This invention relates to cleaning devices and more particularly to vacuum cleaners of the type in which a suction producing apparatus and the cleaning means are portably encased together and connected to the cleaning nozzle by means of a length of flexible hose.

One of the objects of my invention is to provide an improved secondary screen for a vacuum cleaner by which a larger proportion of the fine dust is prevented from entering the fan chamber.

Another object of my invention is to provide an improved form of vacuum cleaner operating mechanism which will be stable and capable of maintaining itself in operative position without auxiliary supporting means.

Another object of my invention is to provide, for a vacuum cleaner of this type, an improved cleaning mechanism having a plurality of dust collecting devices in series, one of said devices being more readily removable than the other, the parts being so arranged that removal of one device serves to clean the other.

Another object of my invention is to provide an improved air cleaning or dust collecting device made entirely of metal or other rigid waterproof material.

A further object of my invention is to provide in one of the forms an improved dust collecting device and attaching mechanism whereby the device may be removed, washed, and immediately placed back in use without waiting for it to dry, and without soiling the hands of the operator.

Another object of my invention is to provide a dirt trap in which the incoming air is cleaned and passed directly out of the trap without having to pass through any dirt accumulated therein.

A further object of my invention is to provide an improved suction producing apparatus and means to control the flow of air therethrough either on the suction or the blower side thereof.

A further object of my invention is to provide an improved nozzle and connections between the nozzle and air moving apparatus whereby the air may be blown from or sucked into the nozzle, these operations being obtainable alone or in combination.

A still further object of my invention is to provide a dirt trap to which the suction hose may be directly connected, thus facilitating manipulation of the cleaner.

Other objects and advantages of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Fig. 1 is a perspective view of the suction end of my improved vacuum cleaner.

Fig. 2 is a fragmentary perspective view of the blower end of the cleaner.

Fig. 3 is a longitudinal sectional view of my cleaner, the section being taken on a vertical plane parallel to the center line of the cleaner, and showing in detail the suction producing and air cleaning mechanisms.

Fig. 4 is a transverse vertical sectional view taken on the line 4—4 of Fig. 3.

Fig. 5 is another transverse vertical sectional view, taken on the line 5—5 of Fig. 3.

Fig. 6 is still another transverse vertical view, taken on the line 6—6 of Fig. 3, showing the means for automatically cleaning the inner of the two cleaning devices.

Fig. 7 is a fragmentary perspective view showing a part of the cleaner mechanism.

Fig. 8 is a view showing the inner cleaning device.

Fig. 9 is a transverse view partly in section taken on the line 9—9 of Fig. 3.

Fig. 10 is a view showing the means for regulating the size of the suction opening in the casing.

Fig. 11 is a sectional view of a combined suction and blower nozzle.

Fig. 12 is a sectional view showing a modified construction of a part of the cleaning system.

The vacuum cleaner to be described preferably comprises an outer member into which is built a vacuum chamber at the intake end and in which is located air cleaning means of the two-stage type. The outer member also forms an intermediate chamber in which is located suction producing means, and a final or discharge chamber that provides a free outlet for cleaned air eliminating the necessity for baffles or shutters.

The first cleaning stage is effected by a cleaning screen which arrests any of the smaller dust particles which may impinge thereon.

Means are also provided in my improved cleaner for convenient removal of the collector and for discharging the entrapped dirt, and also for automatic shaking of the screen while the collector box is being removed.

The cleaner is adapted to be used selectively as a suction cleaner, as a blower, or as a combined
blowing and suction device, means being provided for adjustably regulating both the suction and the blower action thereof.

In the drawings there is shown, by way of example, a cleaner embodying the present invention. Referring to Fig. 1, the cleaner comprises an enclosing member 10 of rectangular prismatic shape, said member being adapted to rest on one of its sides. The member is preferably made of sheet metal, and a plurality of protecting and supporting lugs 21 may be pressed out of the metal at the supporting side. The ends of the member 10 are closed by air tight covers 22 and 23. The front or suction cover 23 is provided with a coupling having a bayonet slot for connecting a length of rubber hose 24, the opposite end whereof is fitted with a suction nozzle 25. At the top of the enclosing member, and above the center of gravity of the cleaner, there is provided a rigid handle 26 secured thereto in any suitable manner such as by screws 27. One end of the handle 26 is recessed as shown at 28 for covering prongs 29 adapted to engage a plug 30 provided on the end of a cable 31. Thus the cleaner may be connected with a suitable source of electric energy. A switch 32 controls electric connection of said prongs 29 with an electric motor 33 driving a two-stage centrifugal blower 34 secured at the end of the armature shaft 35 of the motor, said shaft being disposed substantially along the center line of the casing 38. The directing vanes 34a are carried by the motor jacket, to be described, in any convenient manner.

The motor 33 is supported by a ring 36, which forms the division wall between the intermediate and discharge chambers previously referred to, of angular cross section secured inside of the member 10, lugs 37 provided on the motor housing being connected to said ring 36 by means of a plurality of screws 38. Rubber inserts 39 are provided between the screws 38 and the lugs 37 for the purpose of resiliently mounting the motor 33 and dampening vibrations thereof.

A substantially streamlined air jacket consisting of two portions 40 and 41 encloses the motor 33 and the blower 34 and directs the air toward an opening 42 provided in the back cover 22 of the member 10. Said jacket portions are secured to the flange 43 of the motor housing by means of a plurality of screws. The front end of the portion 41 bears against the partition 44 attached to the member 20, a suitable gasket 45 being provided between said partition and the flanged edges of the portion 41, screws 38 operating yieldably to press said gasket 45 against the partition 44. A circular hole 46 is provided at the center of the partition 44 concentric with the axis of the motor shaft 35. The partition forms the division wall between the vacuum and intermediate chambers.

The jacket portion 40 converges rearwardly, and its rearmost extremity is provided with hose connecting means for use during blowing operation of the cleaner. Openings 47 adapted to be adjustably closed by a spring pressed shutter 48, controlled with the aid of a handle 49, are provided in said portion 40 for the purpose of adjustably controlling the area of the blower discharge openings, thus providing means for regulating the action of the cleaner.

The air cleaning means are of the two-stage type. The first stage cleaning means is a collector box or cleaning trap 50 rigidly secured to the front cover 22. This box may be made of sheet metal or other rigid waterproof or absorbent material. Between the front wall 51 of said box 50 and the cover 23 are provided means for locking and unlocking the cover-and-box unit to the member 20. Said means comprise a handle 52 carrying a plate 53 to which 5 are hingedly connected lock bars 54 sliding outwardly in brackets 55. When the handle 52 is in the position shown in Fig. 1, the lock bars 54 are extended outwardly, and their ends engage the flanges 20a of the member 20, and thus securely hold the box-and-cover unit thereto. When the handle 52 is turned 90°, the lock bars are drawn inwardly away from the flange 20a and thus permit withdrawal of the box-and-cover unit out of the member 20.

The rear part of the collector box 50 is provided with a hinged door 56 normally locked by a spring 57, said door forming a dirt outlet when the box is to be emptied. The top of the box 50 is formed of a perforated plate 58 preferably of metal or other waterproof material, sloping rearwardly and downwardly. The bottom plate 59 of the box slides on runners 60, the flanges 60a whereof operating in the slots formed between said plate 59 and strips 61 secured to the plate 59. The front plate 51 is provided with a hole 62 through which the air enters the box near its top.

Means are provided within the box to cause curvilinear air flow through the box, said means, as shown, being baffle plates 63, 64 and 65, which are secured to the front plate 51 and slope rearwardly therefrom. These baffles are disposed in such a relation with respect to the opening 52 that the air entering therethrough is directed diagonally downward to the curved portion 56a of the door 56.

The second stage of the air cleaning process is effected by a cloth member 66 comprising a piece of finely woven cloth or other screening material held in a frame or retainer ring 67 which is removably attached to the portion 44 by means of a plurality of spring holders 68. Reenforcing wire screen 69 is secured to the frame for the purpose of supporting the cloth and preventing the cloth from being pulled out of the frame by the pressure of the flowing air.

Means for shaking off the fine dust particles which adheres to the cloth are exemplified by a metal pin 66a secured to a plate fastened to the cloth at the center thereof and adapted to engage the slotted end 70 of a shaker bar 71 perpendicular to the plate. This bar is hingedly supported in the member 20 along the bottom thereof as shown in Figs. 6 and 7. The horizontally extending portions of the shaker bar 71 is provided with a wavy edge 73 adapted to be engaged by a slotted follower 74 (see Fig. 7) secured to the bottom of the box 50. When the box 50 is being removed the follower 74 causes rapid oscillations of the bar 71 and, consequently, shaking of the cloth to remove therefrom any adhering fine particles of dust.

With the structure described above, the operation of my novel and improved cleaner is as follows: When the plug 30 electrically connected to a suitable electric circuit is inserted into the recess 28 and the switch 32 is thrown on, the motor 33 rotates the blower 34 and draws the air out of the air cleaning or vacuum compartment. The partial vacuum created therein causes the air to flow into said compartment through the nozzle 25 and hose 24, and to carry therein the dust and dirt particles picked up at the nozzle. Upon entering the box 50, the speed
of the air decreases and the heaviest dirt particles which were rolling along the lower portion of the hose 24 drop down to the bottom of the box 50 between the baffles 63 and 64, and are collected or plied in the middle of the front corner of the box as indicated at 78. The air continues its travel between the baffles 63, 64 and 65 and is discharged downwardly against the curved portion of the door 56, whereupon it turns downwardly and forwardly as indicated by the arrows in Fig. 3. Because of the centrifugal force, the heaviest particles of dust are thrown outwardly and are deposited in the bottom of the rear portion of the box as indicated at 76. In its continued travel the air strikes the front wall 51 of the box and turns upward depositing more dirt at this point. Because of the strong current of air between the baffles, the air is partly recirculated and follows said current, but most of it is separated in two streams by the obliquely arranged baffles 63 and 64. These two streams flow forwardly between the side walls of the box 56 and the baffles 63 and 64. Upon reaching the end of said baffles the air in said two streams rises up along the edges of the baffles 65 and flows upward along the side walls of the box 56 into the wedge space formed by the baffle 65 and the perforated plate 58. Here the air loses most of its velocity and filters through the plate 58. The dust particles which are too heavy to be held in suspension in the air passing through the plate 58 fall down mostly in the middle of the baffle plate 59 where the air speed is the least, and slide downward to the lower end of the plate where they get into the downward current of newly drawn air flowing between the baffles and sent on a repeated cycle, during which most of the remaining dust particles are deposited (because of the centrifugal force) in the corners of the casing as above described. It should be distinctly understood that above are indicated and explained only the main tendencies of air currents in the box, and that under actual conditions numerous eddies will somewhat modify and divert said currents from the paths indicated.

The partially cleaned air flows away from the plate 56 and toward the cloth member 66. By passing through the cloth the air is finally filtered and any remaining dust particles contained therein are detained by said cloth and the second stage of the air cleaning process is thereby effected.

The cleaned air continues its flow and passes through the rollers or impellers of the blower 34 and is discharged under a certain amount of pressure into the rear part of the jacket 41. Part of the discharged air passes through the motor 33 and cools the same, while the remaining air passes around the motor and enters the rear portion 40 of the air jacket from where it is discharged partly through the openings 47 and partly through the central opening, through which is also discharged the motor cooling air.

All the air is finally discharged through the openings 42 of the cover 22.

It is an important feature of the present invention that both the suction and the blower action of the device can be controlled by two independent means. Said means are represented in the present embodiment by the above described shutter 48 at the end of the air jacket and by a damper 78 at the suction end of the cleaner. The damper 78 may be provided at any place between the opening 62 in the front plate 51 and the suction nozzle 25. It comprises means restricting the cross section of the intake opening and it may be made in the form of a flat damper piece slidable in friction ways 79 and adapted to restrict the opening 80, said friction ways being made of rubber serving also as a sealing means for the damper piece 79.

In the operation of the device either as a blower or as a suction cleaner, closing the damper 78 increases the resistance of the air intake means and limits the air discharge. Thus, both the suction and the discharge can be regulated.

When a hose is connected to the central discharge opening of the air jacket 40 as indicated at 77 in Fig. 2, opening of the shutters 48 may thus adequately decrease the air discharge when desirable to do so. When the device is operating as a suction cleaner only, a certain limited amount of control may be secured by opening and closing said shutters. I prefer to use the control situated in the intake air passage of the cleaner since it possesses many inherent advantages. One of them consists in avoiding building up excessive pressure in the enclosing member, such as is done when the discharge opening is being restricted, while another advantage is found in a wide range of regulation control which may extend from the maximum capacity of the device to practically zero. It should be noted that under certain conditions it is advisable to operate the device with the discharge opening completely or nearly closed.

With the above described type of regulation control, the necessity of providing complicated means for regulating the speed of the electric motor is entirely eliminated.

Numerous valuable advantages are attainable with the aid of the novel features provided in my improved cleaner.

The rectangular shape of the casing makes the device more stable, less noise, more compact in operation and in storing, and very easy and pleasant to handle. The rigid handle located at the center of gravity of the device improves the handling characteristics still further.

The collector box is a rigid unit with the front cover and it can be removed, and emptied in a most simple manner. It can also be washed if desired, and the device may be used after such washing without the necessity of drying it. The handle which positively locks the box in the casing is also used for removing, carrying and washing the box.

Preliminary centrifugal separation of the heavier dust particles prevents clogging of the perforated plate.

Fig. 11 shows a modified form of the cleaning nozzle for combined suction and blower action of the device, and referring thereto said nozzle may comprise a body portion 81 in which there is provided a suction opening 82 connected by means of a hose 83 with the suction side of the device. A plurality of blowing openings 84, in the present instance two, are provided in proximity to said suction opening 82 and are connected by means of passages 85 and a hose 86 with the discharge or pressure side of the device. If desired, a valve may be provided in said hose 86 for the purpose of keeping the hose 86 normally interrupted and to permit selective use of blowing openings when the same is advantageous, such as when cleaning under radiators and the like.

Fig. 12 shows a modified construction of the baffle plate. In this case an opening 87 is pro...
vided in the baffle plate 85 corresponding to the plate 65 of the preferred structure, for the purpose of opening up the end of the wedge-shaped space formed between the baffle plate 87 and the perforated plate 68 to allow dust there collected to be sent on a return circulation by letting it be drawn by the air flowing from the air receiving opening in the wall 81. This opening 87 extends downwardly to a point slightly above the top of the opening 62, but no further. Hence no interference can occur with the main currents of air above described.

Although I have described my invention with a specific embodiment, the principles involved are susceptible of numerous other applications which will readily occur to persons skilled in the art. The invention is, therefore, to be limited only as indicated by the scope of the appended claims.

I claim:

1. In a cleaning device having an enclosing member, a cover on said member, means for securing said cover to said member, a dirt trap made of non-absorbent material rigidly secured to said cover and provided with air receiving and air discharging openings, means on said cover for removably connecting a suction hose to said box at the air receiving opening, a plurality of baffle plates within said dirt trap for effecting a flow of air in said box in a plurality of curvilinear paths, and an air filtering metal member arranged at said air discharging opening.

2. In a cleaning device, a plurality of relatively movable air cleaning elements, and means extending between said elements including a member for agitating one of said elements upon the occurrence of relative movement between said elements.

3. In a cleaning device, an enclosing member, an air cleaning element removably mounted in said member, a second air cleaning element in said member, and means extending between said elements including a member for agitating said second element when said first element is moved with respect to said member.

4. In a cleaning device, an enclosing member, an air cleaning element removably mounted in said enclosing member, a second air cleaning element in said enclosing member, means for agitating said second air cleaning element when said first air cleaning element is moved with respect to said enclosing member, said agitating means including a connecting member associated in agitating relation with said second air cleaning element, and means on said first air cleaning element to impart a movement to said connecting member.

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