Nov. 21, 1967 B. E. NILSSON 3,353,338

SUCTION CLEANER

Filed Jan. 15, 1963 4 Sheets-Sheet 1

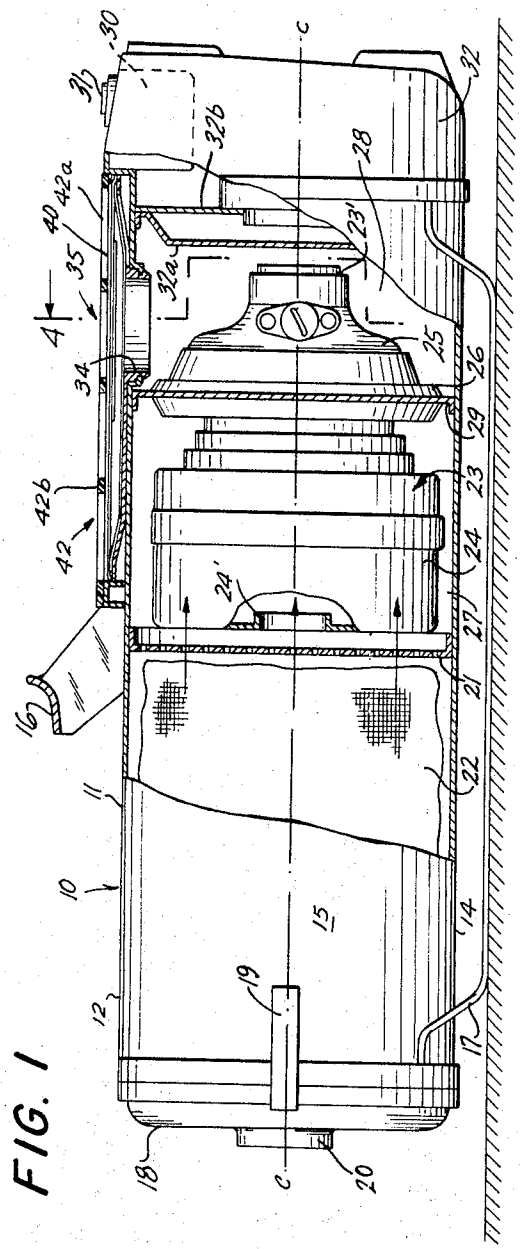


FIG. 1

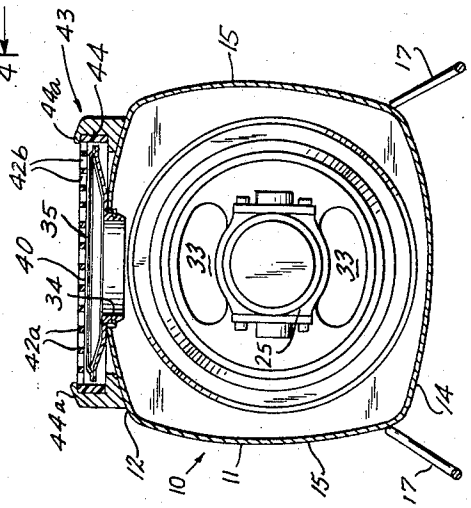


FIG. 4

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SUCTION CLEANER

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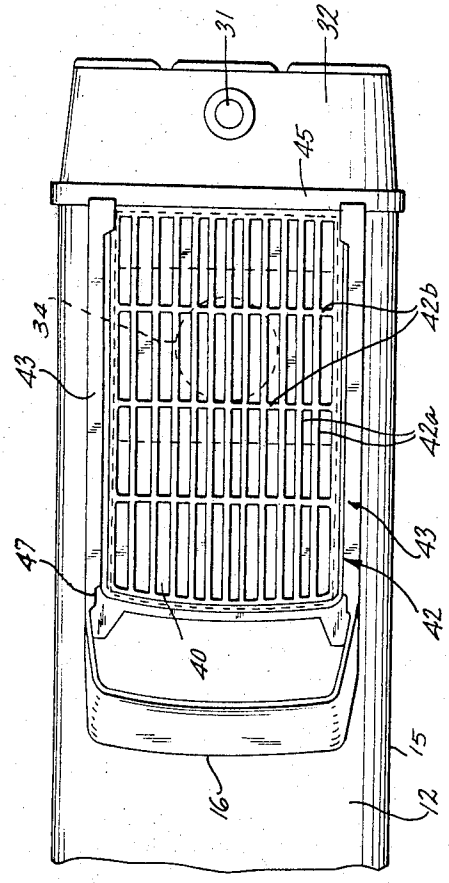


FIG. 2

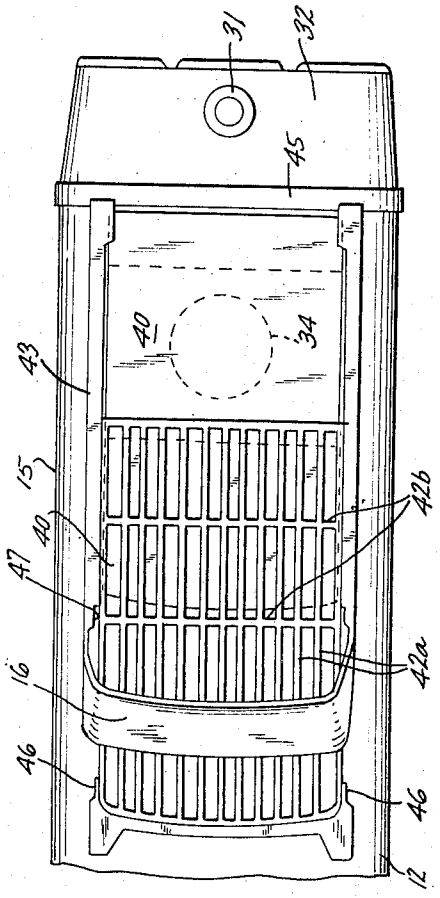


FIG. 3

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SUCTION CLEANER

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FIG. 5

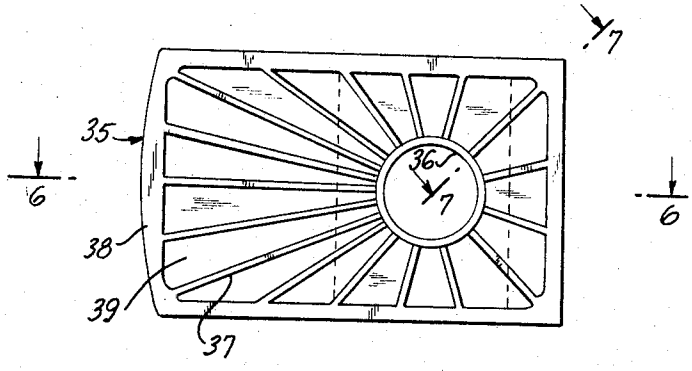
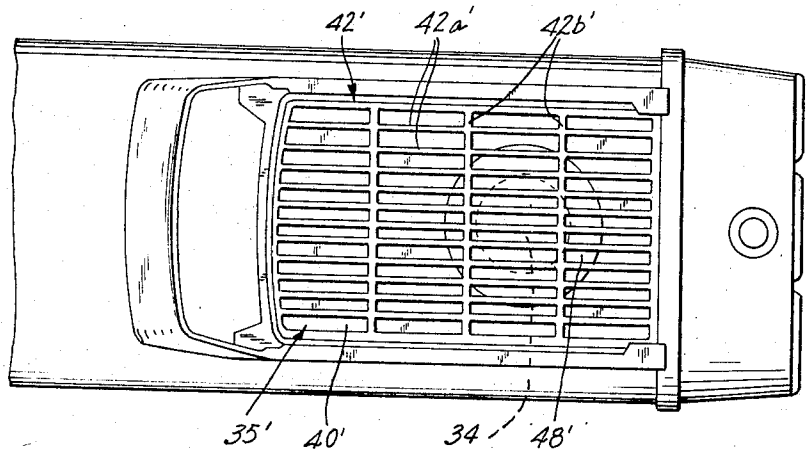


FIG. 10



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SUCTION CLEANER

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FIG. 6

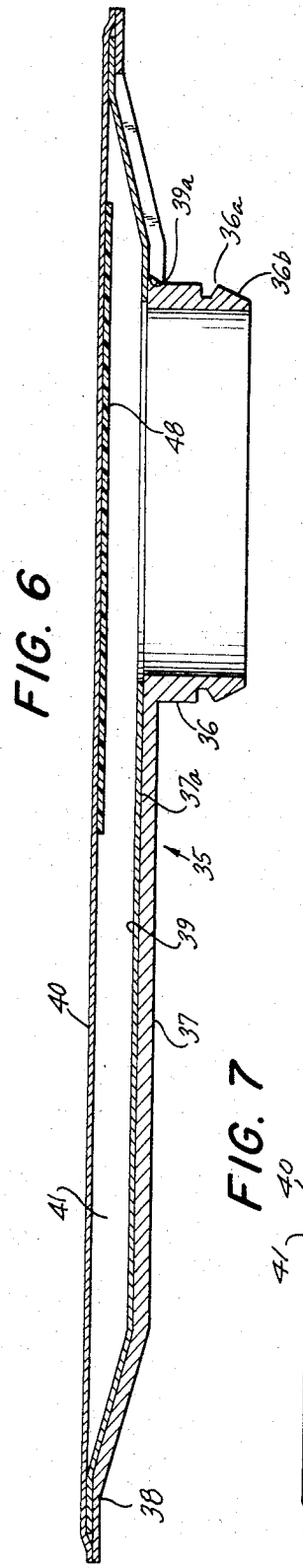


FIG. 7

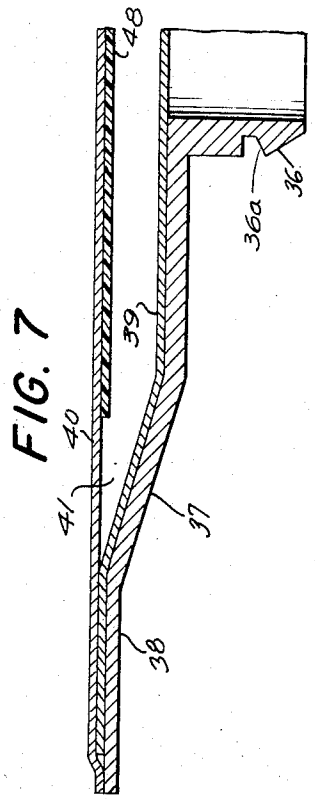


FIG. 8

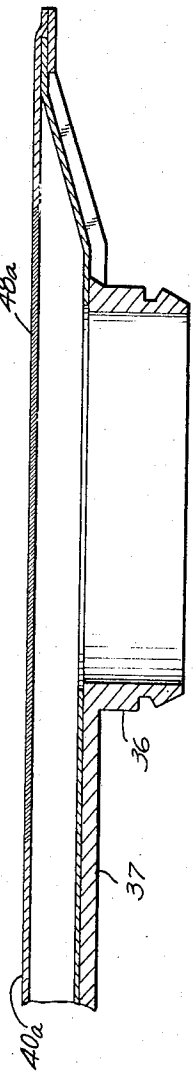
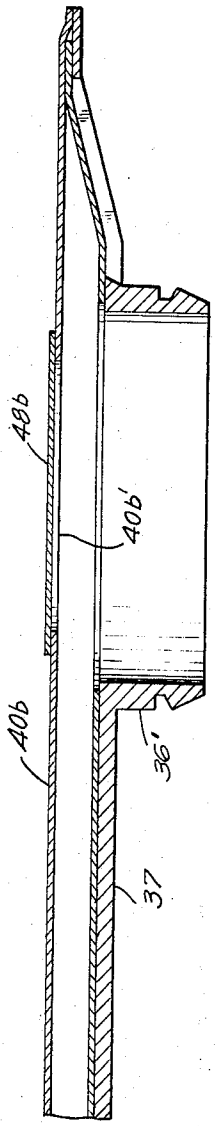


FIG. 9



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United States Patent Office 3,353,338
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3,353,338

SUCTION CLEANER

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Filed Jan. 15, 1963, Ser. No. 251,606
5 Claims. (Cl. 55—276)

My invention relates to suction cleaners.

A motor-fan unit usually is employed to move air in a path of flow from the inlet to the outlet of a suction cleaner. Dust is removed from dust-laden air flowing through the suction cleaner in a dust bag which is located adjacent the inlet and removable from the cleaner. A fine filter often is provided adjacent the air outlet of the cleaner to insure removal of any fine dust particles which may pass through the dust bag before the air is discharged into the room. The air outlet or blowing outlet end of the cleaner usually is formed to detachably receive one end of a hose, to the opposite end of which is connected an accessory, such as a spraying device, for example.

An object of my invention is to provide an improved suction cleaner of the type indicated in which an air discharge opening formed to detachably receive an end of the hose is concealed from view by a fine filter which can be readily removed to make the air discharge opening available for use when desired and functions as a silencer by absorbing noise produced during normal operation of the cleaner for suction purpose.

Another object of the invention is to provide a combined fine filter and diffusion unit having a member which includes one section which is permeable to air and another section which is impervious to air and will promote distribution of air at the side of the member initially contacted by the air. I accomplish this by providing a combined filter and diffuser unit having a chamber defined by a porous sheet of air-permeable material which has a cross-sectional area greater than an air discharge opening in the path of air flow and includes one part which is impervious to air and against which the air is primarily directed from the air discharge opening. In addition to reducing noise produced by the suction cleaner during normal operation, the air-impervious part of the sheet effectively distributes the air discharged into the filter chamber and improves diffusion of air flowing through the porous sheet. The combined filter and diffusion unit is maintained in its operative position by an apertured member which is movable to and from a position over the air discharge opening and forms an exterior wall section of the cleaner, whereby air discharged from the opening is introduced into the filter chamber from which it flows through the porous sheet and through the apertured member to the exterior of the cleaner, the air outlet of which is defined by the movable exterior wall section when positioned over the air discharge opening.

Further objects and advantages of the invention will become apparent as the following description proceeds, and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of the invention, reference may be had to the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevational view, partly broken away and in section, of a suction cleaner embodying the invention;

FIG. 2 is a fragmentary top plan view of the cleaner shown in FIG. 1;

FIG. 3 is a view similar to FIG. 2 illustrating the manner in which access is gained to the air discharge opening of the cleaner;

FIG. 4 is a sectional view taken at line 4—4 of FIG. 1;

FIG. 5 is a bottom plan view of details shown in FIGS. 1 to 4;

FIG. 6 is a vertical sectional view taken at line 6—6 of FIG. 5;

FIG. 7 is a fragmentary enlarged sectional view taken at line 7—7 of FIG. 5;

FIGS. 8 and 9 are fragmentary views of parts similar to those shown in FIG. 6 illustrating modifications of the invention; and

FIG. 10 is a fragmentary view similar to FIG. 2 illustrating a further modification of the invention.

Referring to the drawing, the invention has been shown in connection with a horizontal tank-type suction cleaner **10** having a casing **11** including a top **12**, bottom **14** and vertically extending side walls **15**. The casing **11** is provided with a handle **16** and spaced members **17** which extend lengthwise of the casing along the bottom **14** and serve as skids to facilitate movement of the cleaner on a surface.

A front end cover **18** is removably secured at **19** to the casing **11** in any suitable manner and formed with an inlet opening **20** to which a suction hose (not shown) is adapted to be removably connected. Suitable cleaning appliances may be connected to the outer free end of the suction hose and through which air flows into the casing. Within the casing **11** is provided a perforated partition **21**, at one side of which is disposed a removable dust collector or dust bag **22** which acts to separate dust from air as it flows therethrough.

Flow of air through casing **11** is effected by a motor-fan unit **23** which includes a centrifugal fan **24** carried at one end of an electric motor **25**. The motor-fan unit **23** is suspended in casing **11** by structure **26** which provides a resilient mounting for the motor-fan unit and a seal between spaces **27** and **28** in the casing, the inner and outer peripheries of the suspension structure being respectively fixed to the motor-fan unit **23** and an inwardly extending flange **29** of the casing. The motor-fan unit **23** is controlled by a switch **30** which is arranged to be actuated by a button **31** located at the top of a rear hood or end cover **32** removably secured in any suitable manner (not shown) to the casing **11**.

When the suction cleaner **10** is being operated and the fan **24** driven by the motor **25**, dust-laden air is drawn through the suction hose into the interior of the casing **11**. Dust collects in the bag **22**, and air from which dust has been removed passes through the dust bag and perforated partition **21** into the space **27**. Air in the space **27** flows into the inlet **24'** of the fan **24** from which it is discharged and flows through the shell of the motor **25** to effect cooling thereof, such air passing from the motor at **33** into the space **28** defined in part by the suspension structure **26** which bridges the gap between the motor-fan unit **23** and the flange **29**. In this way the passage formed between the casing **11** and the motor-fan unit **23** is closed by the suspension structure **26** and all of the air discharged from the fan **24** passes through the motor **25** into the space **28**.

The space **28** is also defined in part by a transverse partition **32***a* which is impervious to air and fixed to the casing **11** in any suitable manner to form a seat at the end thereof in which a part **32***b* of the rear end cover **32** nests when it is mounted on the casing. When the rear end cover **32** is removed from the casing **11** to repair the switch **30** or provide a new one for the cleaner **10**, for example, the transverse partition **32***a* remains in its mounted position on the casing **11** so that contact with the motor **25** is prevented.

Air is discharged from space 28 of the cleaner 10 through an opening 34 formed in the top wall 12 of the casing 11 along an axially extending zone of the casing which is disposed above the openings 33 from which air emerges from the motor shell and overlies one end of the motor-fan unit at which it is journaled at 23'. It will now be seen that the casing 11 forms a single housing for the dust bag 22 and motor-fan unit 23 which are disposed alongside one another and have a common longitudinal axis *c—c* extending lengthwise of the cleaner 10. The axis of the air discharge opening 34 is transverse to the longitudinal axis *c—c* of the dust bag 22 and motor-fan unit 23 so that all of the air emerging from the openings 33 of the motor shell will flow to the top part of the casing 11 and be discharged upward therefrom through the opening 34.

A suction cleaner accessory is often detachably connected to the air discharge opening 34 of the cleaner. The accessory may be a hose, or a spraying device which is connected to one end of the hose, the opposite end of which is connected to the air discharge opening 34. Such accessories are usually provided with fittings which are of a kind well known in the art and enable them to be detachably connected to the opening 34.

A fine filter and diffuser unit 35 is provided at the top wall 12 of the casing 11 which is attached to the air discharge opening 34 and removable therefrom to permit a suction cleaner accessory to be detachably connected to the opening 34. The filter and diffuser unit 35 comprises a hollow tubular or throat section 36 and a plurality of spaced ribs 37 which are distributed about the tubular section and extend radially and axially therefrom, the ribs being inclined to the vertical axis of the filter and diffuser unit and sloping from the end of the tubular section. The outer ends of the ribs 37 are joined to a flat rim 38 of rectangular shape, as seen in FIG. 5. The unit 35 is provided with two sheets 39 and 40 of porous material which are permeable to air and preferably microporous in character. The sheet 39, which is apertured, is positioned against the surfaces 37*a* of the ribs 37 with its inner periphery integrally joined at 39*a* to the tubular section 36 and its outer periphery integrally joined to the rim 38 and overlying the latter. The sheet 40 of rectangular shape is essentially flat and perpendicular to the vertical axis of the tubular section 36 and its vertical axis is laterally displaced from the region 39*a* at which the sheet 39 is joined to one end of the tubular section. The outer periphery of the sheet 40 also is integrally joined to the outer edge portion of the rim 38 and overlies both the rim and outer periphery of the sheet 39.

The sheets 39 and 40 form a hollow member defining a chamber 41 which receives air entering through the tubular or throat section 36, the ribs 37 integrally joined to the sheet 39 being disposed exteriorly of the chamber 41. The tubular section 36 is resilient and flexible in character and formed with an external groove 36*a* of annular form adjacent a tapered end portion 36*b* to facilitate its attachment to and removal from the edge of the opening in the top wall 12 defining the air discharge opening 34.

The fine filter and diffuser unit 35 may be formed of a single body of thermoplastic material in which the tubular section 36, ribs 37 and rim 38 are integrally joined to one another to form a frame to which the porous sheets 39 and 40 are bonded and united. For example, the sheets 39 and 40 may comprise single sheets of material, such as cloth, paper or the like, for example, which are formed of fibrous material which is permeable to air and impregnated or bonded with a plastic like polyacrylonitrile butadiene-styrene. The frame also may be formed of a plastic like polyacrylonitrile butadiene-styrene, for example. When a plastic of this type is employed to provide the frame, it may be formed by compression molding in suitable dies in which the sheets 39 and 40 are positioned, whereby the sheets 39 and 40 and the frame become an integral structure with the sheets and frame bonded to one another.

According to my invention, the combined filter and diffusion unit 35 is mounted on the top wall 12 of the casing 11 with the tubular or throat section 36 detachably connected to the opening 34 and securely held in position by an apertured member 42 having a reticulated grill defined by spaced axially extending ribs 42*a* and transverse ribs 42*b*. The holder 42 may be formed of a plastic, for example, which is like the material referred to above from which the frame for the filter and diffusion unit 35 may be formed.

The apertured member 42 is movable lengthwise or axially of the casing 11 in spaced guides or tracks 43 fixed to the top 12 of the casing in any suitable manner. The tracks 43 are formed with U-shaped channels 44, the open ends of which face one another and receive the outermost axially extending ribs 42*a* of the member 42. The top parts of the tracks 43, which form the upper arms 44*a* of the channels 44, overlie the top edges of the outermost axially extending ribs 42*a* and form grooves in which the member 42 is movable lengthwise of the casing 11. As best shown in FIGS. 2 and 3, the handle 16 and spaced tracks 43 may comprise an integral part which may be formed of a suitable plastic, for example. In its closed position the member 42 abuts an end ring 45 of the casing 11, as shown in FIG. 2. When the member 42 is in its closed position and holds the filter and diffusion unit 35 in place at the top wall 12 of the casing, the top sheet 40 is held in place and prevented from flexing upward by the vertically extending ribs 42*a* and 43*b*, the bottom edges of which are in intimate contact with the porous sheet 40. The member 42 forms an exterior wall section of the casing 11 and in its closed position over the air discharge opening 34 defines the air outlet of the suction cleaner.

When it is desired to connect a suction cleaner accessory to the air discharge opening 34 of the cleaner, the member 42 is moved lengthwise of the casing 11 beneath the handle 16 so that the combined filter and diffusion unit 35 can be detached from the air discharge opening 34. In FIG. 3 it will be seen that the left-hand end of the member 42 is notched at 46. When the member 42 is moved to its normal closed position seen in FIG. 2, the notched ends 46 of the member move against shoulders 47 on the tracks which frictionally grip the left-hand end of the member 42 and serve as stops to limit axial movement of the member.

The filter unit 35 serves to remove fine dust particles from air discharged and emerging from the opening 34. The chamber 41 formed by the porous sheets 39 and 40 defines a diffusion chamber which is above the opening 34 and below the top sheet 40 of the filter unit 35. During normal operation of the cleaner 10 a stream of air emerges through the opening 34 at a relatively high velocity. The stream of air is directed toward a single side of said sheet, which has opposing first and second sides, the air stream flowing through the opening 34 in a direction substantially perpendicular to said sheet. The porous sheet 40 has an overall cross-sectional area that is materially greater than that of the opening 34, whereby the air is subdivided into a multiplicity of tiny air streams which are discharged from the outer surface or top side of the porous sheet 40 which reduces the velocity of the air discharged from the cleaner so that settled dust in the vicinity of the cleaner will not be disturbed.

According to my invention, the top porous sheet 40 of the filter unit 35 is provided with one part or zone 48 which is impervious to air and located at a region directly above the tubular section 36 of the filter unit. The air-impervious zone 48 may be formed by fixing a layer of plastic material, such as polyethylene, for example, to the underside of the porous sheet 40.

I have found that by providing the air-impervious zone 48, better distribution of air is effected in the chamber 41 of the filter unit and the tendency for a greater part of

the air stream to pass through a central region of the porous sheet **40** is reduced. Also, the air-impervious zone **48** serves to reduce the noise produced by the suction cleaner. Stated another way, the filter chamber **41** provided with the air-impervious zone **48** at the vicinity of the top sheet directly opposite the region air is introduced into the chamber through the tubular section **36** from the air discharge opening **34** functions as a silencer by absorbing noise.

It will be understood that the layer of air-impervious material forming the part or zone **48** may be fixed to the top side of the porous sheet **40** or located substantially at least at one of said opposing first and second sides of the porous sheet. In FIG. 8 I have illustrated a modification in which the porous sheet **40***a* is treated by a self-hardening liquid which includes a suitable plastic, for example, to provide the zone **48***a*. In FIG. 9 I have illustrated a modification in which the porous sheet **40***b* is apertured and formed with an opening **40***b'* above the tubular section **36'**. The opening **40***b'* is closed by a layer of air-impervious material to form the zone **48***b*.

In FIG. 10 I have shown a modification in which the air-impervious zone **48'** is provided at the underside of the apertured member **42'** at a region overlying the porous sheet **40'** and directly above the tubular section of the filter unit **35'**. When the apertured member **42'** is formed of suitable plastic, the zone **48'** may be formed integrally with the ribs **42***a'* and **42***b'* of the apertured member when the latter is fabricated.

It will now be understood that the dust collector **22** in the path of air flow is disposed between the air inlet **20** and the air moving means **23**, and the fine air filter **35** is disposed between the air moving means **23** and the air outlet of the cleaner which is defined by the apertured member **42** when the latter, which serves as an exterior wall section of the casing **11**, is in its closed position over the opening **34**, as shown in FIG. 1. The dust collector **22** and air moving means **23** and fine air filter **35** comprise a plurality of elements functioning in the path of air flow between the inlet **20** and outlet defined by the apertured member **42**. The fine air filter **35** comprises the last element in the path of flow through which air passes before being discharged through the outlet defined by the apertured member **42**.

The portion of the path of flow of air between the air moving means **23** and the fine air filter **35** includes the opening **34** formed in the top wall portion of the casing **11**. Essentially, the opening **34** formed in the casing defines passage means from which air emerges in its path of flow toward the fine air filter **35**. The passage means constitutes structure which is operable to produce an air stream which is directed through the throat section **36** substantially perpendicularly primarily to one part **48** of the sheet **40** of the fine air filter **35**. The one part **48** of the sheet **40** may be formed by a layer of air-impervious material, other parts of the sheet **40** being permeable to air to promote spreading of air at the one side of the sheet initially contacted by the air and reduce noise produced during operation of the cleaner.

In view of the foregoing, it will now be understood that I have provided an improved fine filter and diffusion unit **35** including a member **40** which is in the path of flow of air circulating through the suction cleaner and includes one section which is permeable to air and disposed about a central section **48** which is impervious to air and will promote distribution of air at the side of the member **40** initially contacted by the air.

Although I have shown and described several embodiments of my invention, I do not wish to be limited to the particular arrangements set forth, and I intend in the following claims to cover all modifications which do not depart from the spirit and scope of my invention.

I claim:

1. In a suction cleaner having a casing provided with an inlet and outlet and having a path of flow for air

therein between the inlet and outlet, means in said casing for moving air in the path of flow from the inlet to the outlet, passage means in said casing which is in said path of flow between the inlet and outlet and has an opening therein which is adjacent to the outlet and from which air emerges in its path of flow from the inlet to the outlet, said casing including an apertured exterior wall section which is movable to and from a position over the opening, the outlet being defined by said apertured exterior wall section in its position over said opening, a fine air filter comprising material in the form of a sheet having a cross-sectional area greater than that of said opening, said sheet having first and second opposing sides and being transverse to the axis of said opening and removably positioned in said path of flow between said opening and said exterior wall section and through which all of the air moving in said path of flow passes to remove fine dust particles therefrom, structure comprising said passage means having said opening to produce a stream of air which is directed toward a single side of said sheet in a direction substantially perpendicular to and primarily to one part of said sheet, and means to render said one part of said sheet impervious to air while other parts of said sheet are permeable to air to promote spreading of air at the single side of said sheet which is initially contacted by the stream of air and reduce noise produced during operation of the suction cleaner.

2. Apparatus as set forth in claim **1** in which said fine air filter in the path of flow of air includes a throat section removably connected to the opening and said apertured exterior wall section comprises an apertured element which overlies said fine air filter in its position over said opening.

3. Apparatus as set forth in claim **1** in which said apertured element in its position over said opening and said sheet of said fine air filter are in intimate physical contact with one another and said one part of said sheet is rendered impervious to air by means which includes structure forming a unitary part of said element.

4. Apparatus as set forth in claim **1** in which said casing includes guide means in which said apertured element is slidably movable to and from its position over said opening.

5. In a suction cleaner having a casing provided with an inlet and an outlet and having a path of flow for air therein between the inlet and outlet, means in said casing for moving air in the path of flow from the inlet to the outlet, the outlet being disposed in the upper part of the casing, passage means in said casing which is in said path of flow between the inlet and outlet and has an opening which is adjacent to the outlet and from which air emerges in its path of flow from the inlet to the outlet, said opening having a vertically extending axis, the top of said casing having an apertured exterior wall section which is movable to and from a horizontally disposed position over said opening, the outlet at the upper part of said casing being defined by said apertured exterior wall section in its horizontally disposed position over said opening, a fine air filter comprising a hollow member defining a chamber and a throat section which is connected thereto and in communication with said chamber, said throat section being detachably connected to said passage means at said opening therein to receive air emerging from said opening, said chamber being defined in part by material in the form of a sheet which is permeable to air and forms a portion of said hollow member and is substantially normal to the axis of said throat section, said sheet having opposing top and bottom sides and a cross-sectional area greater than that of said opening and in said path of flow between said opening and said exterior wall section and through which all of the air moving in said path of flow passes to remove fine dust particles therefrom, structure comprising said passage means having said opening to produce a stream of air which is directed toward the bottom side of said sheet in a di-

rection substantially perpendicular to and primarily to one part of said sheet, means to render said one part of said sheet impervious to air while other parts of said sheet are permeable to air to promote spreading of air at said bottom side of said sheet which is initially contacted by the stream of air and reduce noise produced during operation of the suction cleaner, said apertured exterior wall section comprising an apertured element, and said casing including guide means in which said apertured element is slidably movable to and from its position over the opening, said apertured element in its position over the opening overlying said sheet.

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