ABSTRACT: The disclosure includes a hair shampoo foam generator having a liquid shampoo within a bottle having an air tube and a liquid tube. An air compressor is connected to the air tube to pressurize the container and force the liquid out through the liquid tube. The compressor is also connected directly to the liquid tube to mix with the liquid forced outwardly through the liquid tube within a mixing length of the liquid tube, thereby generating a foam. The characteristic or wetness of the foam may be controlled by valves in the air and liquid tubes, which control the relative quantities of air and liquid introduced into the mixing tube portion.
BACKGROUND OF THE INVENTION

This invention relates to a gas- and liquid-mixing apparatus, and particularly to such an apparatus for producing a foamlike material such as shampoo by simultaneous discharge of gas and a liquid such as a liquid shampoo. In many applications, particularly for cleaning and the like, it has been found that converting a liquid cleaning material into a cleansing foam produces substantially improved cleaning action. Although the present invention is applicable to formation of any foam employing a mixture of liquid and gas, the invention is particularly applicable to and is described in connection with forming of a hair shampoo for purposes of explanation and discussion.

Various systems have been suggested for selectively applying a liquid shampoo to the head of a customer. However, they have generally been relatively difficult to control the precise application of the shampoo and have been relatively wasteful of the shampoo.

SUMMARY OF THE INVENTION

The present invention is particularly directed to an improved apparatus for generating a foam substance by intermixing gas and a liquid as the combination flows outwardly through a discharge or applying passageway. In particular, as applied to a liquid shampoo for hair and the like, air and liquid shampoo are simultaneously passed through a mixing passageway to result in the formation of a foam shampoo which can be accurately and precisely applied with a minimum amount of liquid shampoo required to perform unusually satisfactorily. Generally, in accordance with the present invention, the liquid shampoo is housed within a suitable container having an air inlet and a liquid outlet passageway means. An air source means is interconnected through the air inlet to pressurize the container and, thereby continuously urge the liquid outwardly through the corresponding passageway. The air source means is also applied directly to the passageway such that when the passageway is opened, the liquid is forced outwardly through the passageway, and air is simultaneously introduced into the passageway with the resulting generation of a foam, as a result of predetermined movement through the passageway. The characteristic or wetness of the foam may be readily controlled by controlling the relative quantities of air and liquid introduced into the passageway means. The foam generated in accordance with the present invention has an exceptionally long life and consequently, the intermittent operation of the device with reasonable periods between operations provides a continuous supply of foam from the discharge end of the passageway means.

In a highly novel construction in accordance with the present invention, the air inlet tube and liquid discharge tube are secured within a container opening with the air inlet tube terminating above the normal level of the liquid, and the liquid discharge tube held immersed within the liquid. An air connection is made between the air tube and the liquid discharge tube immediately outwardly of the container fitting or opening. Air adjustment valves are provided in the air tube and the liquid discharge tube between the air connection and the fitting proper to permit adjustment of the particular foam characteristic. Check valves are provided to prevent undesirable backup of the air into the liquid passageways and the like.

In a particularly practical construction for installation in a beauty salon or the like, a common air line and a common liquid line are connected to a shampoo source and extended to a plurality of stations. The air line is connected to an air source through a one-way valve means and to the shampoo container and the liquid line is connected to the container. At each station a mixing line is connected to the adjacent air line and liquid line through suitable taps. Each connection includes an appropriate check valve and regulating valve to permit adjustment of the relative quantities of liquid shampoo and air supplied to the mixing line. This system provides a convenient and relatively simple installation which permits individual adjustment of the shampoo foam characteristic at the several stations in a large salon.

In another preferred construction, the container may be provided with a top sidewall opening having an air-liquid fitting. A first air line pressurizes the container. An air and liquid discharge line extends through the fitting into the container. A mixing unit is connected to the innermost ends of the air-mixing line and the liquid discharge line with the coupling unit carried by a suitable float means to ride in the upper portion of the liquid. A liquid inlet means is provided extending downwardly into the liquid. The air and liquid discharge line are formed of a suitable flexible material to permit the coupling unit to float on the liquid and to move downwardly as the liquid is withdrawn from the container.

BRIEF DESCRIPTION OF DRAWINGS

The drawing furnished herewith illustrates the best mode presently contemplated by the inventor for carrying out the invention in which the above advantages and features are clearly disclosed, as well as others, which will be readily understood from the following description of the illustrated embodiments.

In the drawings:

FIG. 1 is a diagrammatic side elevational view of a foam shampoo apparatus constructed in accordance with the present invention;

FIG. 2 is an enlarged fragmentary view of the coupling unit shown in FIG. 1, with parts broken away and sectioned to more clearly disclose internal details of the construction of an air-liquid mixing unit;

FIG. 3 is a fragmentary view showing a multiple station shampoo supply system in accordance with the present invention;

FIG. 4 is a view showing a single station system employing the mixing arrangement of FIG. 3; and

FIG. 5 is a view showing still a further embodiment of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to the drawing and particularly to FIG. 1, the present invention is shown applied to a foam-shampoo generating apparatus, including a container or bottle 1 within which a liquid hair shampoo 2 or the like is contained. A discharge or applicator tube 3 extends from the lower end of the container 1 and terminates in a controllable nozzle 4 for selective application of a foam derived from the shampoo 2 as hereinafter described. An air compressor 5 is provided and interconnected via an air input line 6 to a special air-liquid mixing unit or fitting 7 interconnected to pressurize the container 1 and to provide discharge of a foam through the applicator tube 3. In the illustrated embodiments of the invention and of FIGS. 1 and 2, the container 1 is a bottelike member mounted in an inverted condition with a bottom neck opening 8. A positive closure 9 is threaded on or otherwise releasably secured to the neck 8 and supports the fitting 7.

In accordance with the present invention, the fitting 7 includes an air tube 10, which extends through the closure 9 and terminates at the upper end immediately adjacent to the base of the container 1, and thus extends above the level of the liquid shampoo 2. A liquid discharge tube 11 is secured within the closure 9 with its inner end terminating essentially immediately adjacent to the innermost surface thereof, such that complete withdrawal of the shampoo 2 from the container 1 can be effected. A cross or connecting tube 12 interconnects the outer ends of the air tube 10 and the liquid tube 11 with the applicator tube 3. The connecting or integrally formed with the crossbar or connecting tube 12. An air connector 13 interconnects the incoming air line 6 to the air tube 10 outwardly of the stopper 9, such that when the compressor is operating and the air line 6 is open, air is simultaneously applied via the tube 10 to the container 1 and directly to the applicator tube 3.
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via the depending portion of the air tube 10. When the
compressor is turned on, the pressurizing of the container 1 forces
the liquid 2 outwardly through the passageway or tube 11 and
into the applicator tube 3. Simultaneously, air is directly ap-
plied via the air tube 10 to the applicator tube 3, such that
there is a relatively violent mixing of the air and liquid shan-
poo 2 as it moves through the applicator tube 3. The char-
acteristic of the foam discharged from the applicator tube 3 is
controllable by controlling the relative volumes or mounts of
air and liquid introduced into the tube 3 when the compressor
is turned on and the nozzle 4 is opened.

In accordance with a particularly novel aspect of the
present invention, an air valve unit 14 and a liquid valve unit
15 are similarly provided in the air tube 10 and the liquid tube
11 immediately inwardly of the interconnecting tube 12.

Each of the illustrated valves 14 and 15 is similarly con-
structed. Valve 14 is shown and described in detail for pur-
poses of explanation. As most clearly shown in FIG. 2, valve
14 includes an encircling frame 15a through which the tube 10
passes. A simple knurled bolt 15b is adapted to be threaded into
and withdrawn through the sideward of the associated
frame 15a to selectively collapse the tube 10. Collapsing of the
associated tube 10 reduces the cross section of the flow
passageway at that part and, thereby increases the resistance.
For a given pressure, the relative amounts of liquid and air
introduced into the applicator tube 3 are, therefore, directly
controlled by the positioning of the associated valves 14 and 15.

When the compressor 5 is turned off, the liquid shampoo 2
will have a tendency to flow back through the fitting into the
air lines 10 and 6, as a result of gravity forces. Although the
compressor 5 may be held above the level of the liquid to
minimize the amount of flow-back, any appreciable amount of
flow-back of liquid in the air lines may cause a concentrated,
especially liquid slug in the applicator tube 3 upon the next
operation of the unit. A ball check valve 16, or other suitable
one-way flow means, is preferably provided in the air tube
between the valve 14 and the cross-connecting tube 12 to
positively prevent the backflow of liquid and to establish an
essentially instantaneous mixing of the liquid and air within
the applicator tube 3.

As previously noted, the compressor may be of any desired
or suitable construction adapted to establish the necessary
working pressure and adapted to be intermittently operated or
connected to the air line 6.

Similarly, the nozzle 4 may be of any desired construction;
for example, as shown and described in connection with the
embodiment of FIG. 4.

Applicant has found that the simultaneous pressurization of
the container 1 and the introduction of air directly into the
passageway or tube 3 results in an unusually satisfactory foam
generation. Generally, the characteristic of the foam is de-
ptended upon the relative quantities of air and liquid in-
troduced into the passageway for any given length of the
applicator or discharge tube for optimum results, which in the il-
ustrated embodiment of the invention is readily controlled by
the air and liquid valves 14 and 15. Further, for optimum
results, applicant has found that the tubing for the several
passageway means should be of the same internal diameter.
Thus, the several lines may be formed of corresponding-sized
plastic tubing. The air pressure level, the consistency of the
liquid and similar physical characteristics will also, of course,
affest the particular generated foam.

In FIG. 3 an upstanding liquid container 17 is shown hous-
ing a liquid shampoo 18. In FIG. 3 an air line or tube 19 is pro-
vided terminating within the upper portion of the container
17, which is sealed by a suitable replaceable closure cap 20. A
liquid discharge line or tube 21 extends through the cap 20
generally to the lower end of the container 17. The air tube 19
and the liquid tube 21 are extended from the container 17 to a
plurality of stations, or a plurality of applicating stations
indicated by similar primed numbers. The tubes 20 and 21 are
interconnected at station 22 by suitable fittings and connec-
tions to an applicator tube 23. The liquid and the air are trans-
ferred to the mixing point at which time the air and liquid
enter the applicator tube 23 to form the desired mixture. The
air line or tube 19 is connected to tube 23 in series with a one-
way check valve 24 and an adjustable flow valve 25, similar to
valves 16 and 17. The liquid line 21 is similarly connected to
line 23 in series with a suitable check valve 26 and flow valve 27.
A check valve 28 is inserted in the air line 19 at the container
17 to maintain a constant pressure on the confined liquid shan-
poo. At the second and all further stations, the tubes 19 and
21 are similarly interconnected to the separate applicator tube
39 of the necessary design strength.

The operation of the unit illustrated in FIG. 3 is basically
similar to that disclosed in FIG. 1. In FIG. 3 the pressurized
liquid is forced upwardly through the liquid tube 21. The pres-
urized source of air maintains air and liquid available at the
entrance to the several mixing and application tubes 23, and
29. Although only two stations are shown, a substantially
greater number will normally be connected to the one source.

The check valves 24 and 26 prevent passage of air through
the connection into line 21 or the reverse passage of liquid into
the air line 19. The flow valves 25 and 27 regulate the relative
ratio of air and liquid. Upon entering the applicator tube 23,
the liquid is combined with air under pressure to form the desired
foam at the terminal end or portion of the applicator
23. Thus, whenever the applicator tube is opened, foam is
emitted.

In FIG. 4 a single station installation similar to that of FIG. 3
is illustrated. In FIG. 4 the shampoo container 30 includes the
cap 31 provided with the air line 32 and liquid line 33 which
especially terminates immediately adjacent the cap 31. The
lines 32 and 33 are connected to a mixing and applicator line
34 with suitable check and flow-regulating valves, similar to
the illustration of FIG. 3. The system of FIG. 4 operates in es-
sentially the identical manner of FIG. 3 and no further
description thereof is given.

In FIG. 5 still a further embodiment of the present invention
is illustrated. In FIG. 5 a container 35 is mounted on its side
and is provided with a top sidewall opening 36. The special
fitting or stopper 37 is secured within the opening 36 and in-
cludes an air line or tube 38 terminating within the upper por-
tion of the container 35. A liquid discharge line 39 extends in-
wardly through the fitting 37. An air liquid coupler 40 is secured
to the inner end of tube 39.

The coupler 40 includes a liquid pickup stem 41 which is
secured to the line 39 and depends downwardly into the
liquid. A float 42 is secured to the stem 41 to support the
coupler 40 riding on the liquid with the lower end of stem 41
within the liquid. An air-mixing inlet 43 is connected to the
stem 41 above the level of float 42 and the connection to the
line 39. Inlet 43 serves to introduce high-velocity air into line
39 to produce foam in the discharge tube 39 and the applica-
tor extension which terminates in a nozzle 44. Generally, the
air inlet 43 is substantially smaller than the liquid inlet or stem
41. Alternately, inlet 43 may be provided with a flow control
valve 45 to regulate the size of the opening for optimum foam
generation.

In the illustrated embodiment of the invention, the nozzle
44 is shown including an outer housing 46 through which the
applicator tube 39 extends. A spring-loaded plate 47 extends
crossing the housing 46 and is provided with a tapered opening
48 through which the tube 39 extends. The plate 47 is spring
loaded to move the plate 47 upwardly with the tube 39 mov-
ing into the narrower portion of the tapered opening 48 and seal
off the tube. A release lever or trigger 49 is connected in the
housing 46 extending from the upper end of the plate 47 to
permit depression thereof and release of the plate, such that
the tube 39 moves into the enlarged portion of the opening 48,
thereby opening the passageway.

The nozzle 44 is a flexible tube, such that the coupler 40 and
attached float 42 move downwardly with the liquid level and
maintain a constant predetermined placement of the liquid
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3. The bottom of the container 35 may be dished and provided with a bottom sump 50 to permit essentially total withdrawal of the contained liquid.

The present invention has been found to produce an extremely stable foam, with the degree of wetness readily controlled by controlling the relative ratios of air and liquid. As applied to hair shampoo and the like, the quantity of liquid shampoo required for any given application is substantially reduced with a consequent substantial cost reduction.

I claim:

1. A foam-producing apparatus for producing foam by mixing a liquid and a gaseous fluid, comprising a liquid source means, a pressurized, gaseous fluid source means, a first passageway means connecting said gaseous fluid source means to said liquid source means to pressurize said liquid source means, a continuous confining passageway means unobstructed in operation and having an inlet portion immersed in said liquid and a discharge orifice spaced from said liquid source means to establish a discharging continuous full liquid flow from said liquid source means through said confined passageway means, mixing means located in the confining passageway means between said inlet portion and said discharge orifice, and a conduit means connecting said first passageway means to said mixing means in said continuous confining passageway means between said inlet portion and said discharge orifice, and said conduit means connecting said first passageway means to said mixing means in said continuous confining passageway means, means in said conduit means for controlling the relative air-liquid mixture within said conduit means, and said conduit means being connected to said mixing means, said conduit means being connected to said mixing means, means in said conduit means and said continuous passageway means upstream of said mixing means to selectively control the relative amounts of air and liquid flow in said continuous passageway means downstream of said mixing means.

2. The foam-producing apparatus of claim 1 wherein said liquid source means and said conduit having an opening and a releasable opening closure means, said gaseous fluid source means supplying air and said first passageway means being an air line connected to the closure means to pressurize said liquid source container, said continuous passageway means including a liquid line having one end terminating in the liquid space in said liquid container, a second air line connected to said first air line, said second air line and said liquid line extending to a plurality of discharge stations, liquid line extensions connected to said liquid line, one each at each station and defining said discharge orifice for the continuous passageway means and said conduit means comprising an air connection line at each station connecting said second air line to said line extension to introduce said air as a high-velocity stream into said liquid line extension with a resulting generation of a foam within said liquid line extension, each of said liquid line extensions and said air connection lines having adjustable valve means therein to control the relative air-liquid mixture within the line extension and one-way valve means in each said air connection line to isolate each liquid line extension from its corresponding air line.

3. The foam-producing apparatus of claim 7 wherein said air connection lines and said line extensions each includes flexible portions and said adjustable valve means includes means to selectively collapse its corresponding line to control flow therethrough.

4. The foam-producing apparatus of claim 1 wherein the fluid source means supplies air and said first passageway means being an air line connected to said fluid source means and extending into said container and terminating above the liquid level, said continuous confining passageway means including a liquid line having one end extending into said liquid and the other end to said mixing means, said conduit means including an air connecting line connected to the first passageway means and the mixing means in said air connection line and in said liquid line to control the relative air-liquid mixture within the mixing means.

5. The foam-producing apparatus of claim 7 having a check valve in said air connection line adjacent the connection to the discharge line to prevent liquid entry into said air line.

6. The foam-producing apparatus of claim 1 wherein said liquid source means includes a container having a liquid partially filling the container, said mixing means is disposed within said container and includes means to float the mixing means on the liquid with a liquid inlet member depending into said liquid and forming part of the continuous passageway means.

6A. The foam-producing apparatus of claim 1 wherein said liquid source means includes a container having a bottom opening through which said first continuous passageway means extends, and said mixing means includes an external connection to said continuous passageway means, said conduit means being connected to said mixing means, means in said conduit means and said continuous passageway means upstream of said mixing means to selectively control the relative amounts of air and liquid flow in said continuous passageway means downstream of said mixing means.

7. The foam-producing apparatus of claim 1 wherein said liquid source means and said conduit means including a container having an opening and a releasable opening closure means, said gaseous fluid source means supplying air and said first passageway means being an air line connected to the closure means to pressurize said liquid source container, said continuous passageway means including a liquid line having one end terminating in the liquid space in said liquid container, a second air line connected to said first air line, said second air line and said liquid line extending to a plurality of discharge stations, liquid line extensions connected to said liquid line, one each at each station and defining said discharge orifice for the continuous passageway means and said conduit means comprising an air connection line at each station connecting said second air line to said line extension to introduce said air as a high-velocity stream into said liquid line extension with a resulting generation of a foam within said liquid line extension, each of said liquid line extensions and said air connection lines having adjustable valve means therein to control the relative air-liquid mixture within the line extension and one-way valve means in each said air connection line to isolate each liquid line extension from its corresponding air line.