

[54] **FOAM GENERATOR**

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[51] Int. Cl. **B05b 7/26**

[58] Field of Search 239/143, 172, 309, 372, 239/373, 375, 308, 175; 169/14, 15; 222/195; 261/DIG. 26

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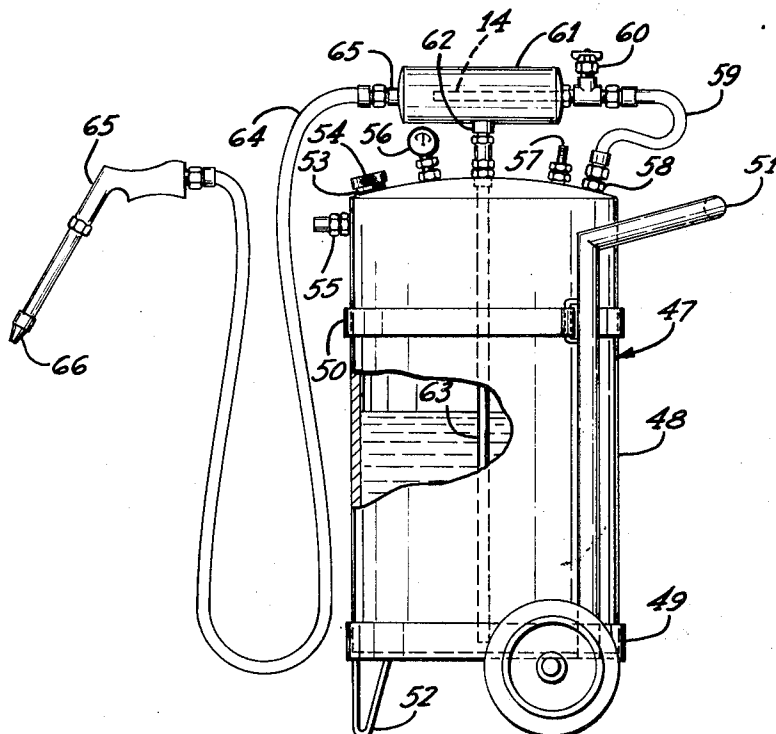
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[57]

ABSTRACT

A foam generating apparatus includes a tank containing liquid chemicals for producing a foam. Gas under pressure is applied to the tank to drive the liquid into a foam generator. In the foam generator the pressurized gas is injected into the liquid to form a foam via a generator core having openings formed at staggered intervals and at right angles, one from another.

4 Claims, 7 Drawing Figures



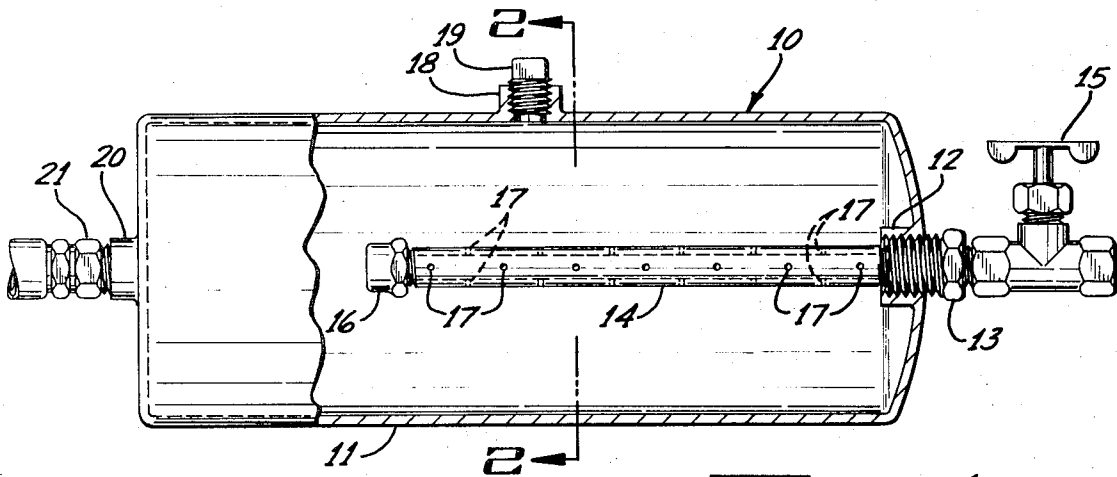


Fig. 1

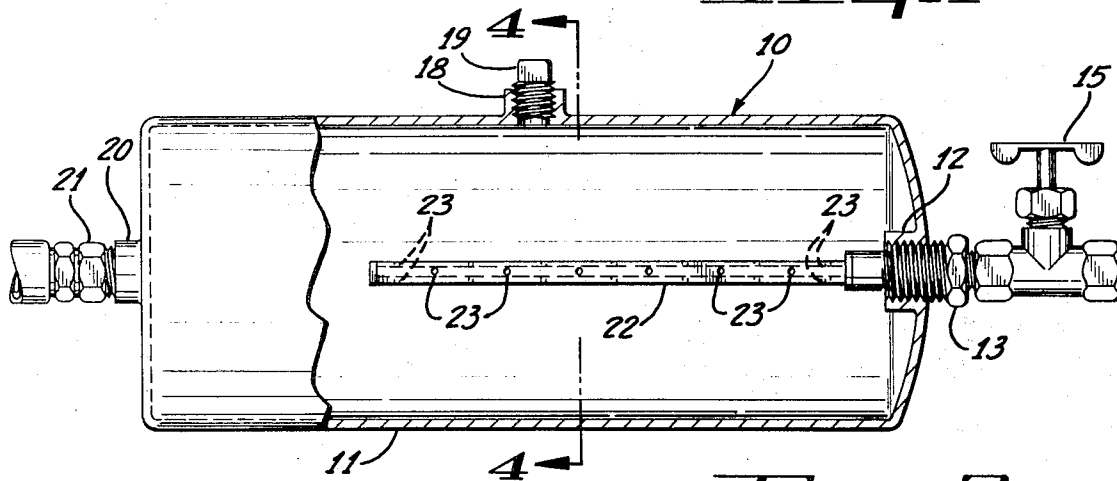


Fig. 3

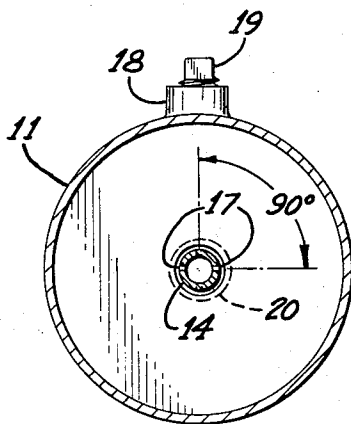


Fig. 2

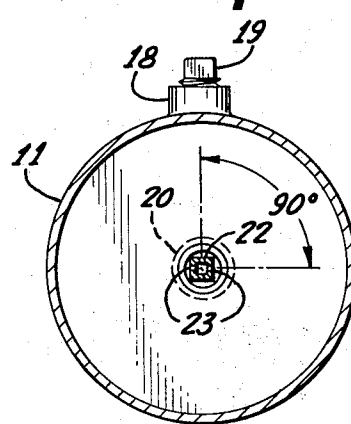


Fig. 4

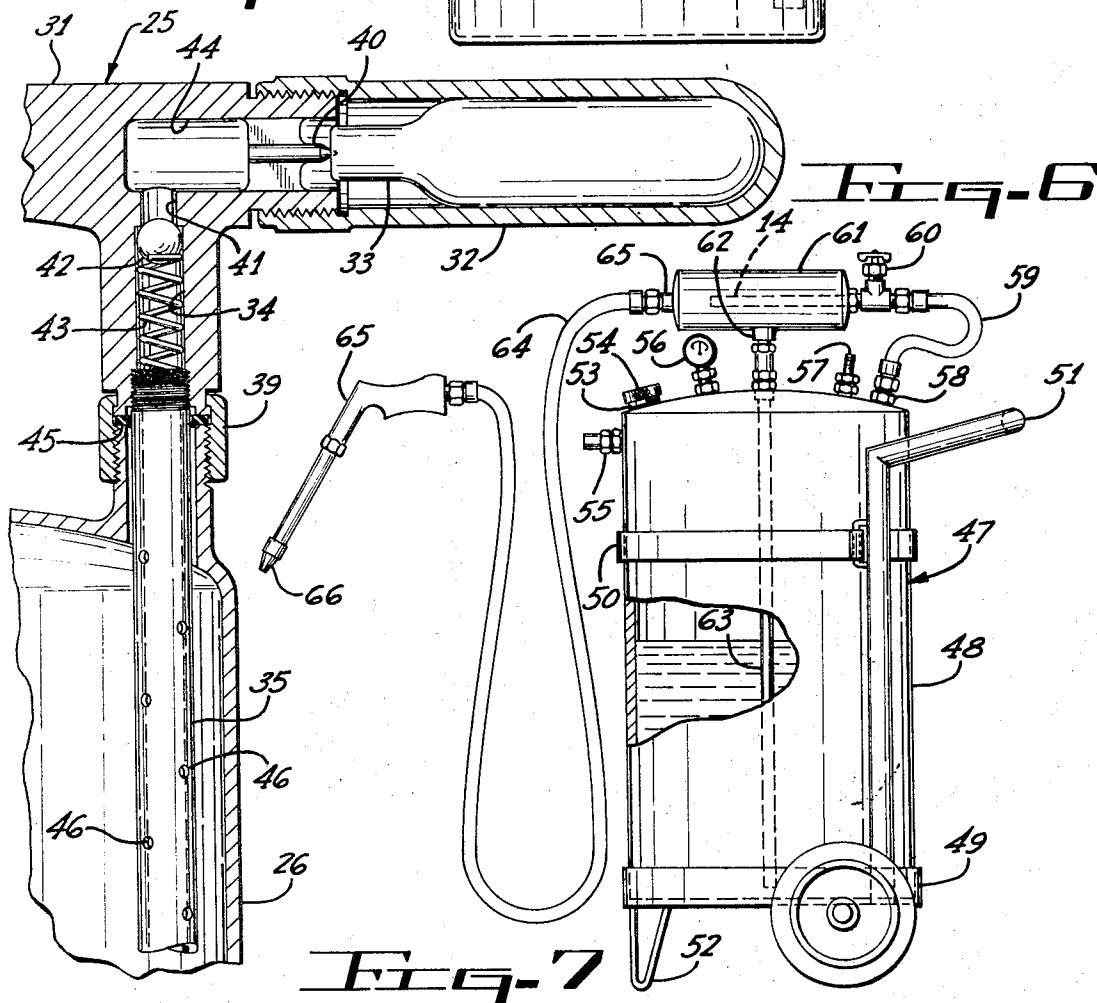
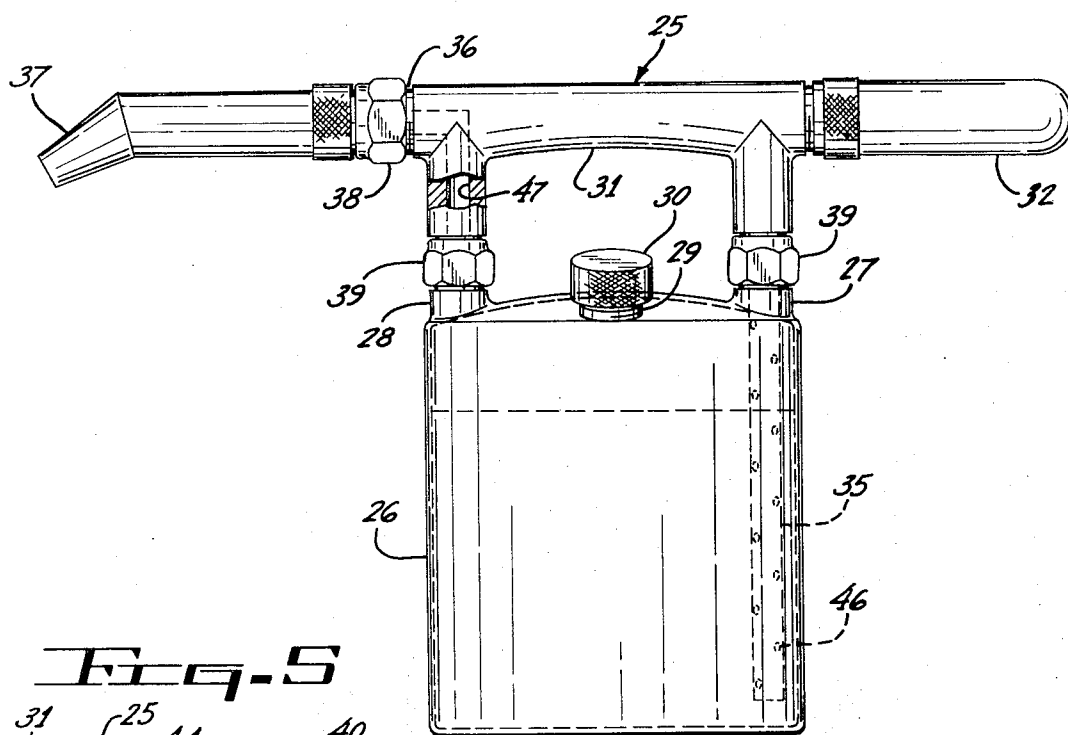


Fig. 7

FOAM GENERATOR

BACKGROUND OF THE INVENTION

This invention relates generally to a fluid spraying and diffusing device and more particularly to a fluid pressure discharge means having a foaming diffuser.

FIELD OF THE INVENTION

The application of cleaning and maintenance agents to an item to be cleaned, such as stuffed cloth chairs, has gone through a rather involved process. At first the item to be cleaned was drenched with the chemicals to accomplish the cleaning. The removal of the excess chemicals caused problems and also many items could not be drenched with the chemicals without damage. Then a fine spray was used by forcing the chemicals through a fine orifice and the chemicals were sprayed onto the item. This also created an excess of chemicals on the item to be cleaned.

Present-day cleaning is accomplished by applying cleaning and maintenance chemicals in the form of a foam. Cleaning chemicals are odorless in the foam state and can be applied to any surface, whether vertical or horizontal. The foamed chemicals adhere to the surface and readily absorb the dirt. The foam can be easily removed with the dirt. Foam further has the advantage of applying the chemicals in a uniform manner and the item to be cleaned is not drenched with the chemicals. Many devices have been designed to accomplish the generation of the foam. However, each agitates the chemicals in an uneven manner to produce either an overaerated foam or a foam which contains too much of the liquid chemical.

PRIOR ART

Prior art devices created the foam for use in cleaning articles by immersing a hollow pipe through which the gas was forced under pressure through the liquid to form the foam. The pipe was generally closed at the free end and included random holes, slits or the like for the gas outlet into the liquid. The random openings produced an instability which resulted in the generation of an unstable foam.

SUMMARY OF THE INVENTION

The problems of the prior art are solved by providing a foam generator which forces gas under pressure evenly into liquid chemicals by the use of precisely placed holes or openings in a foam generator core comprising a hollow tube. The hollow generator core is closed at one free end and the openings formed in the walls of the generator core are spaced at staggered intervals, with each successive opening located around the circumference of the generator core at a 90° interval from the preceding opening. Gas under pressure is forced into the open end of the generator core and the gas circulating through the liquid in the foam generator produces a rich, creamy foam that is ejected through an opening in the foam generator.

The foam generator can be placed into a portable foam producing unit to provide an easily carried unit. A carbon dioxide cylinder can provide the pressurized gas to form the foam. A U-shaped handle connects to a tank carrying the chemicals and provides the connections to gauge the entry of the pressurized gas into the foam generator. The foam generator is inserted into the

foam producing liquid. The handles also provide an exit connection to a nozzle connected to the handle to direct the foam.

The foam generator can also be placed on a unit including a tank having the foam producing liquid placed therein under pressure. An opening to the foam generator is provided for the liquid under pressure and for the pressure producing gas. The pressurized gas produces the foam in the foam generator and forces the foam via pressure hoses to a trigger nozzle.

It is, therefore, an object of the present invention to provide an enhanced apparatus for generating foam from liquid chemicals.

It is another object of the present invention to provide an enhanced foam generator which uses air under pressure forced through regularly spaced openings in a hollow cylinder and inserted in liquid chemicals.

It is yet another object to provide a portable, chemical foaming apparatus.

It is a further object to provide a foam generator that has no moving parts.

It is yet a further object to provide a foam generator for producing foam from a liquid chemical in which gas under pressure is applied to the liquid chemicals in an orderly fashion to produce a rich, creamy foam.

These and other objects of the present invention will become apparent to those skilled in the art as the description proceeds.

BRIEF DESCRIPTION OF THE DRAWING

The various novel features of this invention, along with the foregoing and other objects, as well as the invention itself both as to its organization and method of operation, may be more fully understood from the following description of an illustrated embodiment when read in conjunction with the accompanying drawing, wherein:

FIG. 1 is a cutaway view of one embodiment of the foam generator according to the present invention;

FIG. 2 is a sectional side view taken along lines 2—2 of FIG. 1 and shows the cross-sectional view of the generator core;

FIG. 3 is a cutaway view of a second embodiment of a foam generator according to the present invention;

FIG. 4 is a sectional side view taken along lines 4—4 of FIG. 3 and shows a cross section of the generator core according to the second embodiment;

FIG. 5 is a phantom side view of a portable foaming device showing an adaptation of the foam generator according to the present invention;

FIG. 6 is an enlarged partial cross-sectional view showing the foam generator apparatus of the foaming device shown in FIG. 5; and

FIG. 7 is a partial cutaway side view of another foaming apparatus using the foam generator according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiments of the present invention are shown in FIGS. 1 to 4. The adaptation of these units to a foam producing system is shown in FIG. 7. A further embodiment of the present invention for adaptation to a portable device is shown in FIGS. 5 and 6. In order to fully understand the disclosed foam generator, the unit itself will first be explained.

Referring to FIG. 1, a foam generator 10 is shown comprising a container such as a cylinder 11 having a threaded inlet 12 to which a threaded connector 13 is attached. A hollow circular tube 14 forming a generator core is threaded to the connector internal to the cylinder. External to the cylinder is a suitable valve 15 threaded to the connector to control pressurized gas. The free end of the generator core tube is closed with a threaded cap 16. All connections are threaded to form air and liquid-tight connections and for ease of disassembly of the unit for cleaning and parts replacement purposes. It should be obvious that many other types of connections are contemplated for use with the present invention.

The valve 15 provides a suitable means for introducing gas under pressure to the cylinder via the generator core. The generator core has openings formed therein, extending essentially the entire length of the tube. The openings 17 in the tube are located at spaced intervals along the length of the tube. Each successive opening is spaced along the circumference of the tube 90° away from the preceding opening. Openings in the same 180° plane are located directly opposite each other. Thus, as can be seen by referring to FIG. 2, the generator core according to the first embodiment is a hollow circular tube having openings located in planes at a 90° angle to each other. The openings are preferably drilled holes, but can be of any configuration mainly to evenly supply the pressurized gas to the liquid surrounding the tube.

The cylinder further includes a second inlet 18 for the entry of the foam producing liquid into the cylinder. This inlet 18 is shown closed with a threaded plug 19. The foam generator includes a threaded outlet 20 to which a portion of a hose 21 is connected for exiting the generated foam.

In operation, the cylinder is essentially filled with a liquid chemical which is capable of foaming, such as a cleaning detergent, shampoo, acid or caustic. Pressurized gas such as air is introduced to the core generator 14 via the valve 15. The pressurized air passing through the liquid via the precisely placed openings 17 agitates the liquids in a uniform manner to form a creamy foam. The air passing through the liquid also keeps the liquid completely mixed. The air pressure within the cylinder 11 forces the foam out of the exit opening or outlet 20 into a spraying nozzle (not shown).

Referring now to FIGS. 3 and 4, a second embodiment of the present invention is shown. In the second embodiment the core generator is a flat-sided hollow tube 22. The core generator of FIGS. 3 and 4 comprises a square hollow tubing with openings 23 located along the flat sides of the tubing, thereby placing the openings again in planes spaced 90° around the circumference from each other. Again, as per the first embodiment, openings located in a same plane are located directly opposite each other. All other parts of the foam generator are similar to those shown in FIGS. 1 and 2 and given the same reference characters.

In FIGS. 5 and 6 a portable foam producing apparatus 25 is shown for use with the foam generator according to the present invention. Referring to FIG. 5, the foam producing apparatus comprises a tank 26 having an inlet 27 for the pressurized gas, an outlet 28 for the exiting of the foam produced in the tank, and an opening 29 through which the liquid chemicals are placed into the tank. This opening is shown capped by a

threaded screw covering 30 for preventing the pressurized gas from escaping during operation of the foam producing apparatus. A U-shaped handle 31 connects across the inlet 27 and the outlet 28. The U-shaped handle 31 has a cylinder 32 attached thereto for holding a pressurized gas source such as a CO₂ cartridge 33 (see FIG. 6). The gas pressurized along with the hollow opening 34 in the U-shaped handle 31 and the generator core 35 comprises the foam generator. An enlarged sectional view of the foam generator is shown in FIG. 6 and will be explained later.

At the outlet end 36 of the U-shaped handle 31 is attached a nozzle 37. The nozzle 37 is a funnel-like construction preferably bent or extended diagonally downwards. In this way the foam outlet opening 36, in the upright working position of the apparatus, maintains a favorable position relative to a working surface. The nozzle 37 is preferably detachable from the foam producing system via threaded pressurized gas fittings 38 to prevent leakage of the foam from the fittings and to permit cleaning of the nozzle after a foaming operation. The U-shaped handle 31 is likewise fitted to the tank by threaded high pressure fittings 39 to permit removal and to prevent the escape of the pressurized gas.

Referring now to FIG. 6, the foam generator of the foam producing apparatus 25 of FIG. 5 comprises the cylinder 32 threaded to the U-shaped handle 31, the pressurized gas cartridge 33, a needle valve 40 for piercing the gas cartridge, a valve 41 comprising a ball 42 and spring 43 for permitting only a one-way flow of the pressurized gas into the tank 26, and the generator core 35. A hollow opening 44 is formed through a position of the U-shaped handle 31 to form a path for the pressurized gas from the cartridge into the tank. As shown, the U-shaped handle is fastened to the tank by a gas pressure fitting 39 shown as a brass nut. A seal 45 is shown between the U-shaped handle and the inlet to the tank 26 to prevent the escape of the pressurized gas.

The generator core 35 is threaded to the U-shaped handle 31 and inserted into the tank 26.

For the operation of the portable foam producing system reference is made to FIGS. 5 and 6. The liquid foam producing chemicals are introduced into the tank 26 via the threaded inlet 29. The cap 30 is replaced to form an air and liquid tight seal. The CO₂ cartridge 33 is inserted into the cylinder 32 and the cylinder is threaded onto the U-shaped handle 31. As the cylinder 32 is threaded onto the handle the needle valve 40 pierces an end of the cartridge. The needle is hollow and, once the cartridge is penetrated, it permits the pressurized gas to pass therethrough. The high pressure gas passes through the center of the needle valve and enters the opening 44 into the handle. The gas under pressure causes the ball 42 and the spring 43 to retract from the seat and thereby permits the gas to enter into the generator core 35. The pressurized gas passing through the openings 46 in the generator core 35 causes the formation of the foam as described in FIGS. 1 and 3. The generator core is of similar construction as that shown in FIGS. 1 and 2. But it is obvious that the generator core could also be of a square or rectangular construction as that shown in FIGS. 3 and 4.

The foam is generated by the generator core 35 and passes under pressure through the outlet 28 of the tank 26 up through the opening 47 in the U-shaped handle and out the nozzle 37. The foam producing unit is por-

table and can be carried to the work for ease of operation. As the pressurized gas is depleted, a new cartridge can be inserted by removing the cylinder 32, discarding the used cartridge 33, inserting a new cartridge 33, and rethreading the new cartridge and cylinder 32 onto the U-shaped handle 31 as previously discussed. More liquid can be added after depletion of the liquid in the tank and the gas by removing the threaded screw covering 30 and pouring more of the liquid chemical that forms the foam into the tank.

For larger cleaning jobs, a larger foam producing apparatus may be used such as shown in FIG. 7. The foam producing apparatus 47 of FIG. 7 shows the foam generator, comprising either the embodiment shown in FIG. 1 or 3, mounted to a large tank 48. The tank is shown fastened to a two-wheeled dolly 49 by straps attached to handle 51 of the dolly. The dolly permits the ease of transporting the large tank 48 containing the liquid chemical from one location to another. A rest 52 is provided on the two-wheeled dolly to permit upright operation of the tank. The tank 48 includes a chemical fill opening 53 which is shown covered by a threaded cap 54. After the liquid chemical is placed into tank 48, a pressurized gas is placed into the tank via a pressure valve inlet 55. A pressure gauge 56 is shown mounted to the tank to ensure correct operation of the foam producing apparatus. Also, a pressure safety valve 57 is shown connected to the tank to release any excess pressure in the event the pressure in the tank is inadvertently raised to an abnormally high pressure. The pressure hose fitting 58 and a pressure hose 59 taps off some of the pressurized gas into the adjustable valve 60 of the foam generator 61. The liquid inlet 62 of the foam generator is fastened by threaded connections to a pipe 63 which extends to within a short distance from the bottom of tank 48. A longer length of high pressure hose 64 is fastened to the outlet 65 of the foam generator. The other end of the second high pressure hose 64 is fastened to a nozzle 65, preferably of a trigger type, to permit turn-on and turn-off of the generated foam to the work area. The nozzle 65 may contain an adjustable end 66 to permit either a fine spray of the foam or a larger volume, if desired.

For the operation of the foam producing apparatus of FIG. 7, first the gauge 56 is checked to make sure no pressure remains in the tank 48. The cap 54 is unscrewed from the tank 48 and the liquid foam-producing chemical is poured into the tank. The cap is replaced and a pressurized gas such as air is placed into the tank through inlet 55. When a sufficient amount of pressure to generate the foam is reached as shown on the pressure gauge, the pressurized gas supply is removed. At this time it is preferable that the adjustable needle valve 60 to the foam generator be in a closed position.

The foam supply apparatus 47 is then wheeled on the dolly 49 to the location where the foam is to be used. The pressure in the tank causes the liquid chemicals to rise through the pipe 63 and enter into the foam generator 61. The needle valve 60 attached to the foam generator is then opened and the pressurized gas enters the foam generator 61 via the pressurized hose 59 and fittings and valve into the generator core 14.

Referring now to FIG. 1, the pressurized air passes into the generator core 14 and passes out through the precisely spaced openings 17 to contact the liquid chemicals. The passage of air through the precision

openings 17 creates a rich, creamy foam which then exists through the outlet 65 of the foam generator 61 into the second high pressure hose 64. Referring again to FIG. 7, the generated foam passes through the second pressure hose 64 into the nozzle 65. Thus, as the trigger of the nozzle (not shown) is depressed or such other valve is actuated on the nozzle handle, the foam is exited from the end of the nozzle.

It should be obvious that the foam generator of FIG. 10 7 could contain a generator core either of circular construction as that shown in FIG. 1 or a square or flat-sided generator core of the type shown in FIG. 3. As previously discussed, it is by the particular placement of the openings to the core generator that permits the distinctive operation of applicant's foam generator. Each opening is placed at a 90° circumferential distance from each other and at staggered intervals along the length of the generator core such that the pressurized gas flowing from the openings into the liquid chemical causes minimal disturbance from one opening to the next. It is by applicant's unique placing of the openings that the rich, creamy foam so necessary for cleaning operations is produced. Preferably the generator core is two-thirds the length of the foam generator body.

The principles of the present invention have now been made clear in an illustrated embodiment. There will be immediately obvious to those skilled in the art many modifications of structure, arrangement, proportions, the elements, materials, and components used in the practice of the invention. For instance, the core generator of FIG. 1 is shown as comprising a circular tube. Likewise, the embodiment in FIG. 3 is shown to be a square, hollow tube. It should be immediately obvious to those skilled in the art that an oval hollow tube could easily be replaced in the embodiment of FIG. 1 and a hollow tube of rectangular construction could be used in the embodiment shown in FIG. 3. The appended claims are therefore intended to cover and embrace any such modifications, within the limits only of the true spirit and scope of the invention.

What is claimed is:

1. A device for generating foam from a foam-producing liquid by pressurized gas comprising:

- 45 a tank,
- a first inlet to said tank for introducing foam-producing liquid into said tank,
- a second inlet to said tank for introducing pressurized gas into said tank;
- 50 means for transporting said tank from one place to another,
- a pipe inserted into said tank and extending outside said tank,
- 55 a foam generator including:
- a cylinder having a liquid inlet fastened to the end of the pipe extending outside said tank, said pipe transporting the liquid from said tank to said cylinder,
- 60 a tube fastened to a gas inlet of said cylinder with a free end of the tube closed, said tube having openings formed therein along the length of the tube, said openings being of a size to permit the gas to engage the liquid in the cylinder while under pressure, and an outlet for exiting the produced foam,
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means for introducing pressurized gas from the tank into the gas inlet to said foam generator,

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a hose connected to the outlet of said foam generator, and
a trigger nozzle fastened to the free end of the hose.

2. The device of claim 1 wherein the openings in the tube of said foam generator are formed at staggered intervals with each successive opening spaced along the circumference of the tube 90° away from the preceding

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opening, with openings in the same 180° plane located directly opposite each other.

3. The device of claim 2 wherein said tube is a hollow cylinder.

4. The device of claim 2 wherein said tube is a square shaped hollow tube with the openings formed on the flat surface of the tube.

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