

May 1, 1956

W. G. SECK

2,743,787

AIR SUPPORTED CLEANER WITH DIFFUSER

Filed April 7, 1954

3 Sheets-Sheet 1

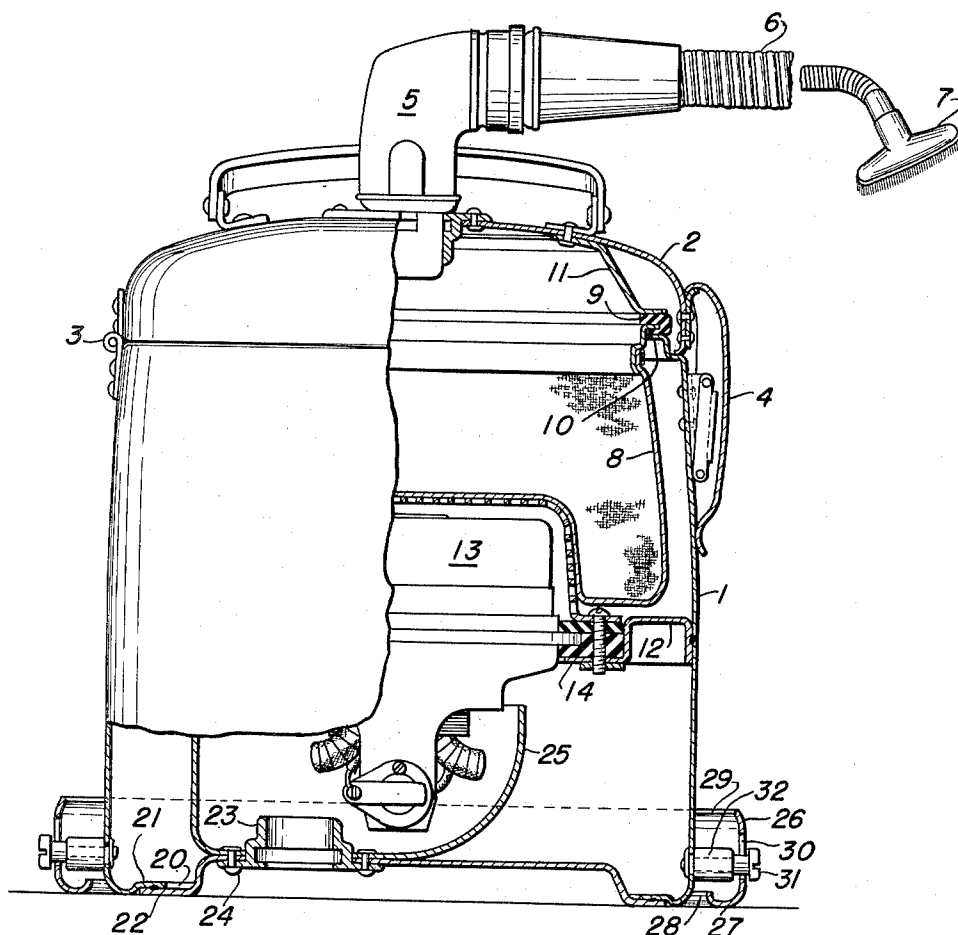


Fig. 1

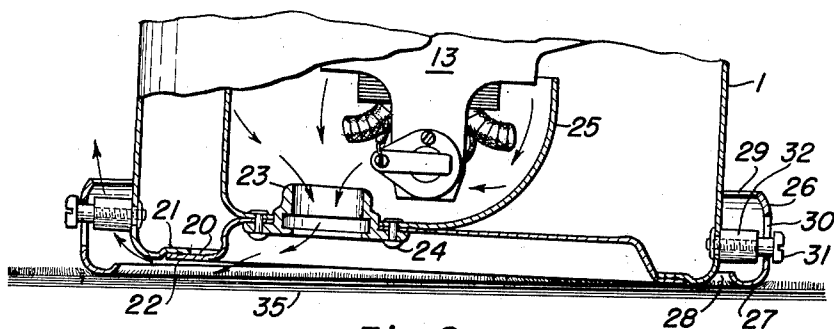


Fig. 2

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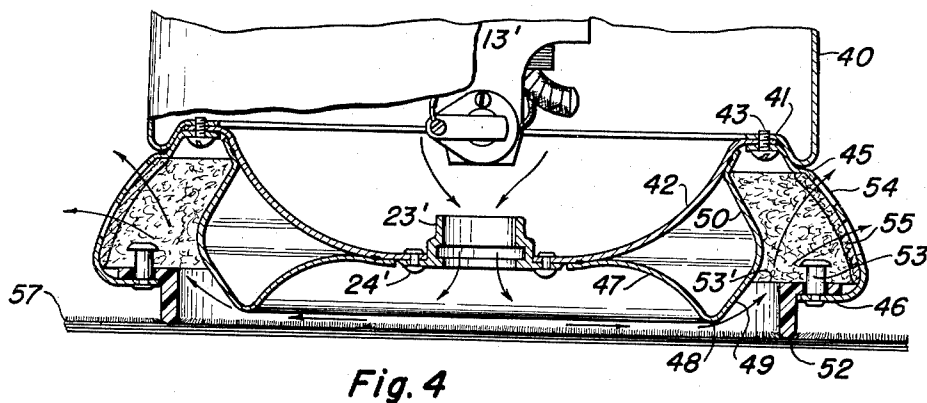
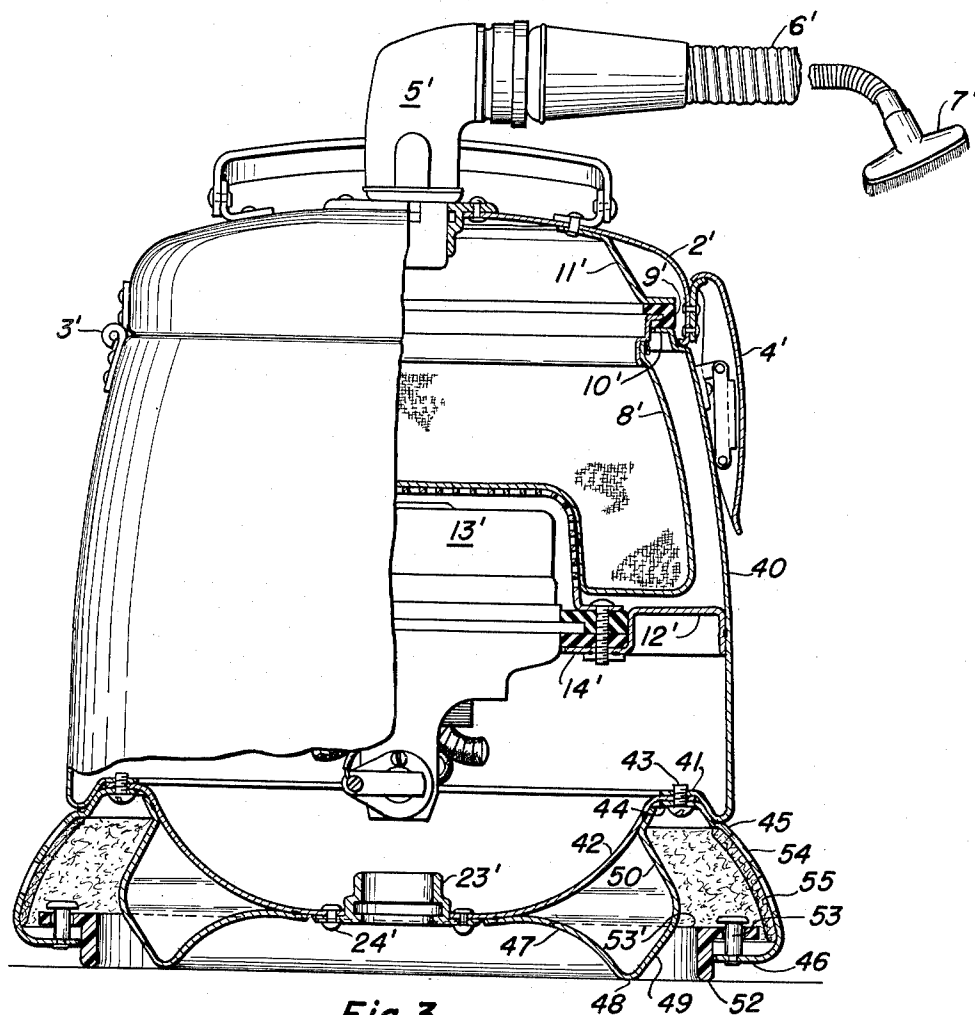
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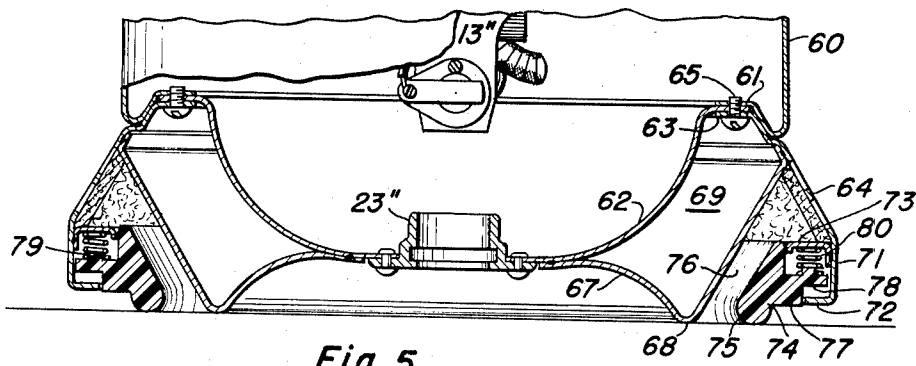


Fig. 5

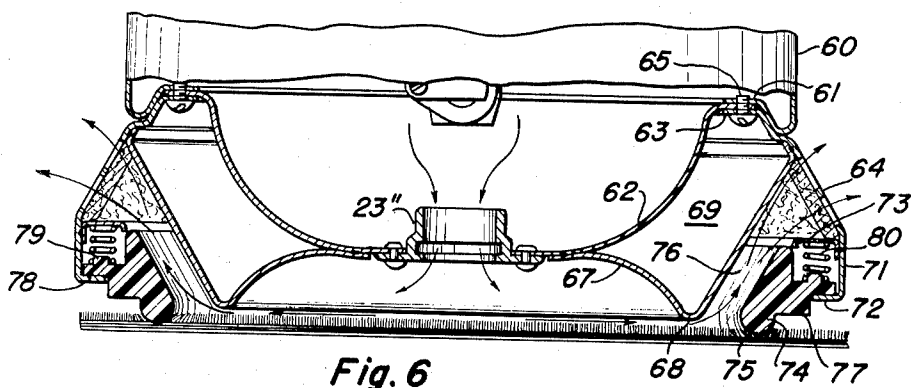


Fig. 6

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AIR SUPPORTED CLEANER WITH DIFFUSER

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Application April 7, 1954, Serial No. 421,493

12 Claims. (Cl. 183—37)

My invention relates to suction cleaners which are supported on a cushion or bearing formed by the exhaust air partially entrapped on the underside of the cleaner and as such my invention represents an improvement over the invention disclosed and claimed in the application of Curtis C. Coons and John C. Montgomery Ser. No. 418,512 filed on March 25, 1954 for Air Supported Cleaner.

Suction cleaners of the type disclosed and claimed in the aforesaid application of Coons and Montgomery exhibit extraordinary freedom of movement in that they are movable across a supporting carpet; for example, when the cleaner is in use, with substantially negligible expenditure of effort due to the fact that the entire weight of the cleaner is supported on a cushion of exhaust air and the cleaner barely grazes upon the supporting surface and does not have a significant frictional contact therewith. Devices such as those disclosed and claimed in the foregoing application of Coons and Montgomery are, however, subject to an undesirable characteristic in that the air from the air bearing or air cushion supporting the cleaner discharges in a ring laterally of the cleaner and directed parallel to the surface of the carpet or other floor covering with the result that such discharging air tends to blow and scatter surface dust and litter which may be in the vicinity of the cleaner.

Accordingly, it is a principal object of my invention to provide a suction cleaner wherein the cleaner body is provided with a supporting structure comprising an air cushion forming member encompassing a substantial area on the underside of the cleaner and into which the exhaust air from the cleaner discharges whereby the air pressure builds up under the cushion-forming member to counterbalance the weight of the cleaner before escaping from the air cushion peripherally thereof, and to provide a baffle or deflector positioned circumferentially of the cushion-forming member having a floating mount whereby the deflector which is at all times floatingly or lightly bearing on the surface of the carpet so as to intercept the escaping air and to direct the same upwardly in a diffused stream well above the supporting surface.

It is a further particular object of my invention to provide a suction cleaning apparatus so constructed that the weight thereof is supported upon an air cushion or air bearing constantly renewed by air exhausting from the cleaner and constantly being diminished by air leaking from beneath the air bearing in conjunction with a diffusing structure which prevents leakage or discharge air from blowing directly across the supporting surface around the cleaner.

Other objects and advantages of the invention will become apparent as the description proceeds when taken in connection with the accompanying drawing wherein:

Figure 1 is a side elevational view partly in section of a suction cleaning apparatus embodying my invention;

Figure 2 is a fragmentary view of the apparatus of Figure 1 illustrating the manner in which the cleaner body

is lifted when in operation to be supported upon an air cushion or air bearing;

Figure 3 is a modified form of my invention wherein the diffusing structure also includes a sound-deadening and secondary filtering material;

Figure 4 is a view similar to Figure 3 illustrating the manner in which the cleaner body is lifted in the use of the device while allowing the inceptor ring to remain in contact with the supporting surface;

Figure 5 is a view similar to Figure 4 illustrating another modified form of the invention wherein the diffusing ring is spring pressed with a light force against the supporting surface; and

Figure 6 is a view similar to Figure 5 illustrating the operative or supporting position of the parts.

Referring now to the drawing in detail and first to Figure 1 thereof, there is illustrated a suction cleaning device comprising a substantially cylindrical outer casing 1 having an open-topped portion which is closed by a movable cover 2 hingedly connected to casing 1 by means of a hinge structure 3 and is normally secured in closed position by means of a known type toggle latch mechanism 4. The cover 2 is provided in its upper central portion with a swivelly mounted elbow hose connecting member 5 to which a flexible hose 6 is detachably connected. The hose 6 will carry a suitable cleaning or dusting tool 7 on the outer end thereof. A fabric or paper filter 8 is mounted within the casing 1 in the upper portion thereof and is sealed by means of a gasket 9 to a top internally extending flange 10 on the casing 1 and is held in position by means of a flanged ring 11 mounted on the cover 2 in surrounding relation to the inlet end of the elbow 5 whereby all air flowing into the cleaner body is directed into the interior of the filter 8.

The interior of the casing 1 is divided into the upper filter chamber as shown in Figure 1 and a lower exhaust air chamber by means of an annular bulkhead 12 which seals with and supports a power plant consisting of an electric drive motor and suction fan of known type indicated generally at 13 which is resiliently secured to the bulkhead 12 by means of the gasket and bolt structure indicated at 14.

The foregoing structures per se form no part of my invention and are disclosed herein only to define a complete suction cleaning apparatus. It will be understood that in the apparatus above described, the motor fan unit 13 when energized creates a low pressure or suction thereabove which causes a large air stream to be sucked through the cleaning tool 7, hose 6, elbow 5 into the interior of the filter 8 through which the air flows, being relieved of any entrained dirt or dust in the process, and then flows into the power plant unit 13 from whence it discharges over the motor into the portion of the casing 1 below the bulkhead 12.

The bottom of the cylindrical cleaner casing 1 is closed by an upwardly-dished bottom plate structure 20 which underlies an upset, inwardly-extending flange 21 on the bottom portion of the casing 1 and is secured thereto as by welding or the like. In consequence of the foregoing, the cleaner actually rests upon an annular plate or ring structure indicated generally at 22 surrounding the upwardly-dished portion of the plate 20.

The upwardly-dished portion of the plate 20 is provided with a conventional hose-connecting fitting 23 to which a flexible hose such as the hose 6 may be connected if desired to convert the apparatus to blowing operation. In using the device as a suction cleaner, which is the condition of the parts illustrated in Figures 1 and 2, the fitting 23 serves as the exhaust outlet to exhaust air into the underside of the cleaner within the upwardly-dished portion of plate 20 for a purpose to be described. The

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fitting 23 is secured in an opening in the dished portion of plate 20 by means of rivets 24 which also serve to secure a bowl-shaped baffle 25 to the dished portion of the plate 20. As is apparent from Figure 1, the exhaust outlet 23 is offset from the center of the cylindrical casing 1 in order to be positioned to one side of the lower end of the motor fan structure 13 so as to conserve height. Air passes through the filter into the fans and then over the motor and exhausts therebelow into the bowl-shaped baffle 25. The baffle 25 is provided merely to minimize turbulence within the bottom portion of the casing 1 and may be omitted if desired; however, this member is made of a size and height such that it completely surrounds the lower end of the motor and extends to a level slightly above the air exhaust portion of the motor housing structure so that all air discharged from the motor fan system flows thereinto.

An annular deflector member 26 of generally L-shape cross section surrounds the lower part of the casing 1 in spaced relation thereto. The up-turned, inwardly-directed bottom flange 27 of the deflector 26 terminates as shown in Figures 1 and 2 in spaced relation to the supporting ring 22 on the casing 1 to form a gap 28 therebetween. The upper edge of the deflector ring 26 is also spaced from the casing 1 to define an exhaust port 29 therebetween. The deflector 26 is provided with four slots 30 equally spaced around the periphery thereof which are adapted to receive the shank portions of securing studs 31. The heads of studs 31 have a diameter greater than the width of the slots so that the studs cannot pass entirely therethrough. The studs 31 thread into bosses 32 secured to the exterior surface of the casing 1 as by welding or the like. The foregoing construction secures the deflector 26 to the casing 1 while allowing free vertical movement and some degree of rocking movement thereof with respect to the casing.

In the operation of the device dirt drawn through the dusting tool 7 passes through the hose 6, swivel elbow connector 5 into the interior of the filter 8 whence the dirt is removed from the air which passes through the walls of the filter and into the fan of the motor and fan unit 13. The air discharged from the fans passes over the motor to cool the same. Air exiting from the power unit flows into the baffle 25 and thence through the fitting 23 into the upwardly-dished section of the bottom plate 20. The air discharged from the fans builds up pressure within the dished portion of the plate 20 until the pressure acting on the large area of the plate 20 is sufficient to balance the weight of the cleaner body and lift the same to allow air to discharge under the supporting ring 22. In Figure 2 of the drawing, an exaggerated situation is depicted in order clearly to illustrate the action of the device. As there shown, the air is shown exhausting underneath one side of the ring 22 into the space between the exterior wall of casing 1 and the deflector 26. The deflector is free of the casing and not subject to the lifting action of the air stream and remains in engagement with the surface covering to form a barrier completely surrounding the bottom portion of the casing 1. The air discharging under the ring 22 is caught by the deflector 26 and is directed upwardly through the exhaust port 29. The deflector 26 prevents any air from discharging beneath the cleaner structure as a whole across the surface of the carpet to blow or scatter surface litter and it also serves as a diffusing ring so that the exhaust air is ultimately led to the atmosphere through a large diameter annular slot with the result that the exhausting air stream has a velocity low enough to be unobjectionable to persons standing in the immediate vicinity of the cleaner.

The exaggerated condition shown in Figure 2 illustrates a situation where the body of the cleaner is cocked at a vertical angle with one portion of the ring 22 well lifted above the surface of a supporting carpet 35 and one edge of the ring 22 still resting upon that carpet. In

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actual practice the maximum degree of inclination of the vertical axis of the casing 1 is considerably less than that shown in Figure 2 of the drawing and the air generally exhausts beneath the ring 22 throughout the entire periphery thereof though inequalities in the carpet and the like may cause the cleaner at times to assume a very slight angle similar to the exaggerated situation illustrated in Figure 2. It has been found in practice that the air cushion formed beneath the dished portion of the plate 20 supports the cleaner in effect on an air bearing so that a very slight tug on the hose or push applied laterally to the side of the casing 1 will move the same with great ease over a large distance on a supporting carpet or the like. The movement of the cleaner resembles that which would be obtained if the cleaner were resting on a series of balls supported upon a hard surface such as a smooth wooden floor. Due to the large area of the bottom of the casing 1, the air pressure need build up only in the order of one to two inches of water in order to counterbalance the entire weight of the cleaner which does not impose a significant burden on the power plant as cleaners of this type customarily have very large power plants capable of handling large volumes of air at significant pressures.

The suction cleaning, supporting and diffusing mechanism above described is generally similar to that disclosed and claimed in the above mentioned application of Coons and Montgomery; however, in the instant improvement thereon the cleaner is provided with a free deflecting and diffusing structure having a floating relation to the cleaner body so that the deflector always remains in engagement with the surface of the carpet being cleaned and it is never possible for exhaust air to discharge in a stream laterally across the surface of the carpet to produce objectionable scattering of surface dust and litter.

Referring now to Figures 3 and 4, another embodiment of the invention is illustrated which is characterized by slightly greater complexity than that described in connection with Figures 1 and 2 but with superior appearance. Those portions of the apparatus of Figures 3 and 4 which are identical with corresponding portions of the device of Figures 1 and 2 are given the same reference characters distinguished by the addition of a prime.

The casing 40 in the device of Figures 3 and 4 is generally cylindrical but tapered slightly at the top and somewhat shorter than the casing 1. The casing 40 is provided with an inwardly-directed annular flange 41 at its lower end which rests upon the peripheral portion of a bowl-shaped bottom plate 42. The bowl-shaped bottom plate 43 is secured to the flange 41 by means of studs 43 which also serve to secure an inwardly-extending flange 44 on a ring member 45. The distributing ring member 45 is a short truncated section of a cone flaring outwardly and downwardly from the supporting and attaching flange 44. The lower end of the ring 45 terminates in an inwardly-directed, horizontal flange 46 for a purpose to be described hereinafter.

The exhaust fitting 23' is seated in the lower central portion of the bowl-shaped deflector 42 through which it extends to provide an exhaust passageway and a connecting conduit for a suction hose to convert the apparatus to blowing operation. The bowl-shaped bottom plate 42 supports a pressure-retaining ring structure comprising an annular dish-shaped pressure chamber forming member 47 surrounding the fitting 23' and terminating at its lower end in a surface-engaging bead 48 which connects to an upwardly and outwardly-flared section 49 which in turn adjoins an upwardly and inwardly-flared section 50 secured to the bowl 42 at its end adjacent the outer periphery thereof. The end portions of sections 47 and 50 of the pressure retaining structure may be secured to the bowl 42 by welding or other suitable means.

The inturned flange 46 serves as a limit stop for an annular inverted L-shaped deflector 52 which is preferably

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constructed of plastic material. The outwardly-directed horizontal flange of the deflector 52 overlies the flange 46 and is provided with a plurality of spaced perforations which receive upwardly-directed headed rivets 53 secured at their lower end to the flange 46. By this means the deflector 52 is freely movable vertically with respect to the flange 46 to the limit allowed by the space between the flange 46 and the enlarged heads of the rivets 53. When resting on a hard, smooth surface as is illustrated in Figure 3, the bottom end of the deflector 52 and the bead 48 are co-planar. However, as is apparent from Figure 3, the deflector 52 may move upwardly or downwardly with respect to the position illustrated in Figure 3 to be higher or lower than the bead 48 as the condition of the supporting surface may require. The diameter of the deflector 52 is greater than the maximum diameter of the parts 49 and 50 to define an air-exhausting throat 53' therebetween so as to permit air discharging under the bead 48 against the deflector 52 to flow upwardly through the throat 53' into the space within the diffusing structure 45. The diffusing structure 45 is provided with a plurality of spaced air-exhausting slots 54 around its periphery and is internally provided with a sound-deadening and filtering liner 55 secured in place by suitable cement.

In the use of the device of Figures 3 and 4, air under pressure discharging through the fitting 23' collects under the bowl-shaped portion of the device 47 until the pressure thereof is sufficient to counterbalance the weight of the cleaner structure as is illustrated in an exaggerated manner in Figure 4 to allow the entrapped air to flow under the bead 48 against the deflector 52 which still rests by gravity on a supporting surface or carpet indicated at 57. The air so discharging is then directed upwardly through the filtering and sound-deadening material 55 to exhaust in a diffused low velocity stream through the slots 54. The function of the deflector 52 is substantially that of the deflector 26 in the device of Figures 1 and 2. It is, however, completely within the maximum perimeter of the cleaner structure and is generally concealed from view as is apparent from an inspection of Figures 3 and 4. The filtering material 55 serves to deaden sound transmitted through the air system and also to catch such dust as may be blown up from the carpet beneath the cleaner by the air stream discharging therefrom so as to insure that the air discharging through the slots 54 is completely clean.

In this form of the invention, like that described heretofore, the cleaner rests upon a cushion or air bearing with the result that it is moved across a supporting surface with the greatest ease without tracking or scuffing the same and in a noiseless manner.

Another form of the invention is illustrated in Figures 5 and 6. Portions of the apparatus of Figures 5 and 6 which are identical with corresponding portions of the apparatus of Figures 1 and 2 are given the same reference characters distinguished by the addition of a double prime.

In this form of the invention, only the lower portion of the cleaner casing 60 is illustrated as the power plant structure 13'', filter, carrying handle, mounting and the like are identical with those described heretofore in connection with Figures 3 and 4. The bottom portion of the casing 60 is formed with an intumed, annular horizontal flange 61 which rests on a similar flange formed on the periphery of a bowl-shaped diffusing and bottom plate structure 62 which forms a closure for the bottom of casing 60. The peripheral flange on the bowl-shaped member 62 overlies an inwardly-directed horizontal flange 63 on a generally conical exhausting and diffusing plate structure 64. The flanges on the members 60, 62 and 64 are secured together by spaced studs 65.

The exhaust fitting 23'' rests on the bottom central portion of the member 62 and is riveted thereto as illustrated to form an exhaust connection for air discharging

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from the power plant unit 13'' and also to form a connecting fitting for a flexible hose when the apparatus is used for blowing operations.

The air-bearing and entrapping structure comprises an inverted bowl-shaped section 67 having an opening around the fitting 23'' and which is secured around the fitting 23'' to the underside of the bowl-shaped plate 62 by welding or the like. The member 67 terminates in its lower end in an annular bead 68 which forms the carpet or surface-engaging portion of the air-entrapping structure. The bead 68 joins the lower end of an upwardly and outwardly-directed annular flange 69 which terminates at its upper end in a junction with the upper portion of the diffusing structure 64 to which it is secured by welding or the like.

The lower end of the downwardly and outwardly-inclined diffusing structure 64 joins a cylindrical imperforate section 71 which terminates at its lower end in an inwardly-directed horizontal flange 72. An annular inverted channel-shaped member 73 is secured to the inner surface of the member 71 adjacent the top thereof to form an anchoring means for a structure to be described.

The apparatus of Figures 5 and 6 is provided with an annular air-stopping deflector 74 which is provided at its lower end with a surface-engaging bead 75 smoothly merging into an upwardly and outwardly-directed surface 76 positioned in spaced parallel relation to the surface 69 to form an air-directing throat therebetween. The member 74 is also provided with an outwardly-directed, substantially horizontal flange 77 having a diameter slightly less than the inside diameter of the flange 72 to which it is complementary. The deflector 74 at its upper end is provided with a plurality of spaced outwardly directed tabs 78 provided on their upper surface with spring-anchoring buttons 79 which fit within and position lightweight compression springs 80 engaged between the tabs 78 and the channel member 73 which tends to urge the barrier structure 74 downwardly as viewed in Figures 5 and 6 to the limit allowed by engagement between the flange 72 and the projecting tabs 78. The purpose of the springs 80 is to urge the deflector 74 downwardly into engagement with a supporting surface with a light force and also to prevent the member 74 from rattling or moving freely about when the device is being transported.

It is characteristic of each of the disclosed forms of my invention that the air cushion forming and supporting structure is surrounded by an air intercepting and deflecting means floatingly mounted on the casing for limited vertical and rocking movement with respect thereto whereby the deflector always remains in engagement with the supporting surface to intercept the air stream discharging from the air bearing and to direct such air upwardly in a diffused low velocity stream. By reason of the foregoing, apparatus constructed in accordance with my invention completely avoids objectionable discharge of cleaner exhaust air in a high velocity stream across and parallel to the supporting surface.

While I have illustrated and described the invention in considerable detail, it is to be understood that various changes may be made in the arrangement, proportion and construction of parts without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. In a suction cleaner having a casing, an air pump in the casing to draw cleaning air into the casing and to discharge such cleaning air under pressure, the combination of a supporting member having a substantial perimeter enclosing an area on the underside of the casing open to a supporting surface, means for conducting air discharged from the air pump to the said area within the perimeter of the supporting member whereby such air under pressure supports the casing on an air cushion and escapes under the perimeter of the supporting member, a deflector member surrounding the supporting member in

spaced relation thereto, and means mounting the deflector on the casing for movement relatively thereto to maintain the deflector on the supporting surface to intercept and direct upwardly air escaping from beneath the supporting member.

2. Apparatus according to claim 1 wherein the deflector supporting means comprises pins mounted on the casing slidably supporting the deflector.

3. Apparatus according to claim 1 wherein the deflector supporting means includes spring means biasing the deflector downwardly of the casing into contact with a supporting surface.

4. Apparatus according to claim 1 wherein the casing includes an annular exhaust air diffuser provided with circumferentially arranged exhaust ports and extending from the casing around the upper end of the deflector to receive air intercepted by the deflector.

5. Apparatus according to claim 4 wherein the diffuser is internally lined with filter material to entrap dust and the like picked up by air exhausting from the cleaner casing.

6. Apparatus according to claim 4 wherein the deflector mounting means includes a horizontal inwardly-directed flange on the lower portion of the diffuser, the deflector is provided with a portion extending radially outwardly over the flange, and means are provided for limiting movement of the radial portion of the deflector away from the flange.

7. Apparatus according to claim 4 wherein the deflector mounting means includes a horizontal inwardly-directed flange on the lower portion of the diffuser and a horizontal inwardly-directed flange spaced above the first mentioned flange, the deflector is provided with radially projecting means between the flanges and spring means are provided bearing between the upper flange and the radially projecting means to bias the radially projecting means toward the lower flange.

8. Apparatus according to claim 1 wherein the supporting member is formed in an inverted dish shape to provide a downwardly projecting ring at its periphery surrounding an air cushion forming chamber.

9. In a suction cleaner comprising a casing, a filter in the casing, an air inlet in the casing, an air exhaust port on the underside of the casing and a motor fan unit arranged to draw air through the air inlet and filter and to discharge such air under pressure from the casing through the air exhaust port, the combination of a supporting structure on the casing comprising an annular barrier projecting below the casing around the exhaust port enclosing an area on the underside of the casing to define an air cushion forming chamber between the underside of the casing and a supporting surface, a deflector associated with the barrier in spaced relation thereto to form an annular upwardly directed air exhaust throat around the barrier, and means floatingly mounting the deflector on the casing.

10. Apparatus according to claim 9 wherein the deflector mounting means provide for limited rocking and vertical movement of the deflector with respect to the casing.

11. Apparatus according to claim 9 including an exhaust air diffuser having a plurality of air exhaust ports therein, said exhaust air diffuser being attached to the casing and having a part surrounding the deflector to define a chamber receiving air directed upwardly by the deflector.

12. Apparatus according to claim 11 wherein a body of filter material is mounted over the diffuser exhaust ports.

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