

Sept. 3, 1946.

D. G. SMELLIE

2,406,915

SUCTION CLEANER

Filed April 26, 1943

3 Sheets-Sheet 1

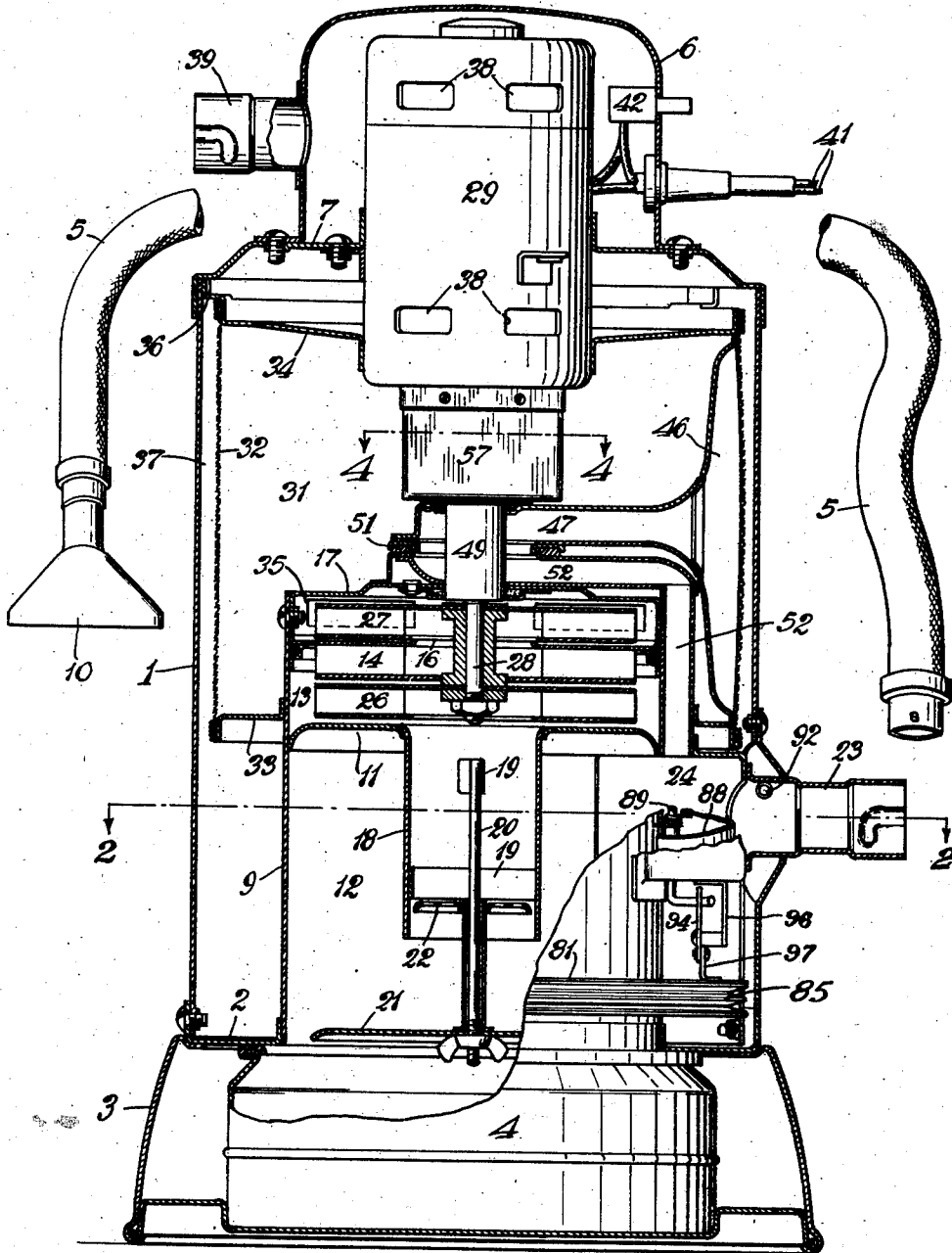


Fig. 1

INVENTOR.
Donald G. Smellie
BY
Harry S. Duncanson
ATTORNEY

Sept. 3, 1946.

D. G. SMELLIE

2,406,915

SUCTION CLEANER

Filed April 26, 1943

3 Sheets-Sheet 2

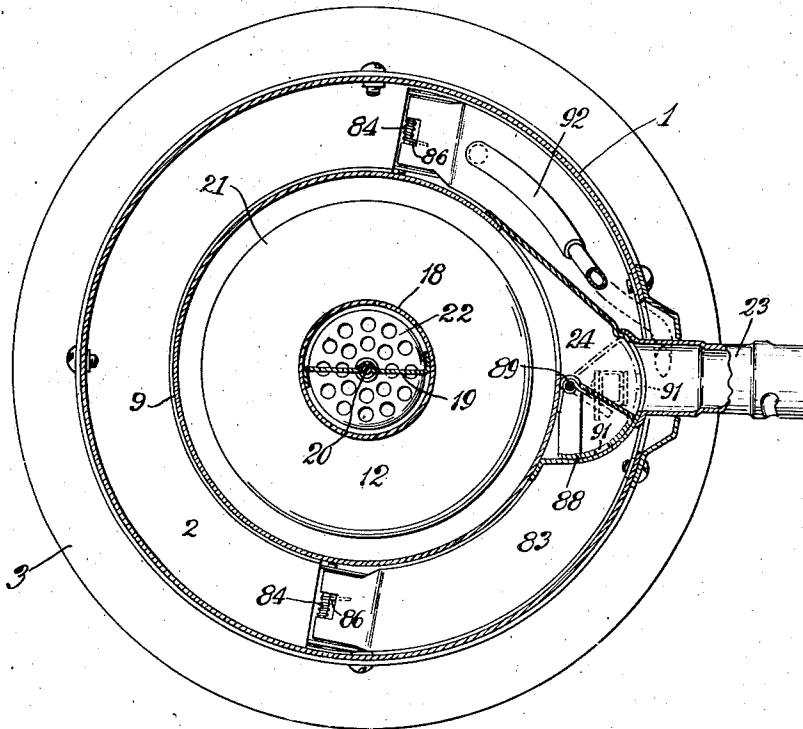


Fig. 2

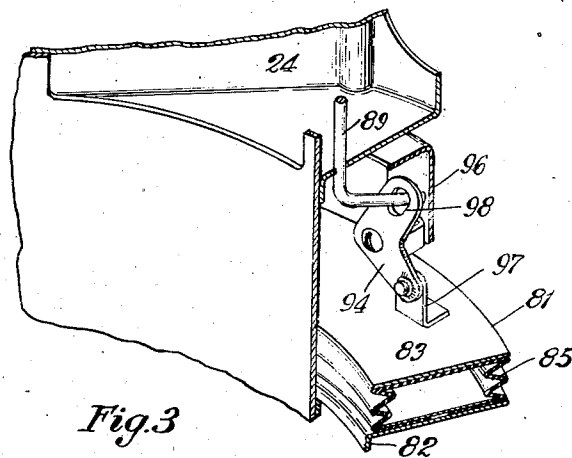


Fig. 3

INVENTOR.

Donald G. Smellie

BY

Harry S. Dumas

ATTORNEY

Sept. 3, 1946.

D. G. SMELLIE

2,406,915

SUCTION CLEANER

Filed April 26, 1943

3 Sheets-Sheet 3

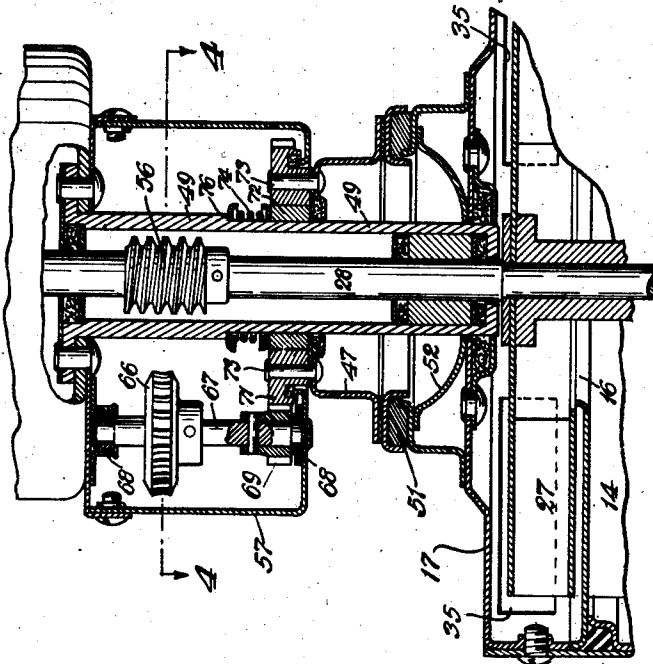


Fig. 6

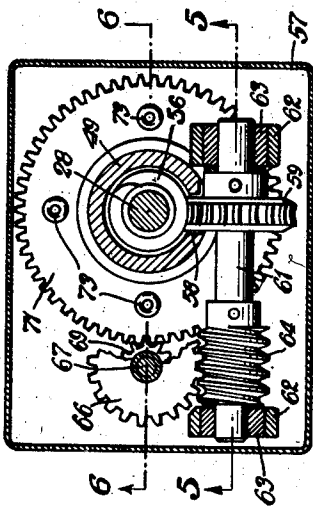


Fig. 4

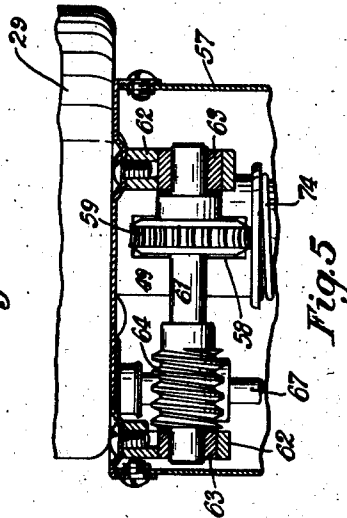


Fig. 5

INVENTOR.

Donald G. Smellie

BY

Harry S. Dumas
ATTORNEY

UNITED STATES PATENT OFFICE

2,406,915

SUCTION CLEANER

Donald G. Smellie, Canton, Ohio, assignor to The Hoover Company, North Canton, Ohio, a corporation of Ohio

Application April 26, 1943, Serial No. 484,515

7 Claims. (Cl. 15-16)

1

The present invention relates to suction cleaners in general and more particularly to 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 to clean the final dirt-separator comprising a continuously operated cleaning nozzle which is supplied with a maximum flow of cleaning air each time the seal of the main cleaning nozzle is broken.

The instant application discloses certain features in common with the co-filed and co-pending applications, Serial Nos. 484,510 and 484,514, filed in the names of Louis K. Acheson and the present inventor, respectively, and both assigned to the assignee of the present application. The present invention is viewed in the nature of an improvement upon the inventions disclosed in those applications and common subject matter is to be protected therein. In Serial No. 484,510 the general arrangement of the cleaner and the filter-cleaning nozzle mounting, connection and driving means will be claimed. In Serial No. 484,514 the continuously driven filter-cleaning nozzle will be claimed as will the broad aspects of the pressure-controlled valve structure, the present application being directed to the improved air-flow controlling features of the valve and the mechanism which cooperates therewith.

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 a continuously actuated cleaning nozzle which is provided with a maximum flow of cleaning air to convey the foreign material to the initial separator whenever the seal of the main nozzle of the cleaner is broken. A still further object of the invention is to provide a suction cleaner of the multiple dirt separator type which incorporates means to prevent inrushes of undesirable non-working cleaning air under certain conditions. 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:

2

Referring now to the drawings in which a preferred embodiment of the invention is 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 upon the line 2-2 of Figure 1 through the suction cleaner and shows the air-flow-controlling valve;

Figure 3 is a vertical section through the bellows valve-actuating mechanism illustrated in Figure 2;

Figure 4 is a transverse horizontal section through the speed-reducing mechanism connecting the filter-cleaning nozzle to the main motor shaft, being a section taken upon the lines 4-4 of Figures 1 and 6;

Figure 5 is a section upon the line 5-5 of Figure 4;

Figure 6 is an enlarged partial vertical section through the suction-creating fan unit and speed-reducing mechanism, being taken upon the line 6-6 of Figure 4.

The present invention comprises an improvement relating to the basic invention disclosed in the patent to Bible 2,247,472 in which a suction cleaner is disclosed which comprises an initial dirt separator, suction-creating means to draw air from a cleaning nozzle into the initial separator and to remove it therefrom, and a final dirt-separator which receives air from the suction-creating means for the purpose of removing any escaped foreign material from the air stream which has escaped from the initial separator. Mr. Bible teaches the use of a filter-cleaning nozzle which is adapted to remove foreign material from the final filter and to return it directly to the initial filter where it is, upon the second passage there-through, removed completely. In the Bible patent construction in order to operate the filter-cleaning nozzle it is necessary to disconnect the main cleaning nozzle and to attach the dusting tool hose to the connection leading to the filter-cleaning nozzle. The operation is manual and is accomplished at the election of the operator.

In the suction cleaner construction in accordance with the present invention, means are provided which clean the final filter at all times and which increase the effectiveness of that cleaning to a maximum each time the seal of the main cleaning nozzle with the surface undergoing cleaning is broken. Pressure-actuated means are provided which serve to operate an air-flow-controlling valve in a manner such that each time the main nozzle seal is broken, and the pressure at the suction cleaner inlet increases beyond a

3

predetermined point, the air moving power of the cleaner suction is directed from the main cleaning nozzle and is transferred to the continuously actuated filter-cleaning nozzle. A speed-reducing mechanism connects the filter-cleaning nozzle with the main driving shaft of the cleaner motor so that the speed of movement of the filter-cleaning nozzle over the final dirt separator or filter is relatively slow. This invention has the desirable result not only of keeping the final filter clean but also of preventing the inrush of a large volume of air into the cleaner and through the final filter each time the main cleaner nozzle is lifted from the surface covering. Such rushes of air accomplish no useful function and have the undesirable characteristic of driving foreign material into the interstices of the final filter thereby increasing the back pressure of that element and making the cleaning thereof more difficult.

Referring again to the drawings the invention is seen to comprise a cylindrical main casing 1 which 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 pan-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

4

partially within the motor hood 6 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 35 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 connect to the inlet chamber 24 of the whirl chamber 12.

It is undesirable that the filter-cleaning nozzle

zle 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 23 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 23, 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 62 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 71 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.

According to the present invention means are provided to prevent the inrush of air into the cleaner which occurs when the seal of the main nozzle 10 with the surface undergoing cleaning is broken. When this seal is broken an inrush of air occurs which surges through the initial filter, the suction-creating means and into the final filter. It serves no useful function but instead accomplishes the objectionable result of imbedding more firmly into the filter 32 the foreign material particles which are lodged thereon. In this invention means are provided which not only prevent the inrush of non-cleaning air which performs no useful function but which also turn the effective action of the cleaner suction-creating means to the useful work of drawing an increased volume of cleaning air through the filter-cleaning nozzle 46. This construction will now be described.

Referring now to Figures 1, 2 and 3 in particular there is seen to be provided a bellows element 81 comprising a rigid lower wall 82, which is rigidly secured to the peripheral surface of the inner cylindrical casing 9, and a second rigid element 83 which is pivoted at its ends upon pivot pins 84 carried by the lower rigid bottom plate 82. A flexible air-tight accordion-pleated bellows member 85 is seen to connect plates 82 and 83, the bellows being of suitable material which is impervious to air and which will permit relative movement between the plates 82 and 83 upon a change in pressure of the range which is possible within the suction cleaner. At the pivot pins 84 of the plate 83 are provided coil springs 86 which at all times exert a pivoting force tending to move the plate 83 upwardly from the fixed stationary plate 82, that is, to expand the bellows.

Within the inlet valve chamber 24 between the inlet 23 and the whirl chamber 12 is a valve 88 fixed to a vertical rotatable shaft 89 for swinging movement upon a vertical axis. Valve 88 is mov-

able between two positions, that shown in full and dotted lines in Figure 2. In the full line position of the valve 88 as illustrated in Figure 1 both the conduit 52 and the inlet 23 are fully opened to the whirl chamber 12 and the suction present therein, created by the suction-creating fan unit, is effective to draw air through both the filter-cleaning nozzle 46 and through the main cleaning nozzle 10. The main volume of air will, of course, be drawn through the main nozzle 10. In the dotted line position of the valve in Figure 2, the closed-port position, the forward curved wall thereof has swung into closing relationship to the inlet port 23 and the flow of air therethrough is cut off with the exception of a small leakage flow which is permitted through the leakage port 91 in the valve. This leakage is necessary in order that, when the nozzle 10 is again sealed with a working surface, there will be sufficient suction within the inlet 23 and attached hose 5 and nozzle 10 to effect a reduction in pressure.

Connecting the bellows 81 and the inlet 23 in order that the pressure in the latter can be effective within the former, is an air conduit 92 clearly shown in Figures 1 and 2. The presence of this conduit insures that the pressure which exists within the inlet by virtue of its connection to the whirl chamber 12 and as controlled by the valve 88 will at all times be felt within the bellows 81. An increase in pressure in inlet 23 results in an increased pressure within the bellows and that element expands, the pressure being aided and assisted by the action of the coil springs 86 at the pivot axes 84. The presence of a reduced pressure in the inlet 23 places a reduced pressure within the bellows and causes that member to contract against the action of the springs.

To transmit the movement of the upper plate 83 of the bellows under the variations in inlet pressure there is provided a toggle 94 which is pivotally mounted at its center to a bracket 95 supported from the underside of the inlet chamber 24. Toggle 94 is suitably connected, as by a pin and slot connection, to a bracket 97 upon the top plate 83 of bellows 81 and at its upper end is formed with a slot 98 through which extends the lower right-angled end of the valve-carrying shaft 89. The relationship is such that the upward and downward movement of the top plate 83 of bellows 81 causes the toggle 94 to pivot upon a horizontal axis and effects the rotation of the valve-carrying shaft 89 about a vertical axis, the lower right-angled end of the shaft 89 sliding within the toggle slot 98.

The operation of the invention is as follows: The machine having been placed in operation by virtue of the operator closing the manually operable switch 42 the rotation of the cleaner motor 29 effects the rotation of the shaft 23. The suction-creating fans 25 and 27 carried by the shaft 23 cause a reduced pressure within the whirl chamber 12 and air is drawn into the main cleaning nozzle 10, through the dusting tool hose 5, through the inlet 23, valve chamber 24 and into the whirl chamber. With the nozzle 10 passing over a surface covering to be cleaned foreign material removed by the air stream is brought into the whirl chamber where practically all of the foreign material is separated from the air and drops into the dirt pan 4 positioned below the transverse plate 21. The cleaned air enters the fan unit 13 via the centrally located inlet 18 and is exhausted into the final filter

7
 chamber 31 from which it escapes through the final filter 32 into the discharge chamber 37. From the latter chamber the air, now entirely clean, escapes into the motor hood 6 via the ports 38 in the motor 29. From the interior of the motor hood the air passes to the ambient atmosphere through the exhaust port 39. Incidentally, should the operator desire to use the machine as a blower, the dusting tool hose 5 would be attached to this port 39 rather than to the inlet 23.

At the same time that the main flow of cleaning air is being drawn through the nozzle 10 and dusting tool hose 5 into the inlet 23, a relatively limited flow of air is also taking place through the conduit 52, conduit 47 and the filter-cleaning nozzle 46. This nozzle moves in contact with the cylindrical filter 32 under the actuation of the power-transmitting and speed-reducing mechanism within the housing 57 and the air therethrough, which of course passes through the filter 32 in the reverse direction to the main air stream, functions to remove the foreign material which has escaped from the initial dirt separator 12 and which has passed into the final separator 31 to be collected on the filter 32. While the flow of air through the nozzle 46 during the cleaning operation of the cleaner is smaller than the flow of air through the main nozzle, yet it is effective to perform cleaning upon the filter 32 and it being possible to apportion the flow of air between the two nozzles by the design of the air passageways leading thereto and by the size of the mouths or slots at the nozzle ends.

So long as the operator continues to perform the cleaning function with the main nozzle 10 in sealing contact with the surface undergoing cleaning, the action will be as described and both nozzles will perform their cleaning functions. Should the operator, however, lift the main nozzle 10 from the surface thereby breaking the seal of the nozzle mouth with the surface undergoing cleaning and permitting the inrush of a large volume of air which is performing no useful cleaning function, there will immediately result an increase in the pressure which is present within the inlet 23, and this increase in pressure will be immediately effective within the bellows 81 which will expand. The expansion of the bellows with the upward movement of the rigid plate 83 at the top thereof causes, through the toggle mechanism 84, the valve 88 to move to its position in which it closes the inlet port 23. The entire flow of air through the inlet port 23 is not stopped, however, the leakage port 91 in the valve 88 permitting a sufficient flow of air such that should the nozzle 10 again seal with a surface covering, the pressure within the inlet 23 will again be reduced, the pressure within the bellows 81 will be reduced, and that bellows will collapse and thereupon return the valve 88 to its original position in which the main flow is through the main nozzle as described above.

With the valve 88 in the port-closing position, however, substantially the entire air-moving power of the suction-creating fan unit is effective to draw air through the conduit 52 leading to the filter-cleaning nozzle 46 and so long as this condition continues a greatly increased volume of air and a greatly increased suction is present within the nozzle and the cleaning effectiveness of the nozzle 46 is greatly increased. The closure of the valve 88 with respect to the inlet port 23 to avoid an increased and non-working flow of air therethrough, results not only

in increased cleaning effectiveness for the filter-cleaning nozzle 46 but additionally accomplishes a second and important function. Were the increased volume of air permitted to enter the whirl chamber 12 and to pass through the suction-creating unit into the final filter chamber 31 and escape therefrom through the filter 32, the result would be that the force of this air moving through the filter would drive the collected foreign material more firmly into the filter, resulting in increased back pressure of that element and a greater difficulty in the cleaning. The operation of the valve, therefore, has accomplished two useful functions, and a device is provided in which useful filter-cleaning action is provided at all times which action increases to maximum effectiveness when the main cleaning nozzle is performing no useful work.

I claim:

1. In a suction cleaner, an initial separator having an inlet port, a suction-creating fan unit to draw air through said initial dirt separator, a motor to drive said fan unit, a final dirt separator to receive air exhausted from said fan unit, a dirt-removing element in said final dirt separator, air-conducting means connecting said element to said initial separator to draw air through said element at all times during normal surface cleaning operation, a valve to close said inlet port, and pressure-operated means to close said port upon a predetermined increase in the pressure at said port.

2. In a suction cleaner, a manually movable nozzle adapted to contact a surface undergoing cleaning, an initial separator having an inlet connected to said nozzle, a suction-creating fan unit to draw air through said initial dirt separator, a motor to drive said fan unit, a final dirt separator to receive air exhausted from said fan unit, a dirt-removing element in said final dirt separator, means to provide a continuous flow of air from said element to said initial separator during cleaner surface-cleaning operation and with air flowing from said nozzle to said initial separator, and means to increase the flow of air from said element and to decrease the flow of air from said nozzle to said initial separator.

3. In a suction cleaner, an initial separator having an inlet, a suction-creating fan unit to draw air through said initial dirt separator, a motor to drive said fan unit, a final dirt separator to receive air exhausted from said fan unit, a dirt-removing element in said final dirt separator, an air conduit connecting said element directly to said initial separator to convey air thereto at all times during normal surface cleaner operation, a valve to close partially said inlet to said initial separator to reduce materially the flow of air therethrough and thereby increase the flow of air through said air conduit, and pressure-operated means connected to said inlet to close said valve upon a predetermined increase in the pressure in said inlet.

4. In a suction cleaner, an initial separator having an inlet, a suction-creating fan unit to draw air through said initial dirt separator, a motor to drive said fan unit, a final dirt separator including a filter to receive air exhausted from said fan unit, a movable cleaning nozzle for said final filter, air-conducting means connecting said nozzle to said initial separator to draw air through said nozzle at all times during the normal surface cleaning operation, power-transmitting means connecting said nozzle to said motor to actuate the latter at all times during cleaner

9

operation, a valve to reduce the flow of air through said inlet and to increase the flow of air through said movable cleaning nozzle, and pressure-operated means to move said valve to reduce the flow of air through said inlet upon a predetermined increase in the flow of air through said inlet.

5. In a suction cleaner, a main cleaning nozzle through which cleaning air enters at a rate variable with the contact of the nozzle with a surface being cleaned, an initial dirt separator connected to said nozzle, a final dirt separator, a second cleaning nozzle for said final separator, air-conducting means to conduct air from said second nozzle continuously during normal surface cleaning operation, suction-creating means to move air through said nozzles, air-conducting means and said separators, valve means to control the flow of air through said nozzles, pressure-operated means to determine the flow of air through said main nozzle, and means connecting said pressure-operated means to said valve means to move the latter to reduce the flow of air through the main nozzle and to increase the flow of air through the second nozzle upon the flow of air through said main nozzle exceeding a predetermined rate.

6. In a suction cleaner, a surface-cleaning nozzle of the type through which the flow of cleaning air varies with the contact thereof with the surface being cleaned, an initial dirt separator connected to said nozzle, suction-creating means connected to said initial separator to draw air therethrough, a final dirt separator connected to said suction-creating means to receive air ex-

10

hausted therefrom, a separator-cleaning nozzle for said final dirt separator, air-conducting means at all times connecting said separator-cleaning nozzle to said initial dirt separator, valve means controlling the flow of air from said nozzles into said initial separator and arranged to vary the air flow through said surface-cleaning nozzle from a maximum to a minimum at which air actually flows and at the same time to vary the air flow through said separator-cleaning nozzle to a maximum, and pressure-responsive means exposed to a point of air flow in said cleaner to actuate said valve means to reduce the flow of air through said surface-cleaning nozzle to said minimum upon the flow of air therethrough exceeding said maximum by a predetermined amount.

7. In a suction cleaner, an inlet adapted to receive a dusting tool unit, an initial separator connected to said inlet, a suction-creating unit to draw air through said inlet and said initial dirt separator, a motor to drive said suction-creating unit, a final dirt separator to receive air exhausted from said suction-creating means, a dirt-removing element in said final dirt separator, means to provide a continuous flow of air from said element to said initial separator during the cleaning operation of the cleaner and while air enters said inlet from a dusting tool unit, and means to vary inversely the flow of air through said inlet from a dusting tool unit and through said means to provide a continuous flow of air from said dirt-removing element to said initial separator.

DONALD G. SMELLIE.