retaining a screen 21, and defines suitable air passages 35 at a position rearward of the flap. Flap 31 is connected to the box-like member by a hinge 32 so that the flap can be pivoted 270° from a foam generating position, wherein the screen is retained in the path of the spray, to a position where no foam is generated (shown in phantom). Suitable locking pins 33 and 34 snap-fit into mating receptacles defined by the box-like member 30 and the upper surface of the dispensing pump 10′ respectively, to enable the user to lock flap 31 in the desired operating position.

The type of dispensing pump to be used in the present foam-spraying apparatus is not critical. For example, the dispensing pump can be a finger-actuated, vertically-oriented mechanism as well as the hand-actuated, horizontally-oriented mechanism like that shown in Figs. 1 and 4. Additionally, the form of the screen can be varied within the scope of the functional requirements suggested earlier. For example, the screen may be arcuate in cross-section, e.g., protruding away from the atomizing nozzle, and the openings of the screen can be of any desired configuration, i.e., the openings need not be square.

Example

In order to demonstrate the effectiveness of the foam-forming apparatus of the present invention, experiments were performed by testing two commercially available dispensing pumps, i.e., the AFA 7510 sprayer and the Canyon CS sprayer, with and without the foam generating device depicted in Figs. 1 and 2. The foam generating device included a 100 mesh (U.S. Sieve Series) nylon screen spaced a distance *d* of 3 to 4 mm from the atomizing nozzle and had an opening *o* of about 10 mm.

For comparison, an AFA 5910 sprayer was tested with and without an AFA 5912BA foaming attachment.

A foamable liquid cleaner having a surface tension of 31.2 dyne/cm, a density of 1.02 g/cc, and a viscosity of 1.37 centistokes was used in all tests.

The results of these experiments are shown in Table 1. It can be seen that the AFA 5912BA foaming attachment severely modified the predetemined spray pattern and rendered the dispensing pump relatively hard to operate.

In contrast, the foam generating device of the present invention did not substantially modify the predetermined spray pattern nor did it substantially affect the amount of effort required to operate the dispensing pump. In addition, the present foam generating device was able to produce a very good quality foam—much like that produced by a typical aerosol dispenser.

TABLE I

Sprayer	Orifice Diameter (mm)	Foam Attachment	Spray Area[1] (in x in)	Ease of Operation	Foam Quality
Control					
AFA 7510	0.56	None	5.5 x 6	Moderate	None
Canyon CS	0.64	None	6 x 7	Easy	None
AFA 5910	0.56	None	7 x 8	Moderate	None
The Invention					
AFA 7510	0.56	Yes	5 x 5.5	Moderate	Scattered, Slowly Runs
Canyon CS	0.64	Yes	5 x 6.5	Easy	Scattered, Hardly Runs
For Comparison					
AFA 5910	N.M.	AFA 5912BA	3.5 x 2.5	Hard	Thick Buildup Slowly Runs

Notes:

[1] Measured on a target located at a distance of about 7 in form the sprayer.

N.M. - Not measured.

CLAIMS

1. A foam generating device, being operatively associated with a dispensing pump, including an atomizing nozzle, for drawing a foamable liquid from a container and ejecting it as a spray into the atmosphere through the atomizing nozzle, the association being capable of producing foam from the spray without substantially modifying the spray pattern thereof, said device comprising a screen retained in the path of the spray, which screen has a size in the range of from 60 to 200 mesh (U.S. Sieve Series) and is spaced at a distance of from 0.8 to 4mm from the atomizing nozzle, and means for introducing air into the spray so that, in use, the spray is permitted to foam upon contact with the screen, and said device is such as to permit the passage of substantially all the spray therethrough without contact except by the screen.

2. A device as claimed in claim 1, including means for connecting said device to the dispensing pump for movement between a first position for producing foam and a second position for permitting spray to be ejected without producing foam, and means for selectively securing the device in the first and second positions.

3. A device as claimed in claim 1 or claim 2, wherein the screen has a size in the range of from 100 to 180 mesh.

4. A device as claimed in any one of the preceding claims, wherein said means for introducing air comprises one or more apertures in the body of said device.

5. A device as claimed in any one of the preceding claims, wherein the screen is spaced at a distance of from 2 to 3mm from the atomizing nozzle.

6. A device as claimed in any one of the preceding claims, wherein the screen has a diameter larger than that of the spray pattern where such pattern contacts the screen, such that, in use, air enters the screen from the front.

7. A device as claimed in any one of the preceding claims, wherein said dispensing pump is manually operated.

8. A device as claimed in any one of the preceding claims, wherein said dispensing pump is in liquid flow communication with a container for foamable liquid.

9. A device as claimed in claim 8, wherein said container contains foamable liquid.

10. A device as claimed in claim 9, wherein said foamable liquid is a household cleaning liquid.

11. A device as claimed in any one of claims 8 to 10, wherein the container is a hand-held container.

12. A foam generating device substantially as hereinbefore described with reference to and as illustrated in any one of the accompanying drawings.

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