

Dec. 26, 1939.

C. A. BREWER

2,184,731

VACUUM CLEANER

Filed April 25, 1936

5 Sheets-Sheet 1

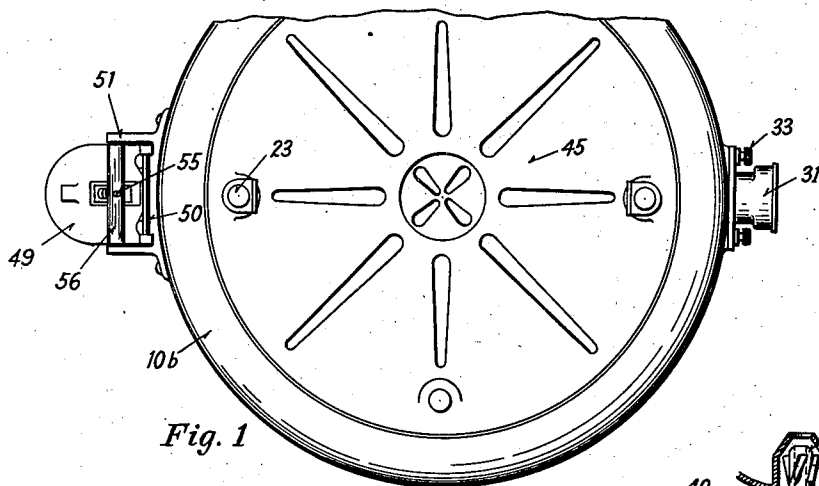


Fig. 1

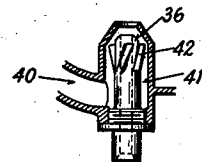


Fig. 2a

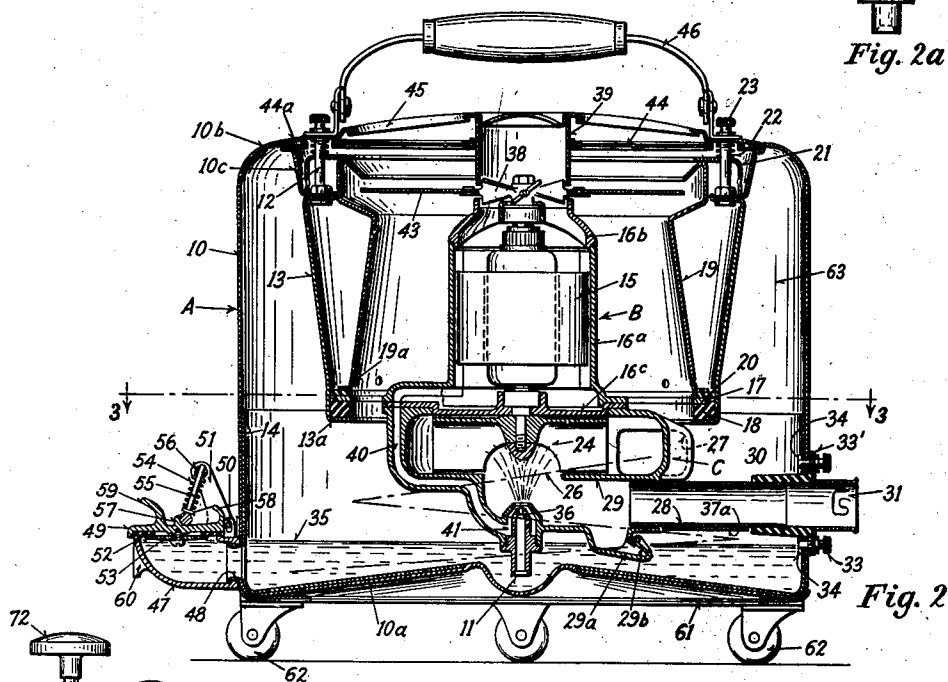


Fig. 2

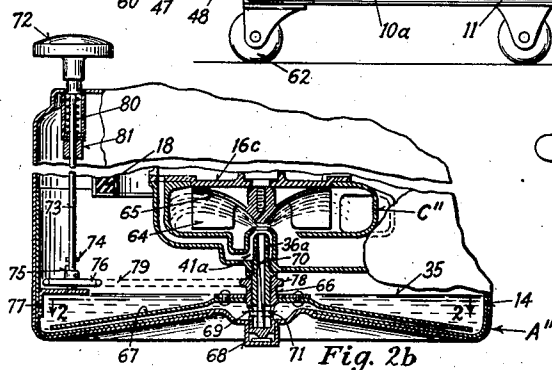


Fig. 2b

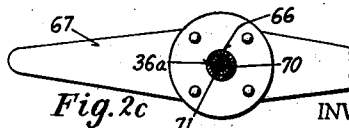


Fig. 2c

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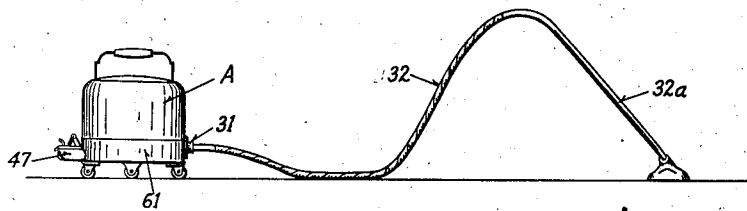
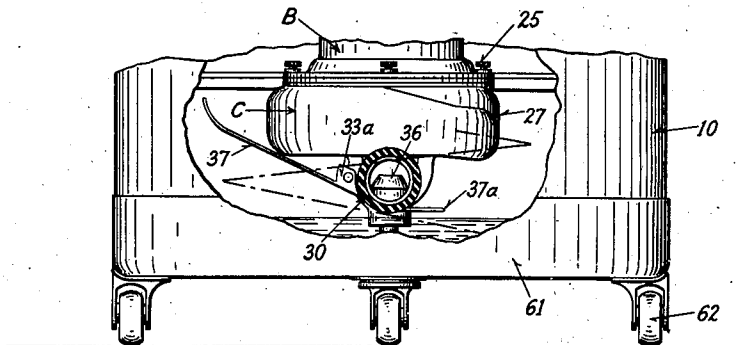
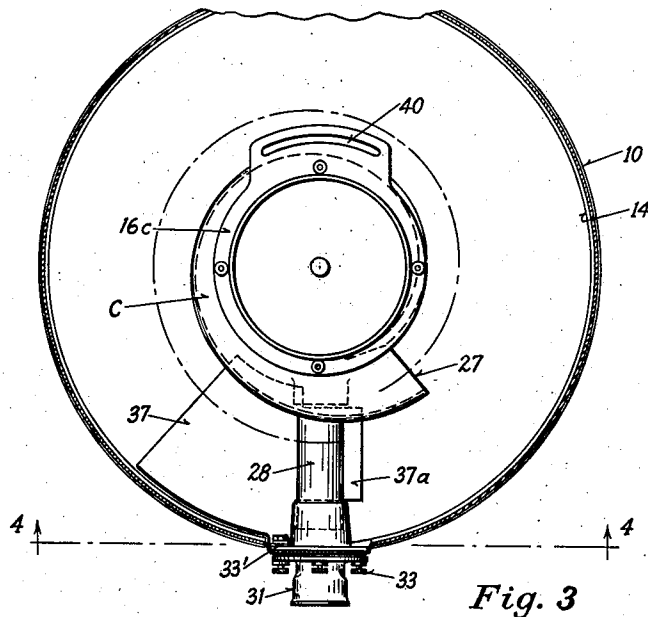
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5 Sheets-Sheet 2



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VACUUM CLEANER

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5 Sheets-Sheet 3

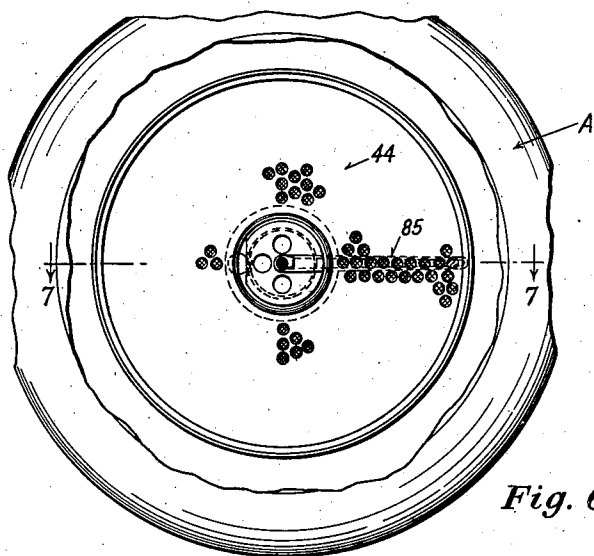


Fig. 6

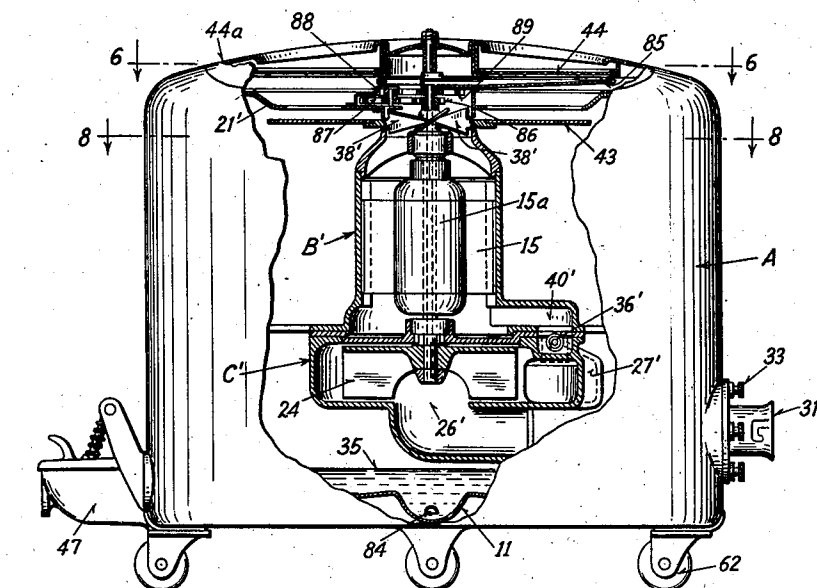


Fig. 7

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VACUUM CLEANER

Filed April 25, 1936

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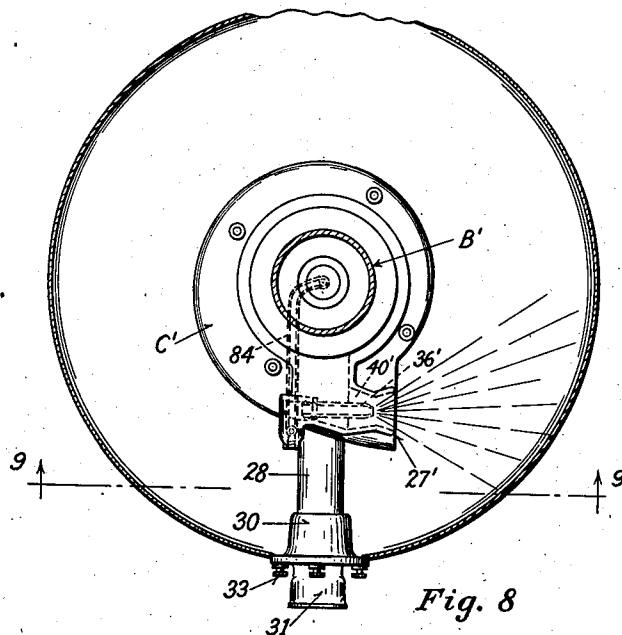


Fig. 8

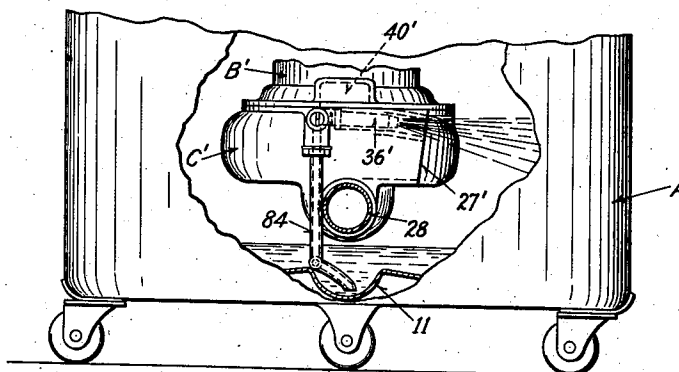


Fig. 9

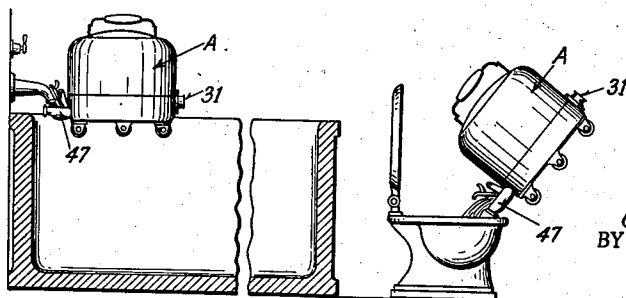


Fig. 10.

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VACUUM CLEANER

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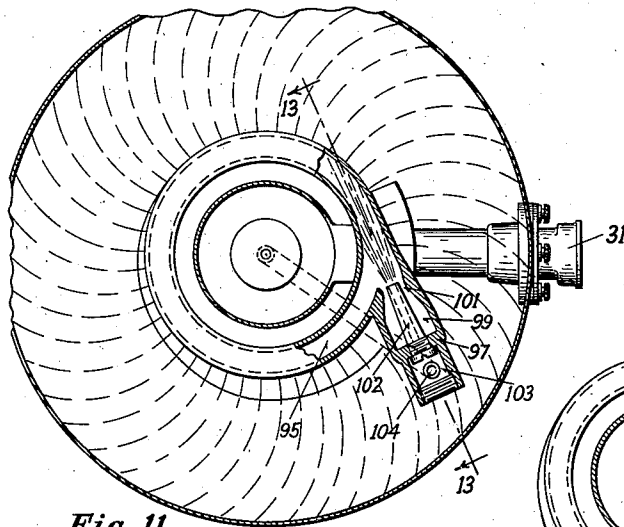


Fig. 11

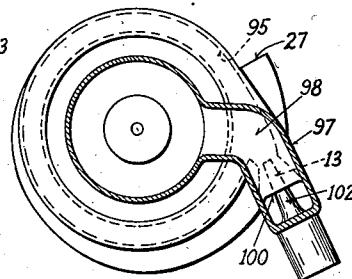


Fig. 14

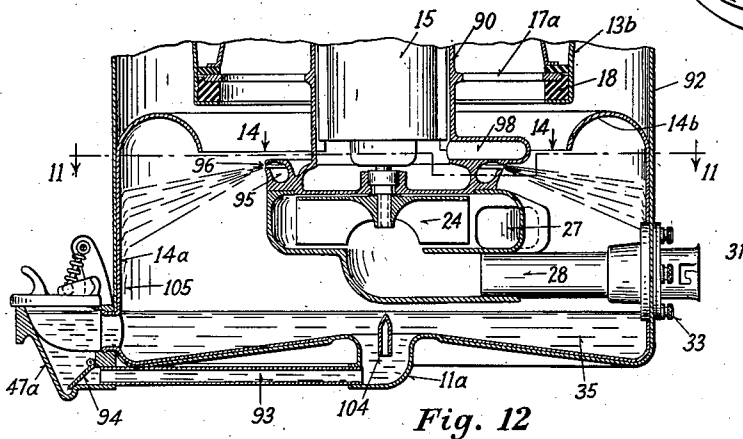


Fig. 12

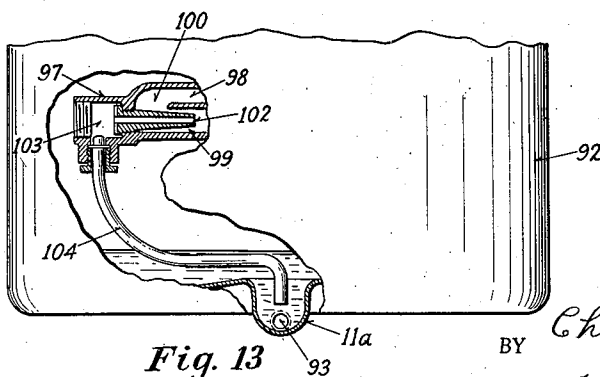


Fig. 13

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UNITED STATES PATENT OFFICE

2,184,731

VACUUM CLEANER

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Application April 25, 1936, Serial No. 76,314

3 Claims. (Cl. 183—8)

This invention relates to apparatus for cleaning floors, rugs, upholstered furniture, tapestries, and the like, and more particularly to that type wherein suction is employed for removing the dust and dirt from such articles.

Practically all vacuum cleaners, and particularly all that have been in the slightest degree commercially successful, employ a cloth or equivalent perforated means for separating dust particles and other foreign matter from the air which passes through the cleaner. This means for separating the dust and air possesses certain inherent disadvantages and objections which are obviated in the present invention. For example, it has been impossible to provide a perforated dust separator which would allow the air to pass therethrough with sufficient facility to permit efficient operation of the cleaner without also allowing the finer dust particles to pass. The amount of dust passing through the separator is enhanced by the fact that the dust particles which are accumulated in the bag or other receptacle are continuously agitated during the operation of the cleaner. Dust and germs are thus scattered throughout the room, settling on furniture and impairing the health of the occupants who must breathe the polluted air.

In addition to the above, it has been found that the dust adheres to a cloth or like separator, tending to clog the perforations thereof, retarding the air flow therethrough, and consequently materially reducing the efficiency and suction capacity of the cleaner. Back pressure which results from clogging of the separator not only decreases the effectiveness of the suction fan but increases the velocity at which the air passes through the separator and hence the quantity and size of dust particles which are entrained with it and carried out into the room. The task of emptying the accumulated dry dust from the receptacle, whether it be a bag or other type container, is not a pleasant one and cannot be executed without agitating the dust and hence polluting the surrounding air.

It is accordingly one of the objects of the present invention to provide a vacuum cleaner wherein novel means are provided for cleaning and purifying the air which passes therethrough.

Another object of the invention is to provide a novel bagless vacuum cleaner wherein the air passing therethrough is thoroughly cleaned and then discharged into the room at a low velocity.

Another object is to provide a novel vacuum cleaner wherein the air is both washed and subjected to centrifugal action as well as to abrupt

changes of course for the purpose of removing all dust and dirt particles therefrom.

Another object is to provide a novel cleaning device wherein the accumulated dirt is placed in solution for disposal via a household sewage system.

Still another object is to provide novel means for separating dirt from the air passing through a vacuum cleaner without restricting the passage of air therefrom so as to result in the building up of a back pressure on the discharge side of the suction creating means and consequent reduction in the efficiency and capacity of the cleaner.

A further object is to provide a vacuum cleaner that is sturdily constructed from a small number of light parts which may be readily assembled so that the weight thereof is substantially evenly distributed about a central axis and with a comparatively low center of gravity, thereby rendering the same stable and easy to handle.

A still further object is to provide a vacuum cleaner embodying novel means whereby the disposal of dirt picked up by the cleaner is facilitated and rendered feasible without removing any parts from the cleaner, such as bags or other dirt containers, for example.

Another object is to provide a novel vacuum cleaning device wherein the dust laden air is projected against a container wall over which a film of liquid is moving.

The above and further objects and novel features of the invention will more fully appear from the following detail description when taken in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not designed as a definition of the limits of the invention, reference being primarily had for this latter purpose to the appended claims.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

Fig. 1 is a top plan, with parts broken away, of one embodiment of the present invention;

Fig. 2 is a side elevation, partly in section, the section being taken substantially on the center line of Fig. 1;

Fig. 2a is an enlarged detail view of a modification of the device of Fig. 2;

Fig. 2b is a partial side elevation, partly in section, showing another modification of the apparatus of Fig. 2;

Fig. 2c is a detail view, taken on line 2—2 of Fig. 2b;

Fig. 3 is a top plan taken substantially on line 3—3 of Fig. 2, but with parts removed;

Fig. 4 is a side elevation, partly in section and with parts broken away, taken at right angles to the view of Fig. 2 and substantially on line 4—4 of Fig. 3;

Fig. 5 is a miniature of the devices of Figs. 2 and 2b with a floor tool connected thereto;

Fig. 6 is a partial top plan of a second embodiment of the invention taken on line 6—6 of Fig. 7;

Fig. 7 is a side elevation, partly in section and with parts broken away, of said second embodiment, the section being taken substantially on line 7—7 of Fig. 6;

Fig. 8 is a plan view taken substantially on line 8—8 of Fig. 7, but with parts removed;

Fig. 9 is a side elevation, partly in section and with parts broken away, the section being taken at right angles to the section of Fig. 7 and substantially on line 9—9 of Fig. 8;

Fig. 10 is a miniature view illustrating one method of emptying and refilling the novel cleaner comprehended;

Fig. 11 is a top plan, partly in section and with parts broken away, of another embodiment of the invention, the section being taken substantially on line 11—11 of Fig. 12;

Fig. 12 is a partial side elevation, partly in section, of the device of Fig. 11;

Fig. 13 is a partial side elevation, partly in section, the section being taken on line 13—13 of Fig. 11; and,

Fig. 14 is a detail plan view, partly in section, taken on the line 14—14 of Fig. 12.

One embodiment of the present invention is illustrated by way of example in Figs. 1 to 4, inclusive, in the form of a vacuum cleaner for cleaning floors, rugs, tapestries, and the like, wherein the dust is removed from the air as it passes through the cleaner by subjecting the same to a washing operation and/or to centrifugal action. The novel cleaner as shown is a substantially self-contained unit wherein the power means, suction creating means and a limited quantity of liquid employed in washing the dirt from the air are provided in a light, yet sturdy, casing which may be readily moved or carried about with utmost ease. The power and fan units are mounted in the casing in a novel manner whereby noises and vibrations are minimized and are so positioned that the same are substantially symmetrical with respect to the vertical axis of the casing, thereby rendering the entire cleaner stable and easy to handle.

In the form shown, an outer casing A comprises a cylindrical body portion 10, the bottom 10a of which is slightly conical with the surfaces thereof sloping downwardly from the center. A depression or well 11 is preferably provided at the center of bottom 10a for a purpose to appear hereafter. The upper end of casing A is provided with an integral annular flange having an inwardly extending portion 10b and a depending portion 10c. Secured to portion 10c by means of bolts 12 which extend through an inwardly extending lip on said portion 10c and constituting in effect a continuation and part of the inwardly and downwardly projecting flange 10b, 10c, is a sheet metal member 13 which has the shape of a frustrum of an inverted cone and is provided with an inwardly extending annular lip 13a at the bottom thereof.

A pan 14 made of somewhat heavier and harder material than that employed in the construction of casing 10 is preferably provided in the bottom thereof for the purpose of preventing wear occasioned by having air, dirt, and water directed against the same, as will more fully appear hereafter. The side walls of pan 14 preferably extend above the plane of the bottom of flange member 13.

Novel means are provided for mounting a power unit such as an electric motor 15 in casing 10 whereby the vibration of the motor may be successfully damped and the noises ordinarily incident to operation of the motor and the fan driven thereby are minimized. In the form shown, a motor housing B comprising a body portion 16a, a top cover 16b, and a bottom cover 16c is supported by means of a flange 17 on body portion 16a which rests upon a resilient washer 18 that is in turn supported on lip 13a of flange member 13. Flange 17 is in the form of a web so as to permit air to pass upwardly therethrough and out the upper end of casing 10.

The field windings and cores thereof of motor 15 are mounted in any suitable manner such as by screws (not shown) in housing B, and the armature thereof is rotatably supported in suitable bearings, the lower bearing being mounted on bottom cover 16c and the upper one being supported centrally of cover 16b by a plurality of webs in said cover. The entire power unit is resiliently held against the pad washer 18 through the medium of a conduit 19 having a cross section similar to a Venturi tube. The lower end of said conduit engages a washer 20 preferably of rubber composition, which in turn rests on the outer edge of flange 17 of motor housing B. The upper end of conduit 19 engages an annular ring 21 which is provided with a depending strengthening flange and a plurality of holes through which bolts 12 slidably extend. A plurality of coil springs 22 are interposed between plate 21 and nuts 23 threaded onto the upper end of bolts 12, said springs thus constituting resilient means for holding the power means against upward movement in casing A. Nuts 23 are preferably comparatively large and knurled so that the same may be readily removed without the use of a wrench for the purpose of disassembling the apparatus to clean or repair the same.

The armature shaft of motor 15 extends downwardly through bottom cover 16c and has a suction fan 24 secured thereto for rotation therewith. Surrounding said fan and secured to housing B by means of stud bolts 25 (Fig. 4) is a fan housing C, the inner periphery of which has the outline of a logarithmic curve, as represented in dotted lines in Fig. 3. Fan 24 is so designed that when the same is rotated by motor 15, a suction is created at a central inlet passage 26 in the bottom of casing C, the discharge being through a peripheral outlet 27 into casing A. Inlet 26 has communication with the exterior of casing A through a conduit comprising a metal tube 28 having a close fit in a depending tubular portion 29 of fan housing C and a flanged ferrule 30 made of flexible material such, for example, as rubber composition. Ferrule 30 extends through an opening in casing A and the flange thereof engages the outer wall of said casing. A short conduit 31, constituting an extension of conduit 28, 30 and the female part of a bayonet joint whereby a floor tool comprising a flexible hose 32 and nozzle 32a may be connected to the cleaner unit, is secured to casing

A by means of a plurality of bolts 33' which are anchored in a heavy washer 34 and extend through the walls 10, and flanges on member 31 and ferrule 30, the outer ends of said bolts being threaded to receive nuts 33 which are so constructed as to be readily removable. Washer 34 is preferably soldered to the wall of casing A to form a water seal and obviate any possibility of leakage. The power and fan means are thus connected together as a rigid unit and completely insulated and cushioned from casing A while being yieldingly supported thereby. The cleaner is accordingly substantially vibrationless and noiseless in operation.

Novel means are provided whereby the air which is drawn into casing A through floor tool 32, 32a by fan 24 may be thoroughly cleaned and, if desired, treated with an antiseptic, germicide, disinfectant, or the like, said means being such that the discharge from said casing is not restricted, thereby avoiding the building up of a back pressure which would be effective to decrease the efficiency of the fan and hence the ability of the cleaner to remove dirt and other foreign matter from rugs and the like. Such means, as shown, comprises a liquid 35, such as water, which may be treated with a suitable disinfectant or germicide, in the bottom of casing A, the level thereof being below discharge opening 27 and preferably below conduit 28. Dust laden air is preferably discharged from fan housing C in a downward direction and at an angle of less than 90 degrees to the horizontal. The air and dirt are thus driven against the surface of liquid 35 with sufficient force to cause the dirt particles to become saturated and remain in the liquid. The walls of discharge opening 27 are preferably curved so that the air discharged therefrom moves about the axis of casing A in a current resembling somewhat that of a cyclone, thus causing the heavier particles of dirt to be thrown outwardly and separated from the air by centrifugal force. After the directive force and velocity of the air are spent, the same passes upwardly through the annular passage between member 19 and housing B and thence out through the top of casing A. It will be noted that by reason of the large cross-sectional area of said annular passage the velocity of the outgoing air is very low, thus precluding any possibility that any dust particles will be entrained therewith.

For the purpose of further insuring the complete cleansing of the air and for enhancing the suction force of fan 24, novel means may be provided for creating a spray of liquid through which the air entering fan housing C must pass. In the form shown in Fig. 2, such means comprise an injector nozzle 36 which projects upwardly into portion 29 of housing C directly below and centrally of inlet opening 26 and which extends downwardly into liquid 35 in well 11. The suction of fan 24, assisted by the tendency of air entering through conduit 28, 29 at a high velocity to create a suction at the mouth of nozzle 36, draws liquid 35 upwardly through the nozzle. The liquid is discharged from nozzle 36 into inlet 26 in the form of a spray that is effective to wash the air passing through and mixing with the same. The churning of the air and liquid mixture by fan 24 and the subsequent driving of the same against the surface of the liquid in pan 14, as pointed out above, insures the dampening or saturation of all the dirt particles, thereby sufficiently increasing the weight of the same so that they will not be car-

ried upwardly by the air which is discharged from casing A at a low velocity. It will also be noted that some water particles passing through fan 24 are thrown outwardly against the vertical wall of pan 14 both by the directive force of the fan and by centrifugal force due to the whirling motion of the air within casing A. This forms a sheet of water on said wall and the dirt particles in the air will be driven into this sheet of water by the same directive and centrifugal forces and washed down into the bottom of pan 14. The force of the air as the same strikes fluid body 35 imparts a swirling motion thereto, thereby causing the dirt particles in solution therein to be centrifugally thrown to and held at the periphery of pan 14 away from the lower end of nozzle 36.

For the purpose of directing the air and dirt discharged from opening 27 beneath inlet conduit 28, 29 and hence insure that the dirt will come into contact with liquid 35, a deflector plate 37 may be provided. As seen in Figs. 3 and 4, plate 37 slopes downwardly in the direction of air flow and is held in place by one of the bolts 33' which extends through a vertical lip 33a thereon. The unbalanced weight of the plate tends to pivot the same about bolt 33' in a counterclockwise direction, as viewed in Fig. 4, and thus hold a horizontally extending portion 37a thereof in engagement with the bottom of conduit 28.

Novel means are also provided for cooling motor 15 and for employing the cooling air to further enhance the suction pull, i. e. the efficiency of fan 24, and to increase the quantity of liquid sprayed into the fan from nozzle 36. In the embodiment illustrated, said means comprise a small fan 38 (Fig. 2) mounted on the upper end of the armature shaft of motor 15, said fan being effective to pull air inwardly through a vertical conduit 39 and to discharge the same into motor housing B. This air, after passing through and cooling motor 15, is directed through a passage 40 which is formed in castings B and C and thence upwardly through an annular passage 41 around nozzle 36. This air, which flows at a high velocity through passage 41 and past the outlet of said nozzle because of the small cross-sectional area of said passage, creates an ejector action, thereby assisting in the creation of and increasing the volume of the spray of liquid entering passage 26. The additional air and water thus entering fan housing C increases the weight and density of the medium in which fan 24 operates to such an extent that the suction of the fan and hence the cleaning ability of the unit are enhanced.

If desired, a plurality of spiral or angularly positioned fins 42 (Fig. 2a) may be provided in annular passage 41, either on the walls thereof or on nozzle 36, to impart a whirling motion to the air passing therethrough, said whirling preferably being in the direction of rotation of the fan 24. The air thus entering housing C from passage 41 is effective to assist in the provision of a heavier medium about fan 24 without retarding the speed of rotation and hence the air moving capacity thereof. Additionally, the swirling motion of the spray and air emerging from the upper end of passage 41 causes the liquid to be broken up into fine particles, thus forming a sort of mist and increasing the ability thereof to penetrate and increase the weight of the entrained dust particles.

Means may also be provided for centrifugally

removing any excess moisture or entrained dirt particles from the air passing out of casing A through member 19 and, as shown, such means are constituted by a disc 43 mounted on fan 38 for rotation therewith. Said disc has a diameter somewhat greater than the throat of member 19 and the periphery thereof is preferably, although not necessarily, above said throat. When the air strikes the rapidly rotating disc, the heavier liquid and saturated dirt particles are thrown outwardly against member 19 by centrifugal force and fall back into the bottom of casing A. The air continues upwardly around the periphery of disc 43 and, if desired, through a coarse mesh screen or a loosely woven cloth separator 44 and a perforated cover 45 into the room. Cloth 44 is preferably supported by a webbed or perforated plate 44a which may be removably supported on flange or shoulder 10b by nuts 23. The latter also serve as means for holding cover 45 and a handle 46 in position.

A suitable supply of liquid 35 may be placed in casing A and the same may be readily removed therefrom when the cleaning has been completed through a suitable outlet, such as a pouring spout 47 secured to said casing at a point opposite connector 31. In the form shown, said spout is provided with a novel cover which is easy to manipulate and obviates any leakage. As shown, spout 47 is supported on an annular flange 48 spun about an opening adjacent the bottom of casing A. The discharge opening of the spout faces upwardly and is provided with a cover 49 which is pivotally mounted on a pin 50 that extends into elongated slots in a pair of brackets 51. A flexible washer 52, made of some suitable packing material, is held in place on the lower face of cover 49 for engagement with the peripheral edge of spout 47 by a plate 53 which is in turn supported on the cover by a set screw.

Cover 49 is held in closed position by the pressure of a spring 54 applied centrally of the cover. Said spring surrounds a pin 55, the ball-shaped lower portion of which engages cover 49 and the upper end of which slidably extends through a bar 56 that spans the upper ends of brackets 51. The movement of the enlarged lower end of pin 55 is limited by a pair of hooks or stops 57 and 58, the former being adjacent the center and the latter adjacent the pivot of cover 49. The cover may be lifted against the pressure of spring 54 by pulling upwardly on a lug 59. When the cover has been raised sufficiently to cause the bottom of pin 55 to slide into contact with stop 58, said pin and spring 54 will become effective to hold the cover in open position. The dirty liquid 35 may then be poured into a closet bowl (Fig. 10), floor drain or other suitable drain having a sewage connection. The unit may be rested on a hook 60 provided on spout 47 when the liquid is being poured from the casing.

In refilling the device with clean water, it is merely necessary to hold the same with spout 47 under a water faucet in the bath tub (Fig. 10), sink or the like. If desired, a disinfectant, germicide and/or a dirt solvent may be added to the water or any other suitable liquid or solution may be employed. The disinfectant or germicide will serve to purify the air passing through the cleaner and the solvent will keep dirt particles in solution, thereby preventing any settling of the same in casing A or other parts of the cleaner. If casing A is held in a substantially level position during the filling operation, the top of spout

47 will determine the liquid level within the casing. After the liquid supply has been replenished, cover 49 may be pivoted back to its closed position, whereupon pin 55 will slide down the inclined face of the cover and against stop 57. The pressure of spring 54 is thus applied centrally of the cover and is effective to hold washer 52 in water-tight engagement with spout 47 entirely around the periphery of the opening therein.

A sump 29a may be provided at the base of conduit 29 to accumulate any liquid which may settle in said conduit and prevent any flow of the same into hose 32. Sump 29a in the embodiment of Fig. 2 is in communication with pan 14 through a check valve, such as flap valve 29b.

If it is desired to disassemble the above described vacuum cleaner for any reason, such as for repairs or cleaning of the parts, it is only necessary to remove nuts 23 and 33. Handle 46, cover 45, dust separator unit 44 to which conduit 39 is attached, plate 21, and conduit 28, 30 may then be readily removed in the order named. After the further removal of fan 38 and member 19, housings B and C may be lifted from the casing as a unit. It will be apparent that the assembly and disassembly of this latter unit is also a very simple matter and may accordingly be accomplished by any housewife or ordinary mechanic.

In order that the vacuum cleaner thus comprehended may be readily movable about the floor while in use, casing A is preferably set into and, if desired, secured to a dolly 61 which is provided with a plurality of rollers 62, some or all of which may be connected to the dolly by swivel joints. The volume of the annular space 63 between the wall 10 of casing A and flange 10c, 13 is preferably sufficiently large so that no liquid will be spilled from the casing if the same is accidentally turned on its side or upset. If any moisture should get into the annular chamber between parts 13 and 19, the same will drain back into pan 14 through a plurality of holes 19a adjacent the base of member 19.

A modification of the embodiment of Fig. 2 is illustrated in Figs. 2b and 2c, the parts of the modified structure which are not shown in section being substantially the same as corresponding parts of Fig. 2. The modified form as shown comprises a suction fan 64 in fan housing C' having the upper edges of the blades thereof joined by webs to form a roof 65 of inverted conical shape. Passage 41a and nozzle 36a, which correspond to parts 41 and 36, respectively, of Fig. 2, extend upwardly to a point adjacent the apex of said conical roof and a liquid spray, created in the same manner as explained above, is directed along the lower surface thereof substantially as indicated in the drawings. As the particles of liquid in the spray disperse, a mist is formed which fills the periphery of casing C' where the air is thoroughly mixed therewith and the dust particles saturated. The space between the fan blades adjacent the bottom of housing C' is thus left free to be occupied by the incoming air, thereby insuring a strong suction and increased cleaning capacity.

Novel means are also provided in the embodiment of Fig. 2b for preventing the accumulation of dirt on the bottom of pan 14 and in the central passage of nozzle 36a. Such means, in the form shown, comprise a scraper having a hub portion 66 and a plurality of fins 67 secured to and extending radially from the hub. The latter has an upwardly extending portion rotat-

ably journaled on the lower end of nozzle 36a and a depending portion which rests on the bottom of a depression 68 in the bottom of casing A'', supporting fins 67 in a position adjacent the bottom of pan 14. A plurality of openings 69 are provided in hub 66 through which liquid 35 may be drawn into nozzle 36a. In order to obviate any possibility of nozzle 36a becoming clogged and to impart a swirling motion to the liquid spray in the direction of rotation of fan 64, a thin blade 70, the surface of which is preferably helical, is inserted in the central passage of the nozzle and is constrained to rotate with hub 66 by a pin 71 which extends through the blade and into diametrically disposed openings 69.

In operation, the body of liquid 35 is swirled in pan 14 by the impact of the air discharged from fan housing C'' by fan 64 in the manner pointed out above, and the swirling liquid causes rotation of scrapers 67 and 70, the former being effective to agitate any dirt at the bottom of pan 14 and the latter to scrape the walls of the fluid passage in nozzle 36a. If desired, said scrapers may also be manually rotated by means of a knob 72 on the upper end of a shaft 73, the lower end of which has a pin 74 adapted to engage a lug 75 on the hub of a sprocket 76 rotatably supported on a bracket 77 within housing A''. Said sprocket is operatively connected with a sprocket 78 formed integrally with hub 66, by any suitable means such as a chain 79. Shaft 73 is normally held in raised position by a coil spring 80 interposed between a guide 81 and an enlarged portion of said shaft so that pin 74 will not normally engage lug 75, thereby leaving scrapers 67 and 70 free to be rotated by liquid 35 independently of shaft 73.

A second embodiment of the invention, wherein a fluid spray is directed across the discharge opening 27' of fan housing C' in lieu of into the inlet opening 26' thereof is illustrated in Figs. 6 to 9, inclusive. The general construction and mounting of the various parts of the device is substantially the same as that described in connection with the first embodiment (Fig. 2), housings B' and C', however, being somewhat modified to accommodate the spray nozzle in its new position. The primed numerals employed in the description of the embodiment of Figs. 6 to 9 are applied to parts corresponding to similar parts in the first embodiment designated by like numerals.

In the embodiment of Figs. 6 to 9, a spray nozzle 36' is supported just above discharge opening 27' in a passage 40' formed by the cooperation of casings B' and C' and is so positioned in said passage as to direct the spray downwardly at an angle across the air stream emerging from the latter housing. A current of air created by fan 38' passes downwardly through housing B' cooling motor 15 and thence through passage 40'. The latter may be given the shape of a venturi (Fig. 8) with the throat thereof surrounding the mouth of nozzle 36'. The suction through the nozzle is thus increased by the increased velocity of the air as it passes the mouth thereof and by the reduction in pressure in passage 40' beyond the throat thereof. Nozzle 36' is connected to fluid body 35 by means of a pipe connection 84 which terminates in well 11.

Another novel feature shown in Figs. 6 to 9 and which may also be employed in combination with the other embodiments of the invention is constituted by means for sucking any dirt or liquid

particles which adhere to separator assembly 44, 44a, back into the fan housing. In the form shown, such means comprise a hollow suction arm 85 (Figs. 6 and 7) which extends radially from armature shaft 15a of motor 15 and the upper slotted surface of which engages the lower surface of said separator assembly. Arm 85 is adapted to be rotatably driven by motor 15 through a train of reduction gears interposed between a hub on said arm and motor shaft 15a. The gear train is constituted by a small gear 86 on armature shaft 15a which meshes with a larger gear 87 that has a small gear 88 rigidly secured thereto and is rotatably supported by plate 21'. Gear 88 meshes with a larger gear 89 secured to a depending hub portion of suction arm 85. The hollow center of said arm has communication with the center of housing C' through a passage in the center of armature shaft 15a. Arm 85 thus rotates slowly during the operation of motor 15 and the suction of fan 24 is effective to continually clean separator 44, thus preventing the accumulation of an excessive quantity of dust or moisture thereon and insuring free discharge of air from the cleaner. This is particularly desirable when no liquid is employed and cloth 44 is relied upon to intercept the finer dust particles not separated from the air by centrifugal force or caused to settle by reason of the reduced velocity of the air current.

In Figs. 11 to 14, inclusive, another embodiment of the invention is illustrated wherein the dust laden air is discharged by the suction fan into a chamber substantially surrounded by liquid for washing the dirt from the air and purifying the latter. The upper portion of the outer casing and the motor supporting means in the latter embodiment is substantially the same as in the embodiments heretofore described and accordingly is not duplicated in the drawings. The flange 13b does not extend as far into the casing as the corresponding flange 13, however, and motor housing 90 is provided with a webbed supporting flange 17a in lieu of the flange 17 of Fig. 2.

The outer casing 92 is substantially the same as casing A above described except that a well 11a in the center of the bottom thereof is connected by means of a conduit 93 to a depending portion of pouring spout 47a for the purpose of preventing the accumulation of any dirt in said well. A check valve 94 may be provided for said conduit, if desired. The bottom portion of casing 92 is lined with a pan 14a of comparatively heavy metal for withstanding wear occasioned by the impact of air, dirt and water thrown against the same in a manner to appear hereafter. The upper edge of said pan is spun inwardly and downwardly, as shown at 14b, the diameter of the opening at the top of the pan preferably being substantially equal to the diameter of the lower end of supporting flange 13b.

Motor housing 90 is preferably cast with an enlarged flange portion having an annular passage 95 cored therein, said passage being in communication with the interior of pan 14a through a narrow slot 96 on a plane slightly below the inner edge of said pan. Also cast integrally with housing 90 is a hollow portion 97 extending tangentially of passage 95. Portion 97 is divided into upper and lower compartments by a horizontal partition, the upper compartment 98 having communication with housing 90 and with the lower compartment 99 through an opening 100 in said partition. Lower compartment 99 communicates with annular passage 95, preferably through a Venturi-shaped opening 101, and a nozzle 102 is

provided in said lower compartment, the mouth or discharge end of which extends into the throat of venturi 101. The intake end of said nozzle is connected with fluid body 35 through a compartment 103 in portion 97 and a conduit 104 which terminates in well 11a.

In the operation of the last described embodiment, air is drawn into motor housing 90 by a fan 38 (see Fig. 2) and driven downwardly over motor 15 into compartment 98, through opening 100 into compartment 99, and thence into passage 95 through venturi 101 past the mouth of nozzle 102. A suction is thus created about the mouth of said nozzle which is effective to pull liquid 35 up through conduit 104. Said liquid is entrained by the rapidly moving air as it passes the mouth of nozzle 102 and is thereby injected into passage 95 from which it escapes through slot 96, thus forming a ceiling constituted by an annular spray or film, most of which is thrown outwardly against the vertical wall of pan 14a. The fluid striking said wall flows downwardly on said wall with a combined vertical and whirling motion due to the directive force imparted thereto in passage 95, thereby forming a mobile liquid film 105 which is effective to scrub the pan wall and carry all dirt particles into the bottom of the pan. Because of the high velocity at which the fluid is moving as it leaves slot 96, some of the moisture particles are broken up to form a mist. Additionally, some liquid particles splash outwardly from the wall of pan 14a into the central portion thereof, thereby further insuring a thorough cleansing of the air in the pan.

Dust laden air is drawn in by fan 24 from a floor tool just as in the other embodiments of the invention through passage 28 and is discharged through opening 27 of the fan housing at a point beneath the ceiling spray ejected from slot 96. The dust particles are thus either driven against the surface of liquid body 35 or thrown by centrifugal or direct force into liquid film 105. In addition, the air, after its velocity has been substantially decreased, must pass upwardly through said ceiling spray. The dirt laden air is thus injected into a mist filled chamber substantially surrounded by liquid walls. The cyclonic path of the air in said liquid chamber insures complete saturation of all dirt particles and hence a thorough cleansing of the air which is discharged into the room.

If desired, the embodiment of Fig. 12 may be operated without the use of a liquid. The air discharged from slot 96 would then form an air ceiling having a high radial velocity in pan 14a. Any dirt particles attempting to penetrate said ceiling would be thrown outwardly against the walls of pan 14a and maintained within the cleaner.

For the purpose of killing bacteria and purifying the air which passes through the cleaners above described, any suitable disinfectant such, for example, as chlorine or formaldehyde or solutions known commercially as Clorox, Lysol, Absorbine, Jr., etc., may be employed in the cleansing fluid of the various embodiments, or, if desired, screen 44 may be treated therewith. A dirt solvent having a carbon tetrachloride or caustic potash base, such, for example, as soap or Sani-Flush may also be placed in the cleansing fluid either at the beginning of the cleansing operation or just before the dirty liquid is removed from the cleaner. If desired, suitable compounds or solutions may be placed in the

cleaner for perfuming the air passing there-through.

There is thus provided a novel vacuum cleaner which may be employed in the household, for example, for cleaning rugs and the like, wherein the dust is separated from the air within the cleaner in a novel and most efficient manner. The air is thoroughly cleaned and purified before the same is discharged into the room again and the dirt deposited in the cleaner is placed in solution so that the same may be readily disposed of through the ordinary sewage disposal system without creating a dust cloud or redistributing part of the accumulated dirt around the house. Additionally, the back pressure against the suction fan of the cleaner is reduced and the efficiency of the fan otherwise increased so that more efficient cleaning is accomplished. The cleaner thus provided is also of light weight so that any housewife may carry the same about the house or upstairs without undue exertion and is so constructed as to be substantially vibrationless and noiseless in operation.

Although only a limited number of embodiments of the invention have been illustrated and described in detail, it is to be expressly understood that the same is not limited thereto but that various changes and modifications may be made, particularly in the design, arrangement and shape of parts illustrated, without departing from the spirit and scope of the invention, as will now be understood by those skilled in the art. For a definition of the limits of the invention, reference will be had primarily to the appended claims.

What is claimed is:

1. A vacuum cleaner comprising a casing having an air outlet adjacent the top thereof, an electric motor mounted in said casing, a housing therefor, a conduit connecting said housing with atmosphere exterior of said casing, a fan in said conduit driven by said motor for drawing air into said housing, a second fan connected to said motor, a housing for said second fan having inlet and discharge openings, a conduit connecting said inlet opening with atmosphere outside of the casing, a predetermined quantity of liquid at the bottom of said casing, a spray nozzle having an extension immersed in said liquid, and means directing the discharge of said first-named fan past said spray nozzle whereby said liquid is sprayed adjacent one of the openings in said fan housing.

2. In a vacuum cleaner, a casing having an air discharge opening, power means in said casing, suction means driven by said power means and adapted to discharge into said casing, and a disc-like member driven by said power means, said member being positioned in said discharge opening whereby dust particles in the air passing from the casing are subjected to the centrifugal action of said member and removed from the air by centrifugal force.

3. A vacuum cleaner comprising a casing having an air outlet opening adjacent the top thereof, a perforated member in said opening for separating foreign matter from the air discharged from said casing, a motor housing in said casing, means for supporting said housing above the bottom of said casing, a motor in said housing, means connecting said housing with the atmosphere exterior of said casing, fan means driven by said motor for drawing air into said housing, means adjacent said opening and driven by said motor for subjecting the air discharged from said cas-

ing to centrifugal action, a fan housing having a discharge opening communicating with the interior of said casing and an inlet opening communicating with the interior of said casing and an inlet opening communicating with the exterior of said casing, a suction fan in said fan housing drivably connected to said motor, a quantity of

liquid confined in said casing, and means rendered operative by the discharge from said first named fan means for lifting said liquid and spraying the same into the air stream created by said second-named fan.

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