

Oct. 5, 1948.

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2,450,845

SUCTION CLEANER

Filed March 23, 1944

4 Sheets-Sheet 1

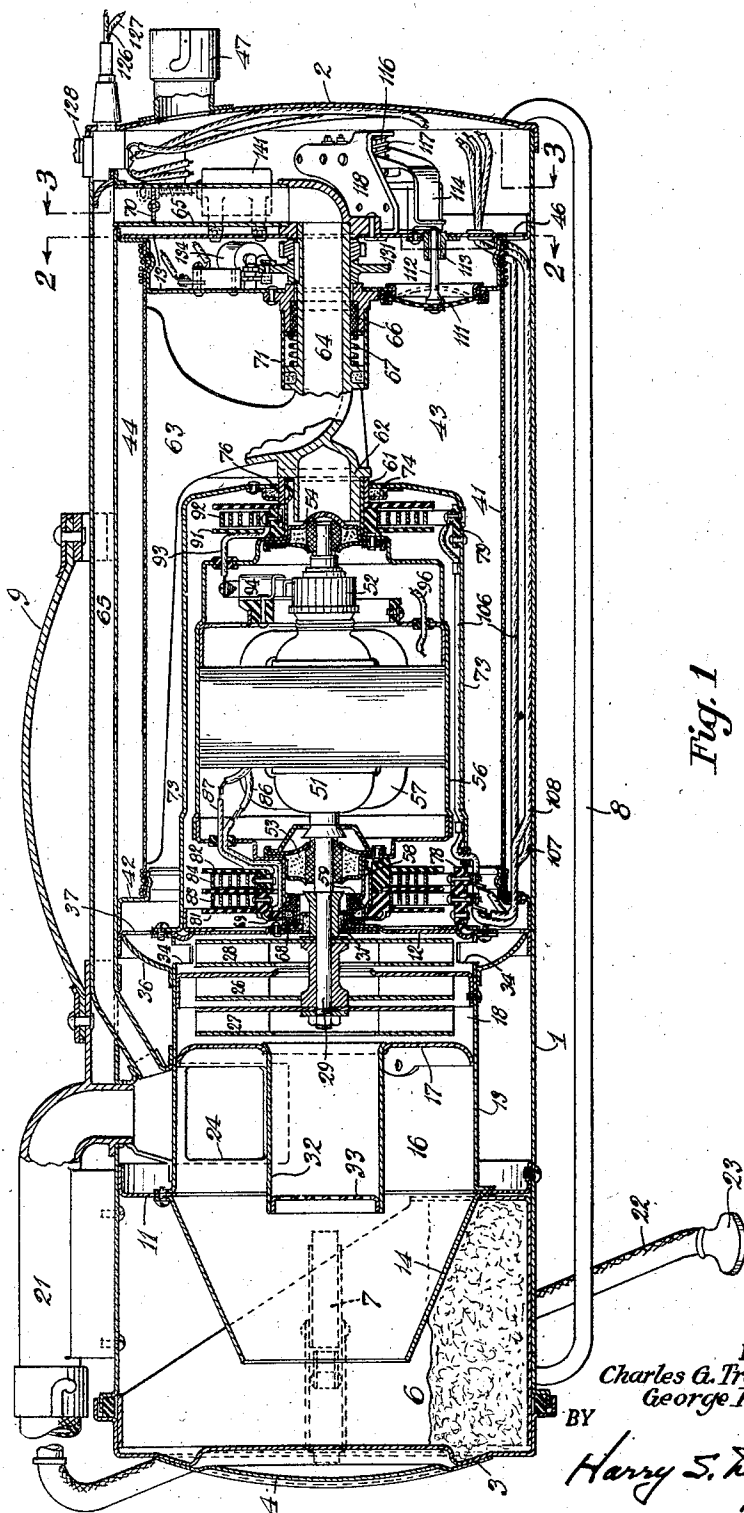


Fig. 1

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4 Sheets-Sheet 2

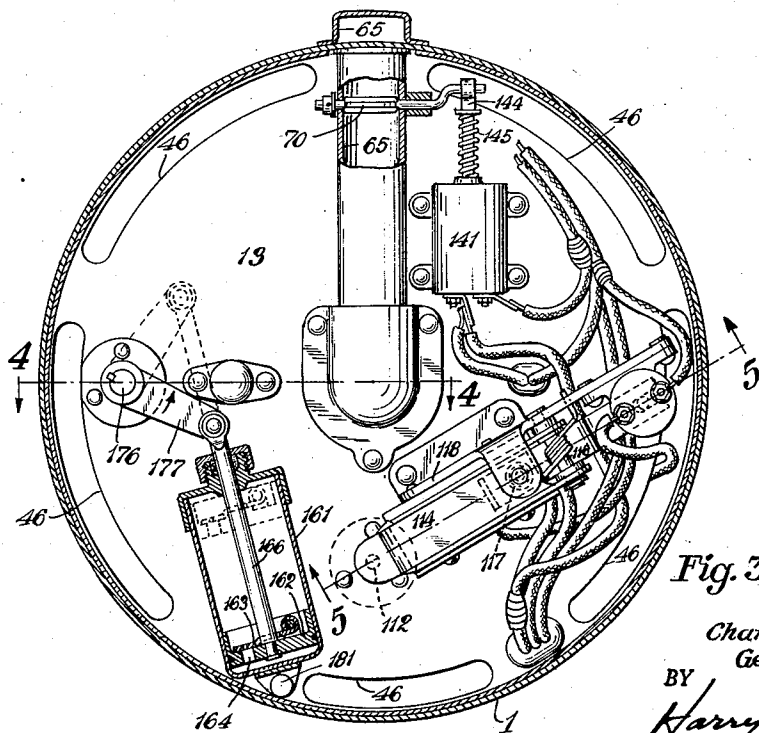
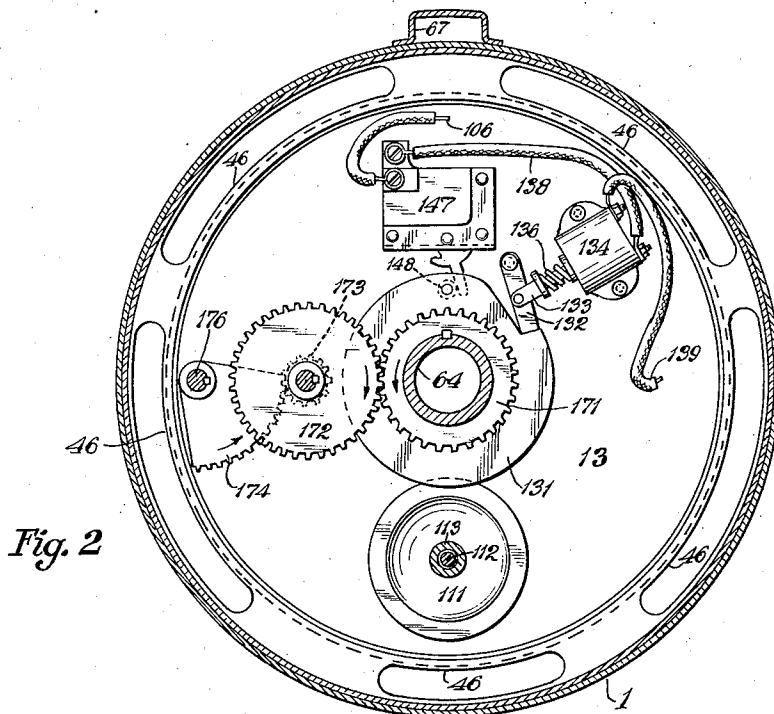


Fig. 3

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Fig. 4

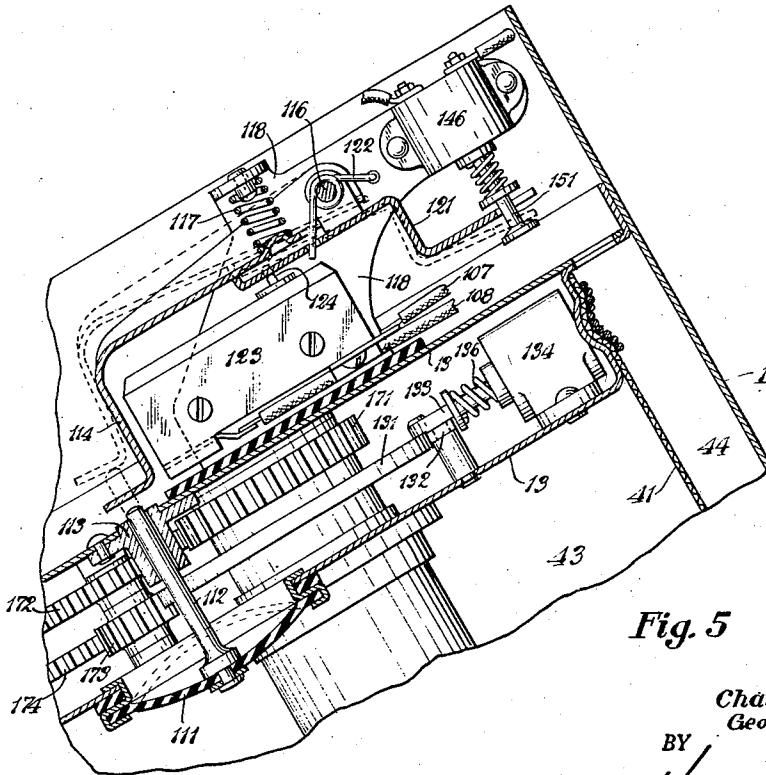
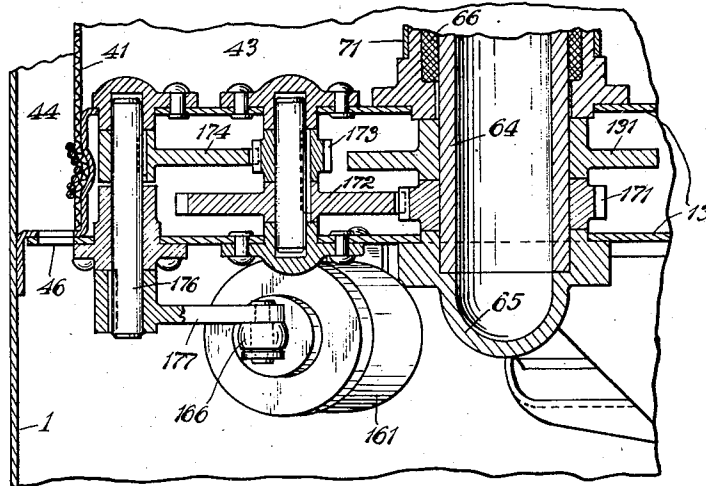


Fig. 5

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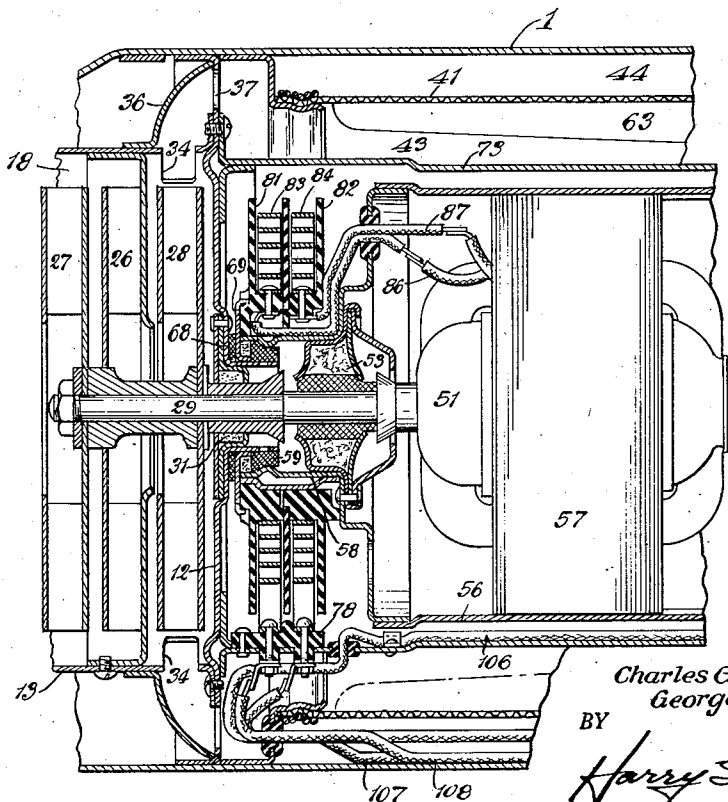
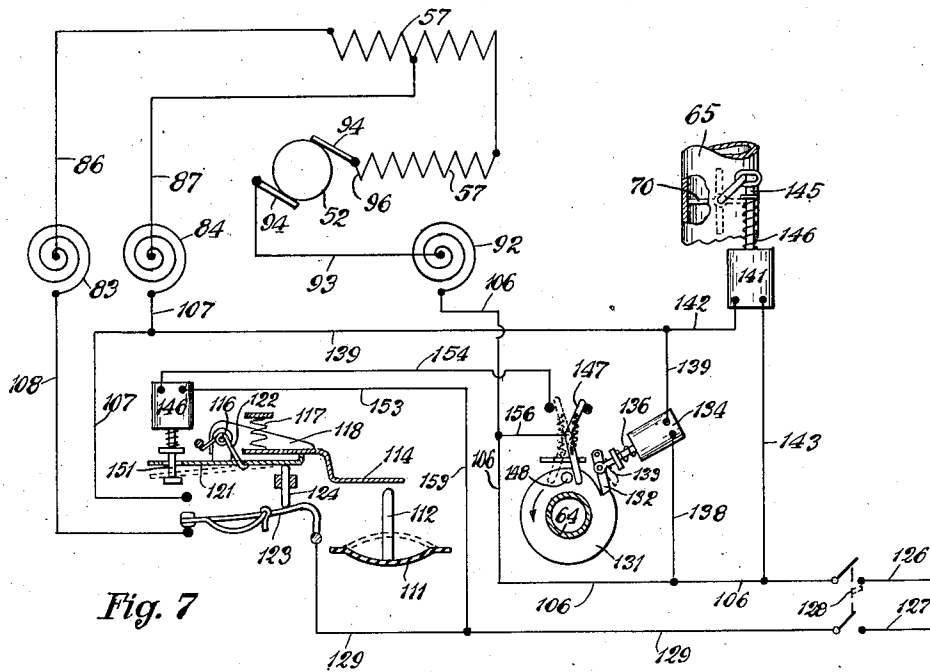
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4 Sheets-Sheet 4



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SUCTION CLEANER

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Application March 23, 1944, Serial No. 527,690

8 Claims. (Cl. 183—57)

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The present invention relates to suction cleaners in general and more particularly to new and novel improvements in suction cleaners of the type incorporating automatically cleaned dirt separators. More particularly the invention comprises improved actuating means for the filter-cleaning nozzle in the suction cleaner of the type comprising an initial dirt separator, suction-creating means, a final dirt separator including a filter, the collected foreign material being returned from the nozzle 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 initial and final dirt separators and automatic means to clean the latter and to return the collected material to the initial dirt separator. A still further object of the invention is to provide a new and novel drive for the filter-cleaning nozzle in a suction cleaner. Still another object of the invention is to provide a suction cleaner in which the filter-cleaning nozzle is actuated by the limited rotation of the stator of the driving motor of the suction-creating means. 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 a preferred embodiment of the invention is disclosed:

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

Figure 2 is a vertical transverse section upon the line 2—2 of Figure 1;

Figure 3 is a vertical transverse section upon the line 3—3 of Figure 1;

Figure 4 is a partial section upon the line 4—4 of Figure 3 and shows the escapement and its drive which function to limit the speed of travel of the filter-cleaning nozzle;

Figure 5 is a partial section upon the line 5—5 of Figure 3 and discloses the pressure-responsive means and related parts which control the operation of the filter-cleaning nozzle;

Figure 6 is an enlargement of that part of Figure 1 showing the motor mounting and current-carrying spring conductors at the forward end of the motor;

Figure 7 is a diagrammatic showing of the electrical circuit of the cleaner.

The present invention relates to suction clean-

ers of the type including a dirt separator provided with automatically actuated means which removes collected dirt. When the actuating means of the suction-creating means are also used to drive the filter-cleaning means it is necessary to provide for tremendous speed reduction. The driving motor for such a machine ordinarily rotates at 10,000 R. P. M., or higher, while the filter-cleaning means, which comprises a filter-cleaning nozzle in a preferred form, is preferably driven at a speed in the neighborhood of 10 R. P. M., or less. It is difficult to use speed-reducing gears for such a reduction. In the present invention the filter-cleaning nozzle is connected to, and is driven by, the stator or field of the motor which in usual cleaner operation is fixed, the suction-creating fan being driven by the rotatable armature. The speed of stator rotation, during the operation of the filter-cleaning nozzle, is governed by suitable means and the nozzle moves through approximately one revolution in one direction after which it returns to its initial position. Thereafter the operation is repeated until the filter is cleaned sufficiently to reduce the back pressure or resistance to the flow of the air through the separator to a predetermined point.

In the drawings a preferred embodiment of the invention is illustrated. A canister type cleaner is shown comprising an elongated casing 1 which may be cylindrical. One end of casing 1 is closed by a fixed cap 2. The opposite end thereof is closed by a removable cap 3 formed with a recessed handle 4 and fixedly carrying a dirt receptacle or container 6 which extends into the casing 1 conforming to the contour of the interior thereof. Cap 3 and container 6 are removably held in place by means of manually releasable latching means 7. The entire machine is slidably supported upon suitable runners secured to casing 1, one of which is indicated at 8, and as is common in this type of machine a strap-like handle 9 is provided on the top side thereof so that the operator may carry the machine.

Within casing 1 are three spaced transverse closure walls or bulkheads which are indicated by the reference characters 11, 12, and 13, the latter being a double wall with spaced sides. Wall 11 is centrally apertured and carries, together with the wall 12 spaced therefrom, a cylindrical member 13 in spaced relationship to the casing 1 and which opens through the wall 11 into a truncated conical member 14. Cylinder 13 and cone 14 form a whirl chamber 16 which opens forwardly into the dirt container

6. A centrally apertured wall 17 in cylindrical member 13 separates the whirl chamber from a two stage fan chamber 18 formed in the rearward portion thereof.

An inlet conduit port 21 is adapted to receive and seat the cleaner end of a flexible dusting tool hose 22 having a suitable dirt collecting nozzle 23 at its outer end, conduit 21 enters the whirl chamber 16 at a tangentially extending inlet chamber 24 and through this port the dirt-laden air stream makes its appearance within the machine proper. The air within whirl chamber 16 is relieved of nearly all the suspended material which it carries by centrifugal action therein. The foreign material advances through the truncated portion 14 of the chamber and into the dirt receptacle 6.

Within the fan chamber 18, which is divided into a first and second stage by a centrally located multi-vaned deflector 26, are positioned the rotating fans 27 and 28 which are rotatably carried by the extended end of a motor shaft 29 which passes through a suitable air seal 31 in the adjacent transverse wall 12. The rotation of the fans 27 and 28 is effective to draw substantially clean air from the whirl chamber 16, via an inlet port 32 which is provided with a strainer 33 at its entrance, and to exhaust that air through circumferentially positioned ports 34 in the second stage of the fan chamber 18 into a circular enclosing passageway formed by a cowl 36. Cowl 36 is sealed to the inner cylindrical casing 18 and to the periphery of wall 12 and guides the air from the fan chamber through ports 37 in wall 12 to the space between the wall 12 and the transverse wall 13.

Between the longitudinally spaced transverse walls 12 and 13 extends a cylindrical filter element 41, being seated upon a shouldered ring 42 adjacent the wall 12 and upon a longitudinally extending shoulder of the wall 13 itself at the other end. Filter 41 serves to divide the space within the main casing 1 between the walls 12 and 13 into an inner filter chamber 43 and an outer exhaust chamber 44. The latter is connected through suitable ports 46 in the wall 13 to the space between the end cap 2 and that wall so that the air exhausted through the filter may escape from the cleaner via the exhaust port 47. The latter is similar to the inlet port, being adapted to seat the dusting tool unit when it is desired to clean by blowing rather than by suction.

The driving unit for the suction-creating fans 27 and 28 comprises a motor the armature 51, including the commutator 52, of which rotates with the shaft 29, being supported thereby in bearings 53 and 54 positioned in the end walls of the motor frame-casing 56 which carries the field or stator 57 of the motor. The stator 57 and the frame-casing 56 are not fixedly and non-rotatably mounted, as in the usual motor, but instead are rotatable. The end of the frame-casing 56 nearest the fan chamber 18 is formed with an axially extending hub portion 58 which is rotatably mounted upon a bearing 59 carried by the wall 12 concentrically of and spaced from the motor shaft 29. The rearward end of the frame-casing 56, or that spaced farthest from the fan chamber 18, is similarly provided with a hub portion, indicated at 61, which is rigidly connected to a hub 62 formed on a filter-cleaning nozzle 63.

The filter-cleaning nozzle 63 is provided for the purpose of removing from the interior surface of the cylindrical final filter 41 the foreign

material which collects thereon after having escaped from the initial dirt separator comprising whirl chamber 16. As the nozzle 63 has a relatively narrow surface-contacting mouth and as it is necessary to clean the entire filter the nozzle is mounted for rotation with the motor stator.

Nozzle 63 includes an axially extending conduit portion 64 which passes through the double wall 13 being rotatably mounted in a suitable bearing 66. Conduit 64 connects directly to a stationary air passageway 65 which connects directly to the inlet chamber 24 of the whirl chamber 16 and so makes available to the nozzle 63 the whirl chamber suction. Passageway 65 is normally closed by a butterfly valve 70. A coil spring 67 exerts a pressure between the adjacent bearing 66 and an abutment shoulder upon the conduit 64 and forces the unitary structure, comprising the filter-cleaning nozzle 63 and the motor frame-casing 56, toward the wall 12. A thrust bearing 68 is provided adjacent that wall which is contacted by a plate 69 rotatable with the hub 58 of the frame-casing. A sleeve 71 encloses the spring 67 to protect it from foreign material.

As both the motor armature 51 and the stator 57 are movable relative to the cleaner body, and as both are positioned within the final dirt separator filter chamber 43, it is necessary to provide suitable means to convey electrical current thereto and therebetween, and also to protect these parts from the foreign material within the filter chamber. To accomplish this there is provided an enclosing housing 73 fixedly carried by the transverse wall 12 and extending into the final filter chamber in enclosing and spaced relationship to the frame-casing 56. The driving motor is sealed within the housing by an air seal 74 which makes sliding and sealing contact with a ring 76 carried by the hub 61. As the driving motor is a two speed unit three conductors convey current thereto and as all motor parts are rotatable relative to the casing 1 it is necessary that these connections permit of this relative movement. The electrical circuit is illustrated diagrammatically in Figure 7. At its opposite ends the non-rotatable enclosing housing 73 is provided with insulator blocks 78 and 79. Opposite block 78 the motor stator, and more specifically the hub portion 58 of the frame-casing 56, carries two spools, indicated at 81 and 82, which are also formed of insulating material and which have a common dividing wall. Spool 81 seats a coil spring 83 which is centrally secured thereto, its outer end being fixedly secured to the insulator block 78. Spool 82 seats a similar spring 84 similarly connected. Conductors 86 and 87 connect the inner terminals of the coil springs or leads 83 and 84, respectively, to the two speed field winding of the stator 57.

Opposite the insulator block 79, and mounted for rotation with the hub 61 at the end of the motor spaced from the springs 83 and 84, is a third spool 91 which seats a coil spring 92. Coil spring or lead 92 is connected between the spool and the block 79, in the manner of springs 83 and 84. A lead 93 connects spool-carried terminus of spring 92 to a brush 94 in contact with the commutator 52 of the armature. A lead 96 connects a second brush 94 to the field winding.

Electrical current is conducted to the stationary insulator blocks 78 and 79 by incoming power leads 106, 107, and 108 which extend rearwardly through the exhaust chamber 44 to the

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rear wall 13 and into the space between the end cap 2 and that wall.

The conductor coil springs or leads 83, 84, and 92 are more than mere resilient electrical connectors between the stationary part of the cleaner and the movable stator of the driving motor. They provide in addition a resistance to the rotation of the stator under the driving torque of the cleaner armature 51 during normal cleaner operation. The combined strength of springs 83, 84, and 92 is such that with the motor armature rotating at low speed the combined spring strength is sufficient to overcome the reactive torque and to move the stator in a direction to unwind the springs. With the motor armature rotating at high speed, however, the torque is sufficient to overcome the springs and the stator rotates to wind the springs. As the motor stator is rigidly connected to the filter-cleaning nozzle 63 this stator movement is accompanied by the movement of the nozzle. The speed of movement and the degree of rotation of the nozzle must be controlled and the means which exercises this control will now be discussed.

During normal cleaner operation the driving motor operates at low speed. During this operation with dirt-laden air passing into the machine the foreign material which escapes from the initial dirt separator 16 is collected upon the interior surface of the filter 41 of the final dirt separator 43. When sufficient material has collected upon the surface of filter 41 as to raise unduly the resistance to the flow of air therethrough it becomes necessary to clean the filter in order that the cleaner can continue to function efficiently. In order that this filter-cleaning operation may be accomplished automatically the inner face of the rear double wall 13 is provided with an air-responsive bellows 111 which carries a plunger 112 slidably mounted in a loose bearing 113 in the rear face of wall 13. The inner face of bellows 111 is exposed to the pressure within the final filter chamber 43 and the outer face thereof is exposed to the pressure within the double wall 13 which is the same as the pressure between that wall and the end cap 2. The outer end of the slidable plunger 112 abuts the overturned end of a lever 114 pivoted at 116 and which is urged thereagainst by a coil spring 117. Spring 117 exerts a force which retains the bellows in its inner, or full line position as illustrated in Figures 1 and 5, except in the presence of an undesirably high pressure within the final filter chamber 43. The coil spring 117 abuts, and the pivot pin 116 is carried by, a bracket 118 secured to the double wall 13 and positioned between that wall and the end cap 2. A second pivoted lever 121 is centrally pivoted upon the pivot pin 116 and an encircling coil spring 122 about that pin exerts a force between the bracket 118 and the lever to hold the latter against the underside of the first lever 114. This relationship is clearly illustrated in Figures 3, 5, and 7.

The primary purpose of pivoted levers 114 and 121 is to control a micro-switch 123 the plunger element 124 of which extends into contacting relationship with the adjacent lever 121, as is clearly illustrated in Figures 5 and 7. Switch 123 selectively connects an incoming current lead 129 to the lead 107 or the lead 108 leading to the coil conductor springs 83 and 84 which in turn connect through the leads 86 and 87, respectively, to the end and midpoint of the winding of the motor field 57. With the plunger 112 in its low pressure position, in which it is normally held by the

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action of spring 117, which is stronger than the opposing spring 122, when bellows 111 is not forced outwardly by the pressure within the filter chamber 43, switch 123 is positioned as shown in Figure 7. The current then passes through the entire field winding to provide a slow motor speed. When, however, the pressure within the filter chamber 43 is sufficiently great as to force the diaphragm 111 from the full line to the dotted line position, as shown in Figures 1 and 5, then also the plunger 112 forces lever 114 from the full to the dotted line position of Figure 5. Lever 121 moves with lever 114, under the action of spring 122, and the switch 123 under its own bias assumes its alternative position and connects the lead 129 to the lead 107. Current then passes through the spring coil conductor 84 and the lead 87 to the midpoint of the field 57 and higher motor speed results.

At this point reference is made to Figure 7 in particular which shows the electrical circuit including the incoming current-conducting leads 126 and 127. These leads connect to the manually controlled switch 128 to which also connect the lead 129, before mentioned, and the lead 106. Lead 129 connects to the micro-switch 123 while lead 106 connects to the coil conductor spring 92 and so to the motor through the lead 93 and brush 94. The circuit connections mentioned provide for manual control of the motor's operation through the switch 128 and control of the motor's speed by the micro-switch 123.

From the foregoing it is clear that an increase in pressure within the final filter chamber 43 resulting from a collection of foreign material upon the filter 41 results in an increase in speed of the driving motor which produces increased fan speed and increased suction. It is additionally desirable, however, to clean the filter which requires the rotation of the filter-cleaning nozzle 63 and the drawing of cleaning air therethrough. More particularly this cleaning air is drawn from the exhaust chamber 44, through the filter 41 and into the nozzle 63 to pass through the passageway 65 to the whirl chamber 16, as previously indicated. The increased motor speed results in a torque on the stator which is greater than the force of springs 83, 84, and 92, and the stator tends to rotate. However, it is necessary first to unlock it, it having previously been locked by the co-action of a cam 131 and a locking pin 132. Cam 131 is fixedly mounted upon the axially extending conduit portion of the rotatable filter nozzle 63 and is positioned between the spaced sides of the double wall 13. The locking pin or latch 132 is positioned adjacent thereto and is pivotally mounted upon the forward face of wall 13. The movable element 133 of an electrical solenoid 134 is pivotally connected to the pin 132 and, by virtue of the presence of a coil spring 136, normally urges the pin into locking engagement with the cam 131 thereby preventing rotation of the nozzle in a counterclockwise direction as viewed in Figure 2. The armature 51 of the motor normally rotates in a clockwise direction, as viewed in this figure, so that the reactive torque upon the stator, which is directly transmitted to the filter-cleaning nozzle, would tend to move that element in a counterclockwise direction. The solenoid 134 is connected by conductors 138 and 139 to the incoming power conductor 106 and to the lead 107 which is energized only during high speed rotor operation. The energization of the solenoid 134 retracts plunger 133, the locking pin 132 is moved to inoperative position, as il-

illustrated in dotted lines in Figure 7, thereby permitting the filter-cleaning nozzle, and of course the motor stator to rotate.

In order for the rotation of the nozzle 63 to accomplish any cleaning result air must flow through it and it is necessary that the butterfly valve 70, normally closing the air conduit 65, be moved to open position. The position of valve 70 is controlled by a second solenoid 141, the incoming power leads 142 and 143 of which are connected in parallel with the leads 138 and 139 of the first-mentioned solenoid 134, so that the solenoids are simultaneously energized when the motor rotates at high speed. The movable plunger 144 of solenoid 141 connects pivotally to valve 70 and a coil spring 145 normally holds the plunger and valve in the valve-closed position except when the solenoid is energized. It is seen then, that upon the movement of the micro-switch to the high motor speed position the filter-cleaning nozzle is released for rotation under the reaction torque and is also immediately provided with suction by the movement of the butterfly valve 70 to its open position.

To limit the rotation of the nozzle 63 to approximately or slightly more than one complete revolution means are provided which return the driving motor to its normal or slow speed of rotation upon the nozzle having moved through that arc. These means comprise a third solenoid 146 connected to the bellows-controlled second lever 121, and an electrical switch 147 which controls the flow of current through the solenoid and which is itself controlled by a pin 148 upon the cam 131. The plunger 124 of the micro-switch 123, as was previously described, contacts the second pivoted lever 121 which is normally held at its underlying end against the first pivoted lever 114. When lever 114 is held by the diaphragm plunger 112, under the actuation of excessive pressure in the final filter chamber 43, so as to compress its operating spring 117 lever 121 follows the lever 114 and permits the micro-switch 123 to assume the high-speed motor position (current through lead 137). Lever 121 is movable independently of lever 114, however, though normally moving therewith by virtue of the action of its spring 122. Electrical solenoid 146 is provided with a plunger element 151 which normally, with the solenoid unenergized, exerts no influence to position the lever 121. With the solenoid energized, however, plunger 151 moves toward the solenoid body and draws the end of the lever 121 in the same direction thereby pivoting simultaneously the opposite end of the lever in contact with the control element 124 of the micro-switch 123. Under this action of the solenoid 146 the lever 121 is returned to the position it held before the filter cleaning operation began. In so moving it returned the micro-switch 123 to its slow motor speed position (current through lead 138).

Immediately upon the repositioning of the micro-switch 123 to the low motor speed position, that illustrated in Figure 7, the combined strength of the coiled spring conductors 83, 84, and 92 overcomes the torque acting upon the motor stator 57 and the filter-cleaning nozzle, under the force of these springs, returns in a clockwise direction to its original position in which it will again be locked by the action of the lever 132 with the cam 131, the holding solenoid 134 of the lever having become de-energized upon the opening of the high speed motor circuit as is clearly evidenced in Figure 7.

To insure that the solenoid 146 controlling the

second lever 121 will be actuated when the filter-cleaning nozzle has made substantially one complete revolution, and also to provide for its de-energization when the filter-cleaning nozzle has returned to its original position, the solenoid is connected electrically by conductors 153 and 154 to the incoming conductor 129 and to the switch 147, respectively, the other side of the switch 147 being connected by the lead 156 to the second incoming lead 106. Switch 147 is of the overcenter snap action type with its moving element or lever positioned in the path of the pin 148 carried by the rotatable cam 131 which rotates with the filter-cleaning nozzle 63. In both directions of rotation of the cam 131 the pin 148 contacts the switch lever near the end of the nozzle rotation and moves the lever to its opposite position. As shown in Figure 7 the cleaner is performing its normal cleaning operation with the motor rotating at low speed. Should the filter-cleaning operation begin the latch 132 would move to its dotted line inoperative position upon the energization of solenoid 134 and the cam 131 would rotate counterclockwise, under the actuation of the high speed motor torque. The cam rotation moves the pin 148 into contact with the opposite side of the snap lever from that shown in full line 5 in Figure 7 and causes that element to pivot from the full line to the dotted line position. This immediately energizes the solenoid 146 and its plunger 151 causes the second lever 121 to return the micro-switch 123 to its original position, that shown in full lines in Figure 7, and slow speed motor operation ensues. Thereupon the filter-cleaning nozzle under the action of the coil springs 83, 84, and 92 as described, returns to its original position. The cam 131, fixed to the nozzle, rotates in a clockwise direction and the pin 148 again contacts the switch lever and returns it to the full line position of Figure 7. The springs having unwound themselves and the latch 132 would assume its locking position under the urging of the solenoid spring 136, it being assumed that the cleaning operation has sufficiently reduced the pressure within the final dirt separator 43 as to permit the diaphragm 111 to return to its original position.

In addition to the foregoing it is desirable that the filter-cleaning nozzle travel at a relatively slow speed during the cleaning operation, and that it be returned to its original position at a much greater speed as it performs no cleaning in the return travel. To provide this result, an escapement 161 is mounted between the double wall 13. Escapement 161 includes a body containing a gas or a liquid and within which is positioned a traveling piston 162 having an apertured valve 163 pivoted adjacent an escape port 164. A rod 166 connects to the piston and the relationship is such that with fluid or gas in the casing the piston is free to move with relatively great speed in one direction, the flow of the gas or fluid through the port 164 opening the valve 163. This would be the downward direction as viewed in Figure 3. The piston moves with a reduced speed in the opposite direction for the valve closes the port 164 and it is necessary for the fluid to pass through the smaller aperture of the valve 163.

The escapement is directly connected to the rotating hollow conduit 64 of the filter-cleaning nozzle 63 by means of a chain of gears 171, 172, and 173, the latter meshing with a toothed quadrant 174 carried by shaft 176, the opposite end of which is provided with a lever 177 which

pivotaly engages the piston rod 166. The gear ratio is such that the lever 177 moves through about eighty degrees upon one complete rotation of the filter-cleaning nozzle. The escapement 161 is pivotaly mounted upon the adjacent wall 13, as indicated at 181, in order to accommodate necessary angular movement.

The operation of the invention constructed as above described is as follows: In normal cleaning operation the electrical circuit of the machine is as illustrated in Figure 7 in full lines, and the driving motor rotates at low speed. Cleaning air is drawn into the machine through the main nozzle 23 and passes through the dusting tool 22 into the inlet port 21, through the inlet chamber 24 and into the whirl chamber 16 under the action of the suction-creating fans 27 and 28. Centrifugal force acting on the whirling air in the whirl chamber 16 causes suspended foreign material to become separated from the carrying air stream and to move from the front end of the whirl chamber into the dirt receptacle 6. The air, less practically all of the foreign material, enters the fan chamber 18 by way of the inlet 32. After passing through the two stages of the fan chamber 18 the air is exhausted through the exhaust port 34 and enters the final dirt separator 43. Under the pressure of the suction-creating fans the air is forced through the final filter 41 into the discharge chamber 44, all foreign material collecting upon the surface of the filter. The air escapes from the discharge chamber 44 through the ports 46 and makes its way from the machine at the exhaust port 47.

In this normal cleaning operation of the cleaner the motor stator or frame-casing 56, together with the filter-cleaning nozzle 63 attached rigidly thereto, are fixed relative to the casing 1 and have no movement. The cleaning operation may continue as described until such time as the foreign material collected in the final filter chamber 43 upon the final filter 41 has increased the resistance to the passage of air through that element to an extent such that it becomes desirable to remove it in order to increase the flow of air through the machine and improve its operating efficiency. This undesirable situation is evidenced by an increase in the back pressure within chamber 43 which increase in pressure has the effect of moving the bellows diaphragm 111 from the full line to the dotted line positions illustrated in Figures 1, 5, and 7. This movement of the bellows immediately effects the pivotal movement of the levers 114 and 121 and the micro-switch 123 is moved by the latter from the low speed motor position, illustrated in full lines in Figures 7 to the high speed motor position in which current flows through the lead 107. This movement of the micro-switch, and this increase in the speed of motor operation, produces several effects immediately. Immediately the solenoid 141 is energized and the butterfly valve 70 opens, thereby connecting the filter-cleaning nozzle with the suction within the whirl chamber and air is drawn through the filter 41, through the filter-cleaning nozzle, and into the whirl chamber. Because the dirt has become agglomerated by collecting upon the final filter 41 it is this time removed from the air in the whirl chamber. Additionally the solenoid 134 is energized and the cam-locking latch 132 moves from the full line position in Figure 7 to the dotted line. The locking cam 131 is thereupon released for rotation and, under the torque ex-

erted upon the stator in the high speed rotation of the armature the nozzle rotates in a counter-clockwise direction as indicated by the arrow in Figure 7. The spring conductors 83, 84, and 92 are wound by this movement. At the beginning of the filter-cleaning operation the switch 147 is related and the switch-actuating pin 148 is positioned as illustrated in full lines in Figure 7.

The speed of travel of the filter-cleaning nozzle 63 is controlled, as described, by the escapement 161. At the beginning of the nozzle travel the piston 162 is positioned as illustrated in full lines in Figure 3 and its travel toward the upper or dotted line position is synchronous with the rotation of the nozzle 63. Because of the relationship of the small aperture in valve 163 to the port 164 in the piston 162 the latter travels at relatively slow speed and, the escapement being geared directly to the nozzle as previously described, the nozzle also is held to a slow speed.

The travel of the filter-cleaning nozzle 63 in its cleaning operation continues in a counter-clockwise direction, as viewed in Figures 2 and 7, for substantially one complete revolution at which time the cam-carried pin 148 upon the cam 131 has contacted the operating lever of the switch 147 upon the opposite side from that shown in Figures 2 and 7 and, with a snap action, has moved the contact to the dotted line position shown in Figure 7. Solenoid 146 is immediately energized by this closing of the switch 147 and thereupon its plunger 151 pivots the second pivoted lever 121 into contact with the actuating plunger 124 of micro-switch 123 whereupon the latter moves from the high speed position, in which current passes through lead 107 to the reduced field winding, to the low motor speed position, that illustrated in full lines in Figure 7 and in which current passes through the lead 108.

Upon the motor speed being reduced the reactive force acting upon the stator 57 is reduced and is less than the combined torque exerted by the coil spring conductors 83, 84, and 92. Thereupon these springs reverse the direction of travel of the stator and the nozzle and cause them to travel in a clockwise direction as viewed in Figures 2 and 7. This clockwise travel of the filter-cleaning nozzle will continue until the cam-carried pin 148 has again actuated the switch 147 to open it, that is, move it to the full line position of Figure 7, whereupon the solenoid 146 is de-energized releasing the pivoted lever 121 which then moves from the plunger 124 of the micro-switch 123. The latter under its own normal bias moves again to the high speed position in which current passes through the lead 107 to the divided field winding. Thereupon the torque acting upon the stator is again sufficiently great to overcome the combined forces of the springs as described and a cleaning travel of the filter-cleaning nozzle again results in the exact manner aforescribed.

In the return travel of the filter-cleaning nozzle the speed of travel is greatly increased for the escapement 161 does not exercise the retarding action, the pivoted controlling valve 163 moving to open position and permitting of a much greater and more rapid flow of the fluid through the piston port 164. Also, in the return travel of the nozzle 63 no air flows therethrough, the solenoid 141 being de-energized upon the movement of the micro-switch 123 to its high speed position and the butterfly valve 70 automatically closing under the actuation of its spring 146.

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This sequence of cleaning travel and return travel of the filter-cleaning nozzle will continue indefinitely until the pressure within the final filter chamber 43 is reduced to a desirable point. This is so because so long as the pressure remains above this desirable point the bellows 111 remains expanded as shown in dotted lines in Figures 1 and 7 and the lever 114 is held in a position to position the second lever 121 to permit the micro-switch 123 to move to the high speed position. The movement of the second lever 121 by the solenoid 146 to effect the return of the nozzle to its starting position effects, it is to be noted, no change in the bellows-controlled lever 114 which controls the position of second lever 121 when the solenoid 146 is not energized. Upon sufficient cleaning of the filter having taken place to reduce the resistance to the flow of air through the filter 41 to a desirable point the pressure within the final filter chamber 43 permits the diaphragm 111 to return to the full line position of Figures 1 and 7. Immediately this occurs the levers 114 and 121 are moved by the spring 117 to their full line positions of Figure 7 and the plunger 124 returns the micro-switch 123 to the low motor speed position, illustrated in full lines in Figure 7. Thereupon, as previously described, the coil conductor springs 83, 84, and 85 return the nozzle to its initial position.

Each time the motor returns to its low speed operation current is cut off from the solenoids 134 and 141 and immediately the latch lever 132, actuated by the former solenoid, returns to its locking position while the butterfly valve controlled by the latter solenoid returns to its closing relationship. The immediate return of the latch lever 132 to locking position does not interfere with the travel of the filter-cleaning nozzle under the impetus of the coil springs until a final locking position has been reached as is clearly evident in Figures 2 and 7, the direction of travel under the springs being in a clockwise direction.

Once the pressure-actuated diaphragm 111 re-assumes its original position the machine immediately re-assumes its original cleaning relationship and the relationship of the parts is as illustrated diagrammatically in Figure 7, the filter-cleaning nozzle no longer being actuated and the flow of air therethrough being cut off by the valve 70.

We claim:

1. In a suction cleaner of the type having an initial dirt separator, a suction-creating fan unit to draw air into and through said initial separator, and a final dirt separator to receive air exhausted from said fan unit, a motor to drive said fan unit including a rotor and a stator; said rotor being connected to said fan unit in driving relationship, means mounting said stator for rotation, a coiled conductor spring connecting said stator to a source of current, a cleaning element movable with respect to said final separator and connected to said stator and driven in one direction thereby, and means to limit the rotation of said stator when actuating said cleaning element.

2. In a suction cleaner of the type having an initial dirt separator, a suction-creating fan unit to draw air into and through said initial separator, and a final dirt separator to receive air exhausted from said fan unit; a motor to drive said fan unit including a rotor and a stator, said rotor being connected to said fan unit in driving relationship, means mounting said stator for rotation, a coiled conductor spring connecting said stator to a source of current, locking means nor-

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mally preventing rotation of said stator, a cleaning element for said final separator connected to said stator and movable therewith relative to said final separator, pressure-operated means controlled by the pressure in said final separator to release said locking means, and means to control the speed of travel of said cleaning element under the actuation of said stator.

3. In a suction cleaner of the type having an initial dirt separator, a suction-creating fan unit to draw air into and through said initial separator, and a final dirt separator to receive air exhausted from said fan unit and including an air permeable filter element; a two speed motor to drive said fan unit including a rotor and a stator; said rotor being connected to said fan unit in driving relationship, means mounting said stator for rotation, locking means normally retaining said stator against rotation, coiled spring conductors connecting said stator to a source of current and positioned as to be wound by the rotation of said stator in a direction opposite to the direction of rotor rotation, said springs exerting a torque on said stator which is greater than the torque exerted thereby in the slow speed rotation of said rotor but which is less than the torque exerted thereby in the high speed rotation of said rotor, a filter-cleaning nozzle connected to said stator and movable thereby relative to said filter to remove foreign material therefrom, and means including means controlled by the pressure in said final dirt separator to control the speed of rotation of said rotor and to release said locking means.

4. In a suction cleaner of the type having an initial dirt separator, a suction-creating fan unit to draw air into and through said initial separator, and a final dirt separator to receive air exhausted from said fan unit and including an air permeable filter element; a two speed motor to drive said fan unit including a rotor and a stator, said rotor being connected to said fan unit in driving relationship, means mounting said stator for rotation, locking means normally retaining said stator against rotation, coiled spring conductors connecting said stator to a source of current and positioned as to be wound by the rotation of said stator in a direction opposite to the direction of rotor rotation, said springs exerting a torque on said stator which is greater than the torque exerted thereby in the slow speed rotation of said rotor but which is less than the torque exerted thereby in the high speed rotation of said rotor, a filter-cleaning nozzle connected to said stator and movable thereby relative to said filter to remove foreign material therefrom, first means to increase the speed of said rotor, second means to release said locking means to permit said stator and nozzle to rotate, third means to connect said nozzle to said initial dirt separator, and pressure-operated means controlled by the pressure in said final dirt separator to actuate said first, second and third means in the presence of a predetermined pressure in said final dirt separator.

5. In a suction cleaner of the type having an initial dirt separator, a suction-creating fan unit to draw air into and through said initial separator, and a final dirt separator to receive air exhausted from said fan unit and including an air permeable filter element; a two speed motor to drive said fan unit including a rotor and a stator, said rotor being connected to said fan unit in driving relationship, means mounting said stator for rotation, locking means normally re-

taining said stator against rotation, coiled spring conductors connecting said stator to a source of current and positioned as to be wound by the rotation of said stator in a direction opposite to the direction of rotor rotation, said springs exerting a torque on said stator which is greater than the torque exerted thereby in the slow speed rotation of said rotor but which is less than the torque exerted thereby in the high speed rotation of said rotor, a filter-cleaning nozzle connected to said stator and movable thereby relative to said filter to remove foreign material therefrom, first means to increase the speed of said rotor, second means to release said locking means to permit said stator and nozzle to rotate, third means to connect said nozzle to said initial dirt separator, fourth means to reduce the speed of said rotor upon said stator traveling through a predetermined arc of rotation whereby said coiled spring conductors are enabled to rotate said stator in the opposite direction toward its original starting position, and pressure-operated means controlled by the pressure in said final dirt separator to actuate said first, second and third means in the presence of a predetermined pressure in said final dirt separator.

6. In a suction cleaner of the type having an initial dirt separator, a suction-creating fan unit to draw air into and through said initial separator, and a final dirt separator including a filter connected to receive air exhausted from said fan unit; a driving motor including a rotatably mounted rotor and stator, said rotor being connected to said fan unit, coiled conductor springs connecting said stator to a source of electrical current, permitting limited rotation of and arranged to exert a turning torque upon said stator to return it to its starting position, a filter-cleaning nozzle mounted for movement over said filter and connected to said stator for movement thereby, locking means to restrain said stator, and pressure-responsive means responsive to pressure in said final dirt separator to effect the release of said locking means to permit said stator to rotate.

7. In a suction cleaner of the type having an initial dirt separator, a suction-creating fan unit to draw air into and through said initial separator, and a final dirt separator including a filter connected to receive air exhausted from said fan unit; a driving motor including a rotatably mounted rotor and stator, said rotor being connected to said fan unit, a coiled conductor spring connecting said stator to a source of electrical

current, permitting limited rotation of and arranged to exert a turning torque upon said stator to return it to its starting position, a filter-cleaning nozzle mounted for movement over said filter and connected to said stator for movement thereby, valve means controlling the flow of cleaning air through said filter-cleaning nozzle, locking means to restrain the rotation of said stator, means to move said valve means and said locking means to open positions, and pressure-responsive means responsive to pressure in said final dirt separator to actuate said last-mentioned means upon the existence of a predetermined pressure in said final dirt separator.

8. In a suction cleaner of the type having an initial dirt separator, a suction-creating fan unit to draw air into and through said initial separator, and a final dirt separator including a filter connected to receive air exhausted from said fan unit; a driving motor for said fan unit, a filter-cleaning nozzle connected to said driving motor for limited travel in one direction over said filter, air-conducting means connecting said nozzle to said initial dirt separator, locking means normally retaining said nozzle in fixed position, means including pressure-responsive means controlled by the pressure of said final dirt separator to release said locking means, spring means to return said nozzle to its starting position, and speed-controlling means restricting the speed of travel of said nozzle under the actuation of said motor and allowing a higher speed of return travel under the actuation of said spring means.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
361,711	Nagel et al. -----	Apr. 26, 1887
540,720	Clark -----	June 11, 1895
2,026,834	Holly -----	Jan. 7, 1936
2,149,135	Eriksson-Jons -----	Feb. 28, 1939
2,247,472	Bible -----	July 1, 1941
2,276,805	Tolman -----	Mar. 17, 1942
2,369,649	Abrams -----	Feb. 20, 1945

FOREIGN PATENTS

Number	Country	Date
114,262	Australia -----	Nov. 19, 1940
353,837	Great Britain -----	Jan. 21, 1930