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[72] Inventors **Bengt Olog Crener**
Taby;
Stig Carl-Oskar Ernolf, Sollentuna, both of
Sweden

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[73] Assignee **Aktiebolaget Electrolux**
Stockholm, Sweden
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[33] **Sweden**
[31] **1973/1969**

[54] **SURFACE CLEANING APPARATUS**
3 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **15/321,** 15/323, 15/339
[51] **Int. Cl.** **A47l 11/34**
[50] **Field of Search** 15/320, 321, 339, 50, 51, 52, 98, 322, 323, 366, 384

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Primary Examiner—Walter A. Scheel
Assistant Examiner—C. K. Moore
Attorney—Edmund A. Fenander

ABSTRACT: Our invention relates to surface-cleaning apparatus having a housing which is adapted to hold a body of liquid that generates foam when air bubbles therethrough. A surface-contacting member, which is carried by the housing and is movable over a surface, functions to distribute foam. Air under pressure is delivered from a source of supply to the inlet of an air line which is located exteriorly of the housing. The outlet of the air line is located within the housing at its bottom and connected to a device to form air bubbles which rise through the body of liquid to generate foam. Foam is conducted through a passageway from the upper part of the housing to the surface-contacting member. A conventional household suction cleaner can be conveniently used as the source of supply of air under pressure. In order to generate foam in the apparatus which is relatively dry and not excessively moist, the air inlet end of the air line is connected to the blowing end of suction cleaner by a coupling which may be referred to as a bypass valve and functions to divert and bleed to the atmosphere a major portion of the air discharged from the blowing end of the suction cleaner. In this way the rate at which air under pressure is delivered to the bottom of the housing through the air line will be correct to generate foam that is relatively dry.

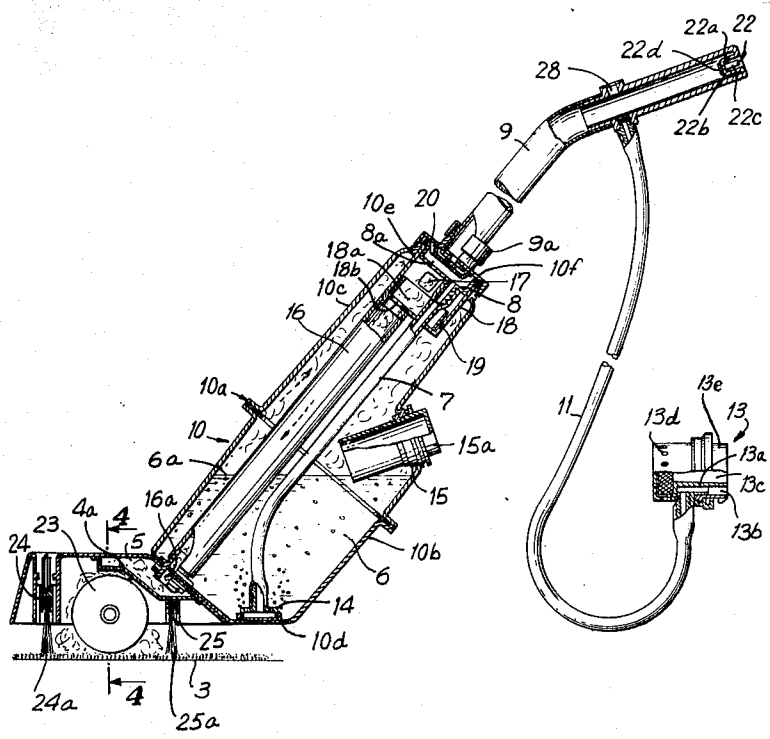


FIG. 1

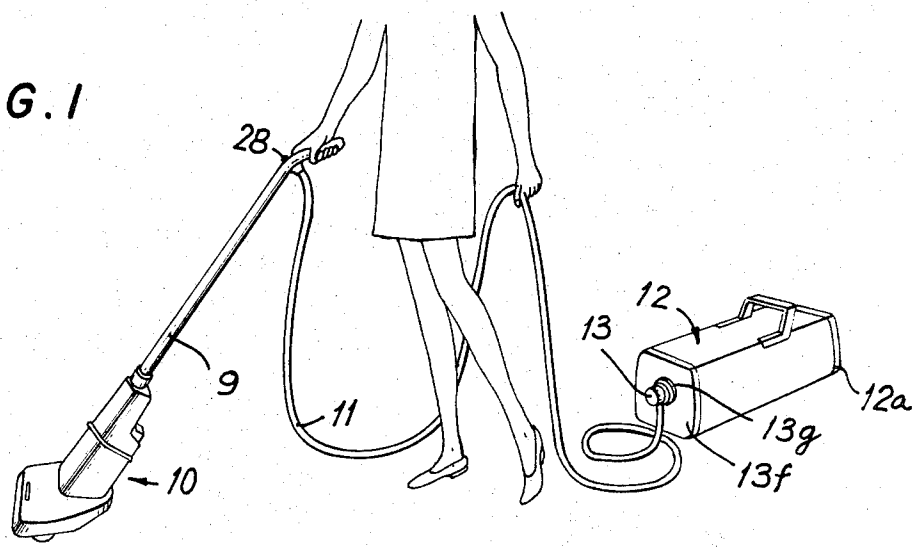


FIG. 6

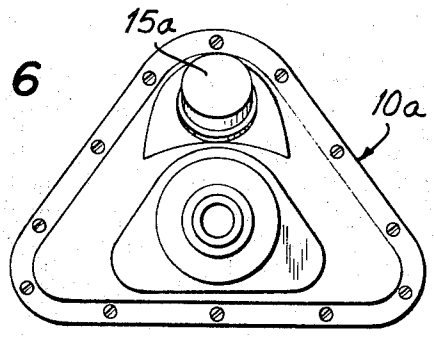


FIG. 5

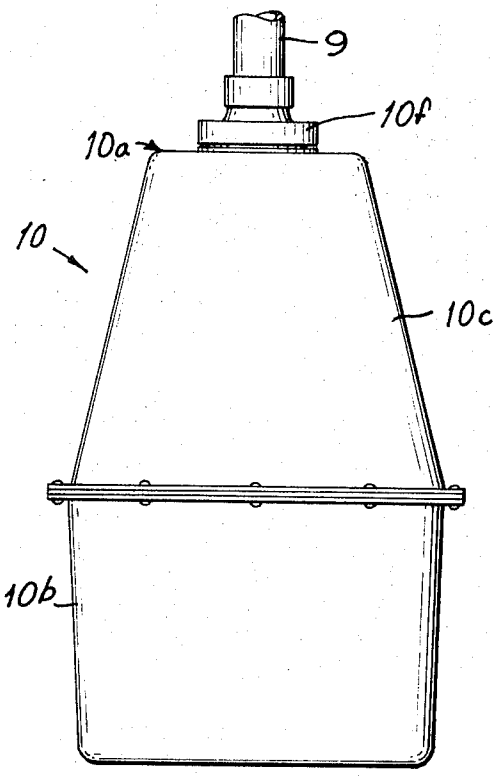


FIG. 4

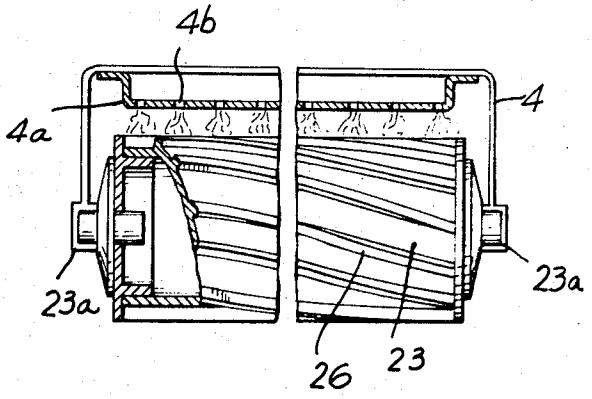


FIG. 3

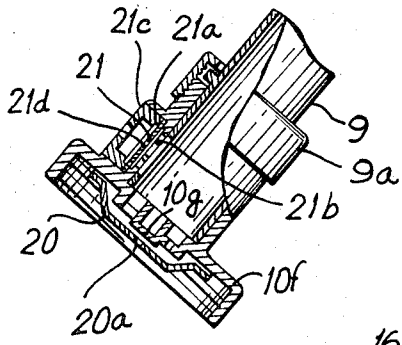


FIG. 2

FIG. 7

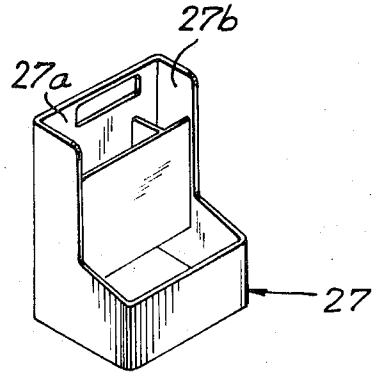
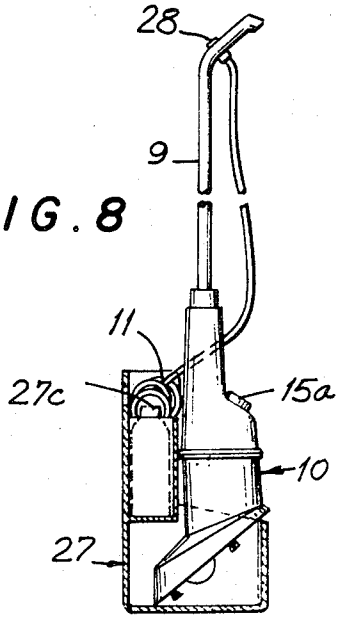


FIG. 8



SURFACE CLEANING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to surface-cleaning apparatus in which foam is generated in a body of cleaning liquid by bubbling air therethrough, the foam being conducted from a space above the liquid surface level of the liquid body to a surface contacting member which is movable over a surface and functions to distribute the foam.

2. Description of the Prior Art

In known surface-cleaning apparatus air bubbles to generate foam in a body of liquid are formed from a stream of air supplied under pressure from a conventional household suction cleaner. With this arrangement foam is generated very rapidly which causes liquid to be carried away with the foam. This is objectionable because the generated foam is extremely moist. After such foam has been distributed on a surface like a rug, for example, the rug becomes wet which is not desirable. This means that the length of time for the rug to dry becomes longer which in turn increases the overall length of time to perform the entire cleaning process. Also, the final cleaning result is impaired when cleaning is effected with foam that is excessively moist.

Filters have been employed to remove moisture from foam passing therethrough. While this way of removing moisture from foam has been successful to a certain degree, this means that additional expense is encountered by providing filters in the surface-cleaning apparatus.

SUMMARY OF THE INVENTION

It is an object of our invention to provide an improved surface cleaning apparatus for producing foam that is relatively dry and not excessively moist. We accomplish this by forming air bubbles in the bottom of a body of liquid from a stream of air under pressure which is delivered thereto through an air line having its inlet end connected to a source of supply of air under pressure and regulating the quantity of air supplied through the air line to prevent liquid being carried away with the foam so that it will not be excessively moist. When a conventional household suction cleaner is employed as the source of supply of air under pressure, the quantity of air supplied through the supply line can be regulated by employing a coupling to connect the air inlet end of the air line to the blowing end of the suction cleaner. Such coupling, which may be referred to as a bypass valve, functions to divert and bleed to the atmosphere a major portion of the air that otherwise would flow from the blowing end of the suction cleaner through the air line.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of surface cleaning apparatus which embodies our invention and a suction cleaner for supplying air under pressure thereto;

FIG. 2 is a vertical sectional view of the apparatus shown in FIG. 1;

FIG. 3 is an enlarged fragmentary sectional view of details illustrated in FIG. 2;

FIG. 4 is a sectional view taken at line 4—4 of FIG. 2;

FIG. 5 is a front elevational view of parts shown in FIGS. 1 and 2;

FIG. 6 is a top plan view of the parts shown in FIGS. 1, 2 and 5;

FIG. 7 is a perspective view of a portable storage receptacle and filling stand for the apparatus seen in FIGS. 1 and 2; and

FIG. 8 is a view, partly in section, illustrating the manner in which the apparatus of FIGS. 1 and 2 is positioned in the receptacle and stand of FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the surface cleaning unit comprises surface cleaning apparatus **10**, a flexible hose **11** for supplying air under pressure to the apparatus **10**, and a suction cleaner **12** which serves as a source of supply of air delivered under pressure to the hose **11**. The suction cleaner **12** includes a casing **12***a* having an end cover **13***f* provided with an outlet **13***g* to which the hose **11** is adapted to be removably secured by a coupling **13**. Air is drawn into the casing **12***a* through an inlet, which is at the end of the casing opposite the end cover **13***f*, by a suitable motor fan unit (not shown) disposed therein. Air discharged under pressure from the outlet **13***g* serves as a source of supply of air under pressure for the surface cleaning apparatus **10**.

In FIGS. 1 to 6 of the drawing, the invention has been shown in connection with surface cleaning apparatus **10** which comprises an elongated multisided housing **10***a* which, as illustrated, is triangular in cross section and includes a large bottom section **10***b* and a smaller top section **10***c*. An opening **15** adapted to be closed by a cap **15***a* is provided at the top of the large bottom section **10***b* of the housing **10**. The housing **10** is adapted to be filled at the opening **15** with a suitable cleaning agent capable of generating foam when air bubbles therethrough, as will be explained presently.

When the housing **10** is viewed with its longitudinal axis in a vertical or upright position, it will be seen that the bottom and sidewall thereof are connected by a flat wall section **10***d* which, in a true sense, forms a part of the sidewall of the housing. However, when the housing **10***a* is in its inclined operating position seen in FIG. 2 the flat wall section **10***d* constitutes the lowest part of the housing for a useful purpose which will be described presently.

The housing **10***a* at its upper end is provided with an opening **10***e* which is closed by a cap or cover **10***f* threadedly connected thereto. The apparatus **10** is provided with a handle **9** which is connected to the cover **10***f* by a coupling **9***a*. The handle **9** is hollow and connected to the hose **11** to receive air under pressure from the suction cleaner **12**. An opening **28** is provided in the wall of the handle for a purpose to be described hereinafter.

An open top vessel **18** is fixed within the upper part of the housing **10***a* by the cover **10***f*. A second smaller open top vessel **8** nests within the vessel **18** and forms a cover therefor, the second vessel also being fixed within the upper part of the housing **10***a* by the cover **10***f*. The second vessel **8** defines a chamber **8***a* which receives air under pressure from the hollow handle **9**. Such air flows from chamber **8***a* through a conduit **7** which extends downward within the housing **10***a* to the flat wall section **10***d* at the bottom thereof. The lower end of the conduit **7** is connected to a nozzle **14** having a plurality of small openings to subdivide the air discharged therethrough which then bubbles upward through the body **6** of cleaning agent in the bottom half of the housing **10***a*.

The air bubbling upward in the body **6** of cleaning agent generates foam which is forced upward in the upper part of the housing **10***a* above the liquid level therein. The foam is forced through openings **17** in the sidewall of the vessel **18** into the interior **18***a* thereof and passes downward therefrom through a bottom opening **18***b* into the upper end of a conduit **16** which is disposed within the housing **10***a*. The lower open end of the conduit **16** is connected to the bottom of the housing **10***a* at an opening therein which defines a passageway **16***a* for discharging the foam into a chamber **5** formed at the underside of a base **4** by a wall part thereof and a plate **4***a* fixed thereto.

An elongated hollow roller or surface contacting member **23** is journaled at **23***a* to the sidewall of the base **4** and provided with spaced ridges **26** which extend lengthwise thereof and are of spiral form. The plate **4***a* extends over the roller **23** and is provided with openings **4***b* through which foam can pass from the chamber **5** onto the peripheral surface of the roller.

Elongated brushes **24** and **25** are fixed to the base **4** at opposite sides of the roller **23**. The tips of bristles **24***a* and **25***a* of the brushes are adapted to frictionally engage a surface **3** being cleaned, such as a carpet, for example, at the same time the roller **23** is being moved back and forth by the handle **9** over the surface in physical contact therewith.

In accordance with our invention, in order to generate foam in the surface cleaning apparatus **10** which is relatively dry and not excessively moist, the coupling device **13**, which may be referred to as a bypass valve, is so constructed and formed that all of the air under pressure is not delivered from the suction cleaner **12** to the cleaning apparatus. We accomplish this by providing a partition **13***a* in the coupling device to form first and second passageways **13***b* and **13***c* into which air is discharged from the suction cleaner.

Air discharged into the first passageway **13***b* flows therefrom through the hose **11** to the hollow handle **9**. Air discharged into the passageway **13***c* flows through openings **13***d* in the coupling **13** to the ambient air. In a broad sense a major portion of the air discharged from the suction cleaner is bled from the main airstream and vented directly to the body of atmospheric air enveloping the coupling **13**. In accord with our invention, therefore, we only make use of a small portion of the airstream that is necessary to generate foam that is relatively dry not excessively moist.

The opening **28** in the hollow handle **9** provides a convenient arrangement for controlling the operation of the surface cleaning apparatus **10**. When it is desired to operate the apparatus **10** an operator holding the manipulating handle **9** simply places a finger over the opening **28** whereby air under pressure can then flow through conduit **7** to the nozzle **14**. When the opening **28** is not closed, air under pressure is discharged therethrough to the atmosphere because the body **6** of liquid cleaning agent in the housing **10***a* offers greater resistance to air flowing thereto than the resistance offered to flow of air at the opening **28**.

By providing the flat portion **10***d* at the bottom part **10***c* of the housing **10***a* and locating the nozzle **14** closely adjacent to this flat portion, air bubbles will pass through the entire mass of the liquid body **6** and it will be effectively used to generate foam.

Since the opening **15** for introducing liquid cleaning agent into the housing **10***a* is about midway between the top and bottom thereof, the liquid surface level **6***a* of the liquid body **6** can never be above the opening **15**. This means that the foam generated in the housing **10***a* must rise therein above the liquid surface level **6***a* through a vertical height which is approximately one-half the height of the housing.

The foam, which slowly rises in the housing **10***a* due to the slight positive pressure therein, in this way is subjected to a drying action in the housing. This drying action, in addition to supplying air under pressure at such a rate that the foam generated will be relatively dry and not excessively moist, results in supplying to the surface being cleaned foam which is practically dry. The foam passing from the chamber **5** and openings **4***b* onto the roller **23** is effectively distributed on the surface **3** by the back and forth movement imparted to the roller **23**.

Additional advantages are realized by employing the coupling **13** to connect the blowing end of the suction cleaner **12** and the hose **11**. Even when the hose **11** has a sharp bend and more or less obstructs the flow of air therethrough, the major portion of the main airstream diverted through the openings **13***d* to the atmosphere will prevent complete blocking of the flow of air through the suction cleaner **12**, so that overloading of the motor fan unit and objectionable overheating of the motor will be avoided. Further, the collar **13***e* at the air inlet end of the coupling **13** forms a unitary part thereof for mounting the coupling at the air outlet or blowing end **13***g* of the cleaner **12**. The coupling **13**, which constitutes an independently movable component of the surface cleaning apparatus, is hollow and has an outer wall. Each of the passageways **13***b* and **13***c* is defined by the outer wall of the coupling and the axially extending partition **13***a* and has an air inlet at the end **13***e* of the coupling connected to the air outlet **13***g* of the cleaner. Since the suction cleaner **12** is of a conventional type having a dust collecting receptacle therein the air discharged from the outlet **13***g* will be substantially free of dust. Hence, the air supplied through the air inlet line **11** to the housing **10** will be substantially clean air.

A sleeve **19** of annular form is movable axially within the interior **18***a* of the vessel **18**. When the surface cleaning apparatus **10** is upright, as shown in FIG. **2**, the sleeve **19** is at the bottom of the vessel **18** and the openings **17** are not closed. If the apparatus **10** should be inverted the sleeve **19** will move axially of the vessel **18** and close the openings **17**. Further, the top and bottom parts **10***b* and **10***c* of the housing **10** are of such shape and size that, when the apparatus **10** is placed on its side, the liquid surface level of the liquid body **6** will be below all of the openings **17**. In this way liquid cannot flow through the tubing **16**, passageway **16***a*, chamber **5** and openings **4***a* to cause objectionable wetting of the surface being cleaned.

In the event the coupling **13** is connected to the suction inlet of the suction cleaner instead of the outlet **13***g* at the blowing end of the cleaner, the suction effect produced in the hose **11** cannot be transmitted to the body **6** of cleaning liquid in the housing **10***a*. As seen in FIGS. **2** and **3**, a flexible diaphragm **20** having an aperture **20***a* is fixed within the cover **10***f*. When air under pressure normally is supplied through the hose **11** to the housing **10***a*, the opening **28** being closed by the operator's finger, the diaphragm **20** assumes the position shown in FIG. **3** and air can flow through the aperture **20***a* which is open. However, the diaphragm **20** will flex toward a wall part **10***g* within the cover **10***f* and close the aperture **20***a* when the opening **28** is closed by the operator's finger and the diaphragm is subjected to suction. Hence, liquid can never be sucked from the housing **10***a* and flow to the suction cleaner **12** when the coupling inadvertently is connected to the suction inlet of the cleaner.

Further, one or more devices **21** and **22** can be employed to produce high pitch sounds which will warn an operator that the hose **11** of the surface cleaning apparatus **10** has not been connected to the blowing outlet **13***b* of the suction cleaner **12**. The warning device **21** comprises a thin reedlike flexible member **21***a* held between an apertured disk **21***b* and apertured plug **21***c* in the cover or cap **10***f* of the housing **10***a*. The reedlike member **21***a* is provided with a very small opening (not shown). When the diaphragm **20** flexes to close the opening **20***a* with the hose **11** inadvertently connected to the suction inlet of the cleaner **12** and the opening **28** is closed by the operator's finger, the reedlike member **21***a* will be subjected to the full suction effect of the cleaner and air sucked inward through the very small opening therein will cause the member **21***a* to vibrate and produce an audible sound and serve as a warning signal.

During normal operation of the surface cleaning apparatus **10**, when the diaphragm **20** is in the position shown in FIG. **3** and the opening **28** is closed by the operator's finger, the air flowing past the reedlike member **21***a* will not cause the latter to produce an audible sound. This is so because the member **21***a* under these conditions is located for all practical purposes in a dead end space through which there is no rapid movement of air.

The warning device **22** comprises a U-shaped cup **22***a* provided in the end of the handle **9**. The bottom of the cup is formed with an opening through which extends a neck portion **22***b* of a part **22***c* disposed in the cup **22***a*. A disk **22***d* is fixed to the outer extremity of the neck portion **22***b*. During normal operation of the surface-cleaning apparatus **10** when air under pressure is delivered to the hollow handle **9** and the opening **28** is closed by the operator's finger, the disk **22***d* is forced toward the opening at the bottom of the cup **22***a* and closes the latter. However, when the hose **11** inadvertently is connected to the suction inlet of the cleaner and the opening **28** is closed by the operator's finger, the suction effect will cause the disk **22***d* to move toward the opening **28** and uncover the opening in the bottom of the cup **22***a* whereby air passing therethrough will produce an audible sound.

A portable storage receptacle **27** is illustrated in FIG. **7** in which the surface-cleaning apparatus **10** can be stored in the manner shown in FIG. **8**. The receptacle **27** is provided with compartments **27***a* and **27***b* to receive the hose **11** and a bottle

27c adapted to hold cleaning liquid. In FIG. 8 it will be seen that the receptacle 27 can also serve as a stand to hold the surface cleaning apparatus 10 in the correct vertical position when filling the housing 10a with cleaning liquid.

We claim:

1. Surface-cleaning apparatus comprising

a. a source of supply of air under pressure comprising a movable tank-type suction cleaner having an inlet and outlet for air, the outlet serving as the blowing end of said cleaner,

b. structure providing a housing adapted to hold a body of cleaning liquid possessing such physical properties that it will generate foam responsive to air bubbling therethrough,

c. surface contacting means which is carried by said housing structure and movable over a surface for distributing foam thereon,

d. an air line having an air inlet exteriorly of said housing and an air outlet within said housing at the bottom thereof,

e. means including a bypass valve for conducting air under pressure from the outlet of said cleaner to the inlet of said air line,

f. means at the outlet of said air line for subdividing the air under pressure to form air bubbles which rise through the body of liquid to generate foam,

g. vertically extending conduit means defining a passageway having its upper end in communication with the upper part of said housing and its opposite lower end communicating with said surface contacting means for flowing thereto foam from the upper part of said housing,

h. the inlet of said air line being connected to said bypass valve,

i. said bypass valve having one passageway which receives a major portion of the air discharged from the suction cleaner outlet and diverts such air to the atmosphere and another passageway which receives the lesser remaining portion of the air discharged from the suction cleaner outlet and conducts such air to said air line,

j. a valve in said air line,

k. said valve including means defining a seat and a valve movable between a closed position at said seat and an open position removed therefrom, and

l. said valve being in its open position when air under pressure is delivered to the inlet of said air line from the outlet of said suction cleaner, and, when the inlet of said suction cleaner inadvertently is connected to the inlet of said air supply line, said valve moving to its closed position responsive to flow of air in said air line toward the inlet end thereof.

2. Surface-cleaning apparatus comprising

a. structure providing a housing adapted to hold a body of cleaning liquid possessing such physical properties that it will generate foam responsive to air bubbling therethrough,

b. surface contacting means which carried by said housing structure and movable over a surface for distributing foam thereon,

c. an air line having an air inlet exteriorly of said housing and an air outlet within said housing at the bottom thereof,

d. means connected to the inlet of said air line for delivering thereto air under pressure from a source of supply,

e. means at the outlet of said air line for subdividing the air under pressure to form air bubbles which rise through the body of liquid to generate foam,

f. vertically extending conduit means defining a passageway having a region at its upper end in communication with the upper part of said housing and its opposite lower end communicating with said surface contacting means for flowing thereto foam from the upper part of said housing,

g. means associated with said air line for diverting and bleeding therefrom a portion of the air adapted to be supplied thereto under pressure from the source of supply,

h. said vertically extending conduit means including an enlarged portion at its upper end which defines a vessel having a top cover and a sidewall which is apertured and constitutes said region in communication with the upper part of said housing, and

i. a member of annular form within said vessel which is adjacent to said sidewall thereof, said member being vertically movable within said vessel between first and second positions, said member being in said first position removed from said apertured region of said sidewall when the apparatus is in a normal upright position and in said second position at said apertured region to cover the latter when the apparatus is in an inverted position.

3. The combination of

a. a source of supply of air under pressure comprising a movable tank-type suction cleaner having an inlet and outlet for air, the outlet serving as the blowing end of said cleaner,

b. structure providing a housing adapted to hold a body of cleaning liquid possessing such physical properties that it will generate foam responsive to air bubbling therethrough,

c. surface contacting means which is carried by said housing structure and movable over a surface for distributing foam thereon,

d. an air line having an air inlet exteriorly of said housing and an air outlet within said housing at the bottom thereof,

e. means including a coupling for conducting air under pressure from the outlet of said cleaner to the inlet of said air line, such air being substantially free of dust removed therefrom in said suction cleaner,

f. means at the outlet of said air line for subdividing the substantially dust-free air under pressure to form air bubbles which rise through the body of liquid to generate foam,

g. vertically extending conduit means defining a passageway having its upper end in communication with the upper part of said housing and its opposite lower end communicating with said surface contacting means for flowing thereto foam from the upper part of said housing,

h. means forming a unitary part of said coupling for mounting the latter on said cleaner at the air outlet end thereof,

i. said coupling constituting an independently movable component of the combination and being hollow and having an outer wall,

j. said coupling having partition means including an axially extending partition to form first and second passageways at opposite sides thereof, each of said passageways being defined by the outer wall of said coupling and said partition means and having an inlet at the end of said coupling connected to the air outlet of said cleaner,

k. the cross-sectional area of said first passageway being greater than that of said second passageway and receiving a major portion of the air discharged from the outlet of said cleaner,

l. said first passageway in said coupling having an outlet for discharging said major portion of the air therefrom directly to the body of atmospheric air enveloping said coupling, and

m. said second passageway in said coupling having an outlet, the inlet of said air line being connected to the outlet of said second passageway to receive the lesser remaining portion of the air discharged from the outlet of said cleaner.

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