Sept. 3, 1946. L. K. ACHESON 2,406,733

SUCTION CLEANER

Filed April 26, 1943 3 Sheets-Sheet 1

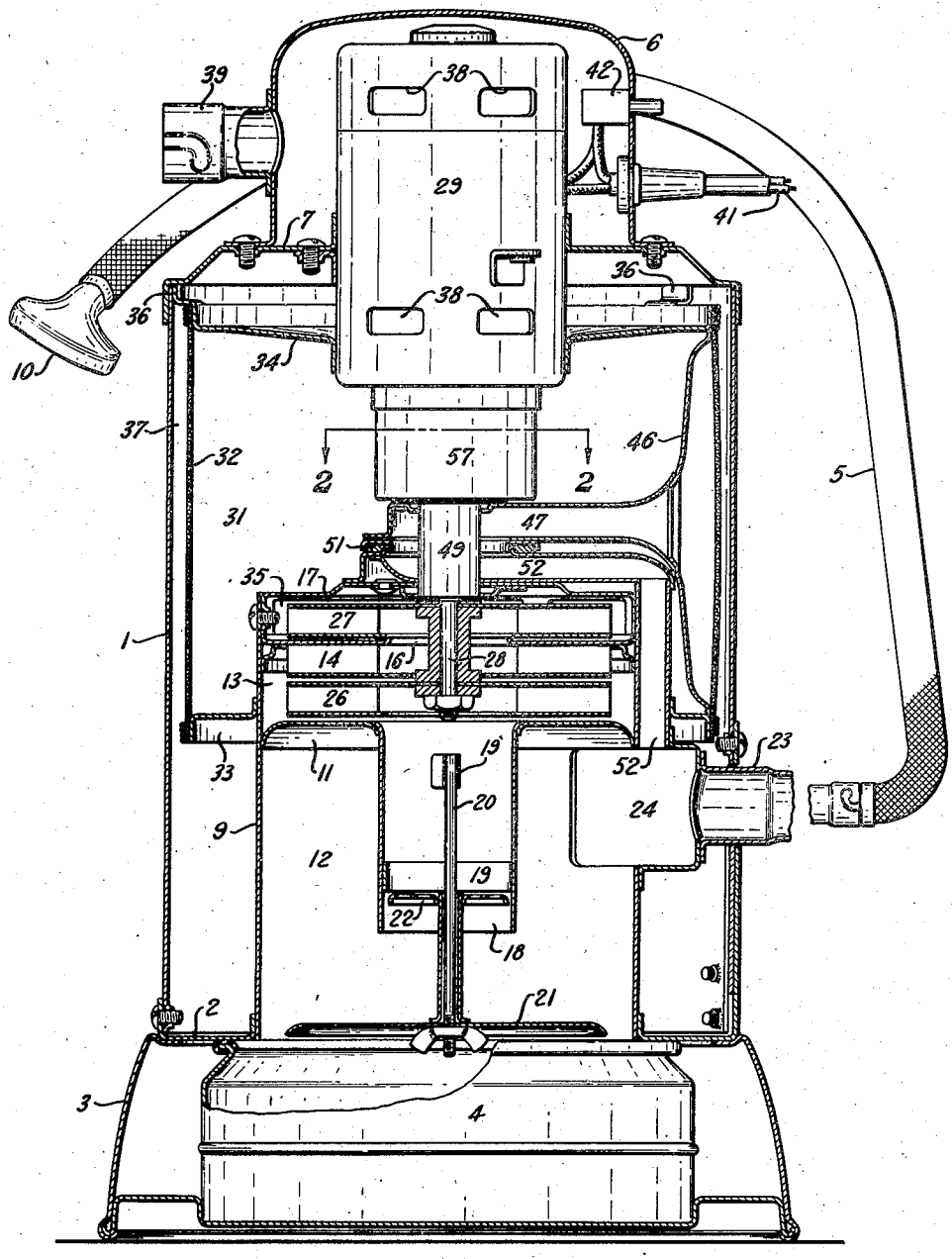


Fig. 1

INVENTOR.
Louis K. Acheson
BY
Harry S. Mecasse

Sept. 3, 1946. L. K. ACHESON 2,406,733

SUCTION CLEANER

Filed April 26, 1943 3 Sheets-Sheet 2

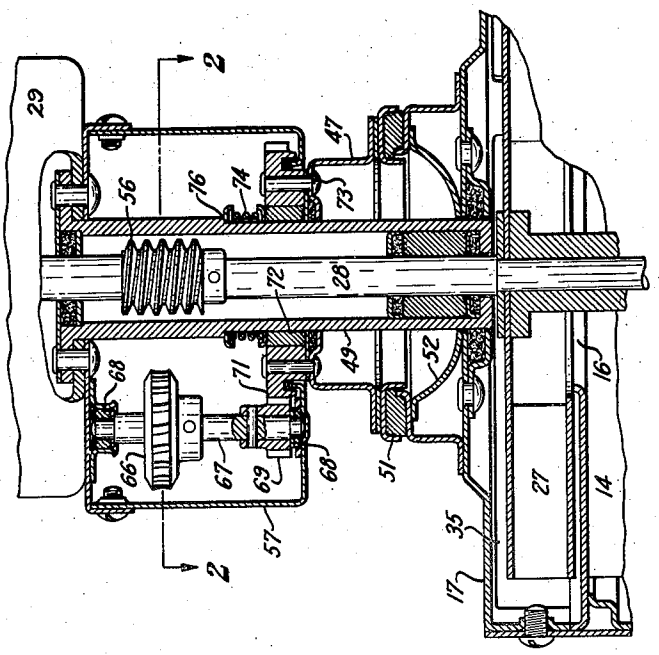


Fig. 4

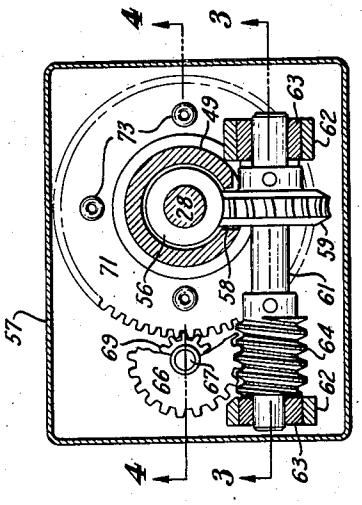


Fig. 2

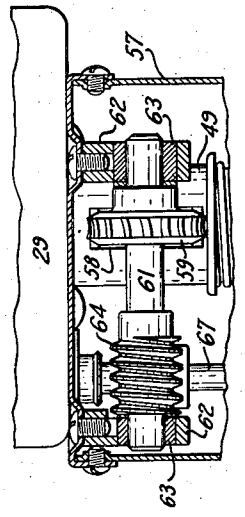


Fig. 3

INVENTOR.

Louis K. Acheson

BY

Harry S. Bruaw

Sept. 3, 1946. L. K. ACHESON 2,406,733

SUCTION CLEANER

Filed April 26, 1943 3 Sheets-Sheet 3

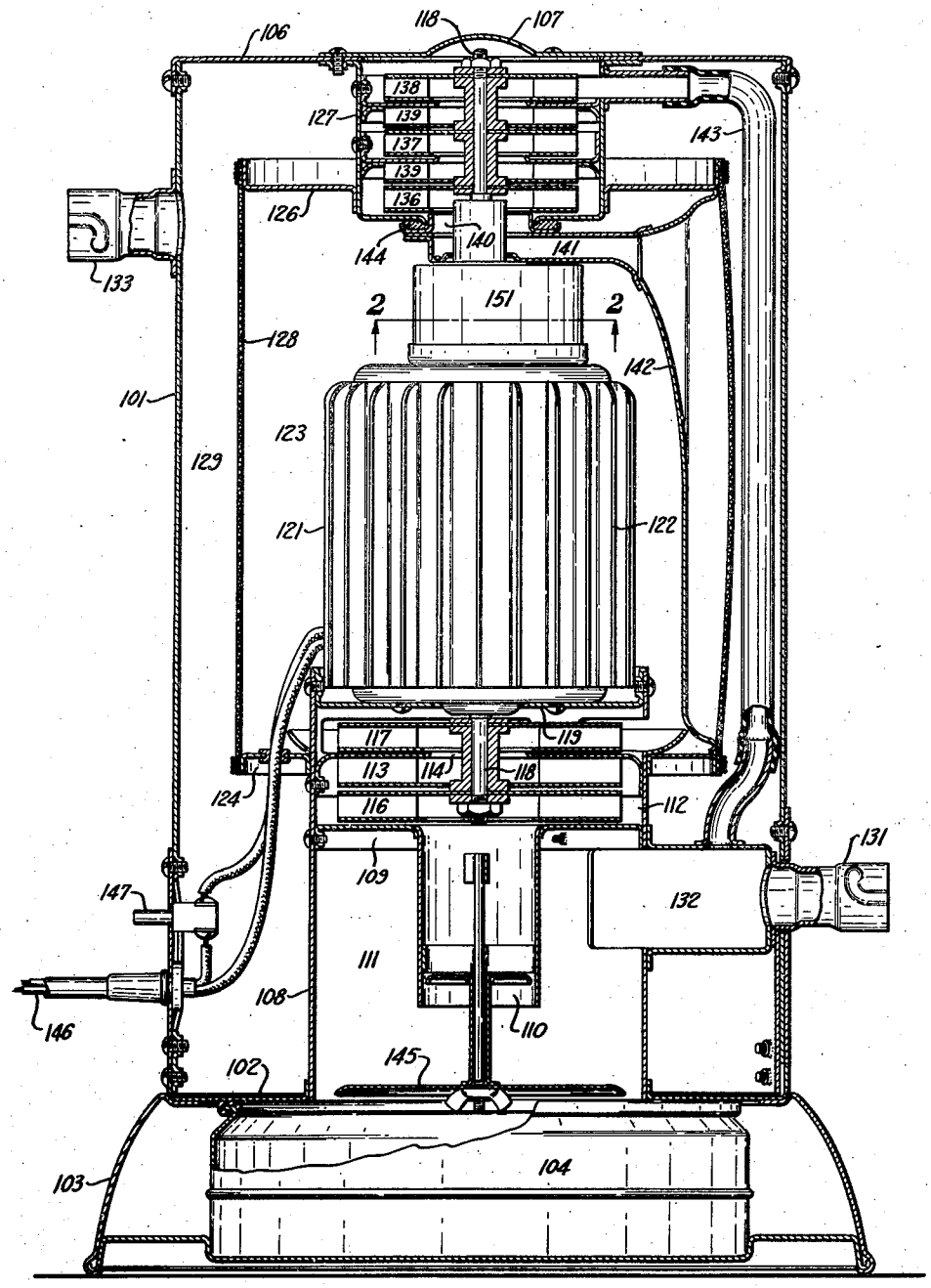


Fig. 5

INVENTOR.
Louis K. Acheson
BY
Harry D. Bucans

Patented Sept. 3, 1946 2,406,733

UNITED STATES PATENT OFFICE

2,406,733

SUCTION CLEANER

Louis K. Acheson, North Canton, Ohio, assignor to The Hoover Company, North Canton, Ohio, a corporation of Ohio

Application April 26, 1943, Serial No. 484,510

11 Claims. (Cl. 183—57)

1

The present invention relates to suction cleaners in general and more particularly to a new and novel arrangement of parts in a suction cleaner. More specifically, the invention comprises an improved type of suction cleaner in which the dirt-laden air stream is drawn by the suction-creating means of the cleaner through an initial dirt separator and is exhausted by the suction-creating means into a final dirt-separator, means being provided which continuously clean the final separator and remove the collected foreign material therefrom and transfer it back to the initial separator.

It is an object of the present invention to provide a new and improved suction cleaner. It is another object of the invention to provide a new and improved suction cleaner of the type incorporating an initial dirt separator and a final dirt separator. A still further object of the invention is to provide a suction cleaner having a plurality of dirt separators, the final dirt separator being provided with cleaning means. Still another object of the invention is to provide a suction cleaner of the type in which an initial separator has its dirt-filtering action supplemented by a final separator, there being continuously operated means provided which remove the dirt from the final separator and return it to the initial separator. A still further object of the invention is to provide a suction cleaner of the type having an initial separator from which air is drawn by the suction-creating means of the cleaner which exhaust substantially clean air into a final dirt separator and in which a constantly driven rotary filter-cleaning nozzle removes the dirt from the final separator and returns it to the initial separator. These and other more specific objects will appear upon reading the following specification and claims and upon considering in connection therewith the attached drawings to which they relate.

Referring now to the drawings in which preferred embodiments of the present invention are disclosed:

Figure 1 is a vertical section through a suction cleaner constructed in accordance with the present invention;

Figure 2 is a transverse horizontal section through the speed-reducing means by which the filter-cleaning nozzle is driven from the main motor shaft, being a section taken upon the lines 2—2 of Figures 1 and 4;

Figure 3 is a section upon the line 3—3 of Figure 2;

Figure 4 is an enlarged partial vertical section

2

through the suction-creating fan unit and the speed-reducing means, being taken upon the line 4—4 of Figure 2; and

Figure 5 is a vertical section through a cleaner constructed in accordance with a second preferred embodiment of the invention which is characterized primarily by being provided with individual suction-creating means for the filter-cleaning nozzle.

The usual modern cleaner embodies a suction-creating unit which draws air from the surface-contacting nozzle and which moves it to a dirt-filtering unit which is permeable to air but impermeable to dirt and which therefore functions to restrain and retain the dirt while permitting the air to escape into the ambient atmosphere. This usual type of machine has the objection that the dust bag must be cleaned at intervals in order that the machine remain operative, for if not cleaned the resistance to the flow of cleaning air through the bag becomes excessive thereby reducing to the point of inoperativeness the flow of air through the machine. Other types of cleaners have been designed incorporating what is called mechanical dirt-separating means, that is, means which usually rely upon centrifugal force, etc., to effect the separation of the dirt from the carrying air stream rather than upon the filtering action of a filter such as a cloth bag. These mechanical separator machines, however, have all been characterized by the objection that they permitted the escape into the atmosphere of a very small fraction of the dirt carried by the air stream and this escaped dirt was of a type which created a noticeable dust odor. Could the escape of this very small percentage of foreign material be eliminated that type of machine would have certain advantages for a mechanical separator need not be removed to be cleaned but instead it is necessary only to remove a dirt container or pan which is very easily emptied.

The suction cleaner of the patent to Bible 2,247,472 comprises a recognition of this problem and provides a solution which is a material advancement over the prior art. The Bible patent provides an initial dirt separator from which cleaning air is drawn by the suction-creating means which in turn exhaust the substantially clean air into a final filter. To prevent the undue accumulation of foreign material in this final filter there is provided a manually operable filter-cleaning nozzle which is connectible to the intake of the initial dirt separator and which, when in operation, functions to clean the final

separator and to reconvey the foreign material therefrom into the initial separator.

The present invention represents an improvement over the construction of Bible 2,247,472 in that it provides, in a cleaner of the basic Bible type, means which continuously maintain the final filter in a clean condition and which continuously return foreign material from that final filter to the initial separator where it can be removed, an agglomerating action having taken place in the collection on the final filter. In one embodiment of the invention, as will be hereinafter described, separate suction-creating means are provided for the filter-cleaning nozzle and which effect the return of the foreign material from that nozzle to the initial separator.

Referring again to the drawings, and to Figures 1 to 4 inclusive in particular, the first preferred embodiment of the invention is illustrated. A cylindrical main casing 1 seats, at its centrally apertured and flanged bottom plate 2, upon a supporting base 3 which seats a removable dirt pan or container 4, the upper peripheral edges of which are in sealed contact with the bottom plate 2. The upper end of the cylindrical casing 1 is closed by a motor hood 6 which includes an inwardly flanged motor-supporting wall 7.

Positioned concentrically within the main casing 1 is a smaller cylindrical casing 9 which is carried by the inner flanged peripheral edge of the bottom plate 2 of the casing 1. A transverse closure wall 11 divides the cylindrical casing 9 into a lower whirl chamber 12 and upper fan chamber 13, the latter being itself divided into a lower stage and an upper stage by a centrally positioned deflector 14. Deflector 14 is formed with a multiplicity of fixed guide vanes which function to direct the air to the central inlet formed therein and which is indicated as 16. The top of the fan chamber 13 is closed by cover plate 17 of the cylindrical casing 9 while the bottom of the fan chamber is provided with a downwardly extending elongated inlet 18 which reaches downwardly beyond the mid-portion of the whirl chamber 12. Vertically spaced spiders 19 within inlet 18 support a downwardly extending rod 20 carrying a transverse closing plate 21 at its lower end and a strainer 22 immediately below the lower spider 19. Plate 21 is spaced inwardly from the wall of casing 9 and provides a peripheral opening through which the foreign material can drop from the whirl chamber into the dirt pan 4 while the strainer 22 prevents the passage upwardly into the suction-creating fan chamber 13 of large size foreign objects.

The inlet of the cleaner comprises a port 23 which is adapted to receive and seat the cleaner end of a dusting tool hose 5 which at its outer end carries a suitable cleaning nozzle 10. Inlet 23 passes inwardly through the outer cylindrical casing 1 and connects directly to an inlet chamber 24 which opens tangentially into the whirl chamber 12. The construction is such that air entering through the inlet 23 and chamber 24 enters the whirl chamber tangentially resulting in a circular rotary movement of the air which tends to throw the foreign material outwardly and permits it to drop downwardly and into the dirt pan 4.

Within the suction-creating fan chamber 13 is positioned a two-stage fan comprising a lower rotary fan 26 and an upper fan 27, both carried by the downwardly depending shaft 28 of a motor 29 which is carried by the wall 7 and is positioned partially within the motor hood 9 and

partially within the upper end of casing 1. The rotation of the motor shaft 28 causes the tandem fans 26 and 27 to draw cleaning air in through the inlet port 23 and to remove the cleaned air upwardly through the inlet 18 into the fan chamber from which it is exhausted through suitable ports 35 into a surrounding chamber which is indicated at 31 and which will be called the final filter chamber for a reason which will become apparent. Defining the side wall of the final filter chamber 31 and spaced inwardly from the enclosing main casing 1 is a cylindrical filter element 32 formed of suitable air-permeable dirt-impermeable material such as filter cloth. Filter 32 is supported at its lower end by a flanged collar 33 fixedly carried by the casing 9. At its upper end filter 32 is carried by a shouldered portion of a centrally apertured and flanged plate 34 which seats in sealing relationship upon the lower end of the casing of motor 29 and which is itself fixed in spaced relationship to the enclosing main casing 1 by means of spiders 36 which may be integrally formed. Collar 33 and upper plate 34 form end enclosures for the filter chamber 31 and air escaping therefrom must pass outwardly through the filter element 32 into that space between the filter and the main casing 1 which space is indicated by the reference character 37 and which will be referred to as the discharge chamber.

Discharge chamber 37 is closed at its upper end by the plate 7 and at its lower end by the bottom plate 2 of casing 1 and the only escape therefrom is afforded by the apertures 38 formed in the casing of motor 29 upon the opposite sides of the supporting wall 7 in the hood 6. Air entering the lower apertures 38 passes upwardly through the motor casing and escapes from the upper apertures and effects a cooling of the motor in doing so which is desirable. The motor hood 6 above the plate 7 is provided with an exhaust port 39 adapted to receive and seat a dusting tool unit when it is desired to use the cleaner as a blowing unit and serves at all times as the cleaner exhaust port. Incidentally, the driving motor 29 is provided with incoming power leads 41 which are connected to a suitable manually operable switch 42 to enable the operator to control the operation of the motor and so of the entire cleaner.

The machine which has hereinbefore been described comprises a completely operative cleaner, but one which has the inherent defect that no means have been provided to clean the filter 32. To accomplish this desirable result there is provided, in accordance with applicant's invention, an elongated nozzle 46 the length of which is equal to the height of the filter element 32 and which is adapted to make sliding contact therewith. Nozzle 46 has a filter-contacting opening or mouth which contacts only a limited area of the filter element 32 in any one position and accordingly means are provided to move the nozzle relative to the filter. This is accomplished by supporting nozzle 46 by a rotatable conduit seat 47 which encloses the vertical sleeve 49 housing the motor shaft 28. Conduit 47 is formed at its inner end with a downwardly facing circular seat which is rotatably mounted upon a supporting bearing 51 carried by the similarly shaped upwardly opening mouth of a stationary conduit 52. The latter conduit is mounted on the top plate 17 of casing 9 and extends across the top and down the side thereof to con-

nect to the inlet chamber 24 of the whirl chamber 12.

It is undesirable that the filter-cleaning nozzle 46 should rotate and move over the surface of the final filter 32 at a speed approaching the speed of rotation of the fan or motor shaft 28 and accordingly speed-reducing means are provided to enable the motor to drive the nozzle but at a reduced speed. These means, including a worm 56 carried by the motor shaft 28, are positioned within a housing 57 located immediately below the motor 29. Shaft-enclosing sleeve 49 is provided with a slot-like opening 58 adjacent worm 56 and extended through this opening and into engagement with the worm 56 is a gear 59 carried by a transverse horizontal jack shaft 61 which is itself rotatably mounted in bearings 63 carried by brackets 62 supported from the top wall of the housing 57. Shaft 61 itself carries a worm 64 at a point spaced from its gear 59 and this worm in turn meshes with a gear 66 carried by a second and vertical jack shaft 67. Shaft 67 is rotatably mounted in bearings 68 carried in the upper and lower walls of housing 57 and is continuously rotated. A gear 69 is fixedly connected to shaft 67 near its lower end and transmits the continuous driving force from shaft 67 to a large gear 71 which carries a bearing 72 rotatably seating upon the sleeve 49. Gear 69 is fixedly connected to the conduit-seat 47 of nozzle 46 by means of suitable rivets 73. A coil spring 74 surrounds the sleeve 49 and exerts a downward force upon the top of the bearing 72 and thereby forces the conduit seat 47 against its supporting bearing 51, a suitable shoulder 76 being provided upon the sleeve 49 to seat the spring.

The operation of this first preferred embodiment of the invention is as follows: The operator having attached suitable dusting tools including a flexible hose 5 and a nozzle 10 to the inlet 23 of the machine, closes the electrical switch 42 thereby causing electrical current to pass through the driving motor 29. The rotation of the motor shaft 28 immediately ensues and with it the rotation of the suction-creating fans 26 and 27 within the chamber 13. Air and dirt are drawn through the cleaning nozzle, the dusting tool hose, the inlet port 23 and into the whirl chamber 12, in which its circular motion causes the foreign material suspended therein to be thrown radially outward under the action of centrifugal force and it drops downwardly and around the peripheral edge of the plate 21 into the pan 4. The clean air is drawn upwardly through the inlet 18 by the action of the fans 26 and 27 and is exhausted from the second stage fan 27 into the final filter chamber 31. From the latter chamber it passes outwardly through the final filter 32 into the discharge chamber 37 leaving upon the filter 32 that very small percentage of foreign material which has escaped from the whirl chamber 12. The air continues on its way and passes upwardly and through the ports 38 of the casing of motor 29 and finally makes its exit at the top of the machine from the motor hood 6 via the exhaust port 39.

During this operation, the filter-cleaning nozzle 46 has been moving at slow speed in a circular path and along the interior dirtied surface of the filter 32 and has effected the reversal of the direction of the flow of air through the filter 32 in the contacted area. This reversed flow of air is drawn from the discharge chamber 37 into the nozzle 46 and passes through conduits 47 and 52 under the suction of the whirl chamber 12 into

which conduit 52 opens at the intake chamber 24. As previously described, the velocity of the filter-cleaning nozzle 46 is relatively slow as the result of the speed-reducing mechanism which is housed within housing 57 and which has been described in detail above.

The continuous cleaning of the final filter 32 prevents the back pressure in the chamber 31 from building up beyond a reasonable point which can be controlled by the speed of movement of the nozzle and by the volume of air flowing therethrough. The return of the escaped foreign material to the initial separator 12 makes possible substantially the entire removal of the returned material for, it has been found, this material in collecting upon the final filter 32 becomes agglomerated, thereby increasing in size and mass.

After the machine has been used for a considerable period of time the dirt container 4 will become filled with foreign material and should be emptied. This can be accomplished by removing the top casing 1 from the base 3 thereby enabling the pan 4 to be removed upwardly from the base 3 or, if desired, pan 4 may be slid transversely from the base, depending upon the type of construction which is used.

Referring now to Figure 5 in particular, the second preferred embodiment of the invention is illustrated and differs primarily from the first described embodiment in that a second and separate suction-creating fan unit is present which provides the suction for the filter-cleaning nozzle. In this second preferred embodiment of the invention the cylindrical main casing is referred to by the reference character 101, its flanged bottom plate by the character 102, and its supporting base by the character 103. A dirt pan 104 is positioned within the base 103 and sealed to the bottom plate 102 of the main casing. In this embodiment, however, the motor is not positioned at the top of the device and accordingly there is no motor hood at the top of the casing 101 which instead is closed by a top plate 106 which is centrally provided with a suitable removable cover plate 107.

An inner cylindrical casing is indicated by the reference character 108 and a separating wall 109 divides the casing 108 into a whirl chamber 111 and thereabove a fan chamber 112, there being a downwardly extending inlet 110 for the fan chamber which is identical to that present in the first embodiment. Fan chamber 112 is divided, as in the first embodiment, by the stationary deflector 113 into a first stage and a second stage which are connected by an inlet 114. The suction-creating fans in this embodiment are represented by the reference characters 116 and 117 in the first and second stages, respectively, both being carried by the depending motor shaft here indicated at 118. The top of the cylindrical casing 108 and of the fan chamber 112 is formed by a plate 119 which in this instance directly supports the cleaner motor 121, the enclosing casing of which is flanged, as at 122, for heat radiation purposes.

As in the first embodiment the upper or second stage of the fan discharges into a final filter chamber which is here indicated by the reference character 123. The bottom wall of chamber 123 is formed by a flanged collar 124 secured to the inner cylindrical casing 108 and the top wall by a flanged plate 126 which is secured at its apertured center to the cylindrical casing 127 which is carried by the top wall 106 of the casing 101. The side wall of the filter chamber comprises the

filter element 128 which is fixedly secured to the top and bottom walls 124 and 126 and is spaced concentrically within the enclosing cylindrical casing 101 which provides therearound the discharge chamber 129, as in the preceding embodiment. In this embodiment the main casing 101 is formed with both the inlet port 131, which extends therethrough into an inlet chamber 132 forming a part of the whirl chamber 111, and also with a discharge port 133, there being no motor hood as in the first embodiment.

The parts which have heretofore been described in connection with the second embodiment of the invention represent an operative cleaner with the exception of the filter-cleaning means for the final filter, and in this embodiment of the invention these means differ in material respects from those of the first embodiment. In this embodiment the shaft 118 of the motor extends both below and above the casing and at its extreme upper end carries, within the casing 127, a plurality of rotatable fans 136, 137 and 138 which are separated by stationary deflectors 139. Casing 127, which is in fact a fan chamber, is formed centrally in its bottom with an intake 140 to which connects the rotatable conduit seat 141 of a filter-cleaning nozzle 142, a suitable sealing bearing 144 being present therebetween. The outlet of fan chamber 127 connects to a discharge conduit 143 which extends directly to the inlet chamber 132 of the whirl chamber 111. The filter-cleaning nozzle 142 is again rotated by speed-reducing means driven by the cleaner motor 121. This speed-reducing means is positioned within the housing 151 immediately above the motor 121 and is identical with that described in connection with the first embodiment with the exception that it is inverted, that is, it is reversed end for end being above the motor rather than below.

The cleaner-actuating motor 121 is again provided with suitable incoming power leads 146 and a manually operable switch 147 which controls the flow of current to the motor and so renders it operative or inoperative at the operator's election. Additionally, and as in the first embodiment, a transverse plate, there indicated by 145, is provided at the lower end of the whirl chamber 111.

The operation of this second embodiment of the invention is as follows: Upon the operator closing the actuating switch 147, having previously attached dusting tools including hose and nozzle to the inlet port 131, air is drawn through the dusting tool and into the whirl chamber 111 by the action of the suction-creating fans 116 and 117. The incoming dirt-laden air enters the whirl chamber 111 tangentially and the foreign material is separated as in the first embodiment, the clean air entering the fan chamber 112 through the elongated inlet 110. The cleaned air is discharged from the final stage of the suction-creating fan unit into the final filter chamber 123 from which it is exhausted outwardly through the final filter 128 into the discharge chamber 129 making its way therefrom via the exhaust port 133 into the surrounding atmosphere.

As in the first embodiment, the filter-cleaning nozzle, here indicated as 142, is slowly moved in a circular orbit around and in contact with the interior of the final filter 128 removing foreign material therefrom. In this instance, however, the suction to the final filter is provided by the separate fan unit positioned above the motor and comprising the fans 136, 137 and 138 of the casing 127. Here, as in the first embodiment, however, the foreign material removed is conveyed via the conduit 143 into the whirl chamber at the inlet chamber 132. The advantage of the separate suction-creating means for the final filter-cleaning nozzle lies in the entire air-moving ability of the main fan unit being available for the drawing of air through the filter-curtain.

I claim:

1. In a suction cleaner of the type having an initial dirt separator, suction-creating means to draw air from said initial separator and including a fan and a motor directly connected thereto, and a final dirt separator to receive air from said suction-creating means; a dirt-removing unit to remove dirt from said final separator and to transport it to said initial separator and including a movable element, and power-transmitting and speed-reducing means connecting said movable element to said motor to actuate said element in the operation of said cleaner at a speed less than the speed of said fan.

2. In a suction cleaner of the type having an initial dirt separator, suction-creating means to draw air from said initial separator and including a fan and a motor directly connected thereto, and a final dirt separator to receive air from said suction-creating means and including a cylindrical filter element; a dirt removing unit to remove dirt from said final separator and to transport it to said initial separator and including a movable nozzle, and power-transmitting and speed-reducing means connecting said movable nozzle to said motor to actuate said nozzle at a speed less than the speed of said fan in a circular orbit in contact with said cylindrical filter element in the operation of said cleaner.

3. In a suction cleaner of the type having an initial separator, a suction-creating fan unit to draw air through said initial separator, a motor having a shaft connected to said fan unit, and a final filter interiorly connected to said unit to receive air exhausted therefrom and including a filter element surrounding said shaft; a filter-cleaning nozzle interiorly connected to a source of suction and mounted for movement about said shaft in contact with said filter element, and power-transmitting speed-reducing means connecting said nozzle to said shaft to move said nozzle during the operation of the cleaner.

4. In a suction cleaner of the type having an initial separator, a suction-creating fan unit to draw air through said initial separator, a motor having a shaft connected to said fan unit, said fan unit being positioned between said initial separator and said motor, and a final dirt separator enclosing said fan unit; dirt-collecting-and-removing means movable in said final separator to carry dirt to said initial separator, and power-transmitting speed-reducing means connecting said dirt-collecting-and-removing means to said motor shaft.

5. In a suction cleaner of the type including an initial separator, a suction-creating fan unit to draw air through said initial separator, a motor having a shaft connected to said fan unit, said fan unit being positioned between said initial separator and said motor, and a final dirt separator to receive air exhausted from said fan unit and including a filter element spaced radially with respect to said motor shaft; a cleaning nozzle movable relative to said filter element, air conducting means connecting said nozzle in all positions to the inlet of said initial separator,

and power-transmitting means connecting said nozzle to said motor shaft.

6. In a suction cleaner of the type having an initial separator, a suction-creating fan unit to draw air through said initial separator, a motor having a shaft connected to said fan unit, a final filter interiorly connected to said unit to receive air exhausted therefrom and including a filter element surrounding said shaft, an enclosing casing, an inlet port to said initial separator extended through said casing, and an outlet port to discharge air exhausted from said final separator; a rotary cleaning nozzle adapted to rotate about said motor shaft in contact with said filter element, an air-conducting nozzle seat enclosing said motor shaft and supporting said nozzle for rotation, power-transmitting speed-reducing means connecting said nozzle to said shaft to rotate said nozzle at reduced speed, and air-conducting means connecting said nozzle seat to said initial separator.

7. In a suction cleaner of the type having an initial dirt separator, suction-creating means to draw air from said initial separator and including a fan and a motor directly connected thereto, and a final dirt separator to receive air from said suction-creating means; a dirt-removing unit to remove dirt from said final separator, second suction-creating means driven by said motor connected to said dirt-removing unit to draw air therethrough, air-conducting means connecting the exhaust of said second suction-creating means to said initial separator, and power-transmitting means connecting said dirt-removing unit to said motor to actuate said unit at reduced speed in the operation of the cleaner.

8. In a suction cleaner of the type having an initial dirt separator, a final dirt separator, and a cleaning nozzle movable with respect to said final separator to collect foreign material therefrom; a pair of suction-creating fan units, one of said units being connected to draw air from said initial separator and to exhaust it in said final separator, the other of said units being connected to draw air through said nozzle and to exhaust it in said initial separator, and a driving motor connected to said suction-creating units.

9. In a suction cleaner of the type having an initial dirt separator, a final dirt separator, and a cleaning nozzle movable with respect to said final separator to collect foreign material therefrom; a pair of suction-creating fan units, one of said units being connected to draw air from said initial separator and to exhaust it in said final separator, the other of said units being connected to draw air through said nozzle and to exhaust it in said initial separator, a driving motor, and means connecting said motor to said fan units and to said nozzle to actuate same in the operation of the cleaner.

10. In a suction cleaner, an initial dirt separator, air-conducting means to conduct a dirt-laden air stream to said initial dirt separator suction-creating means to draw air from said initial separator and including a fan and a motor directly connected thereto, and a final dirt separator to receive air from said suction-creating means; a movable nozzle to remove dirt from said final separator, air-conducting means connecting said nozzle to said initial separator to make available the suction thereof to said nozzle and to transport dirt from said nozzle, and power-transmitting means connecting said nozzle to said motor.

11. In a suction cleaner of the type having an initial dirt separator, suction-creating means to draw air from said initial separator and including a motor, and a stationary final dirt separator including a filtering surface to receive air from said suction-creating means; first air-conducting means to conduct a dirt-laden air stream to said initial dirt separator, second air-conducting means to convey an air stream from said final dirt separator to said initial dirt separator, and nozzle means driven by said motor to dislodge foreign material from the surface of said final dirt separator for conveyance through said second air-conducting means to said initial dirt separator during the operation of the cleaner.

LOUIS K. ACHESON.