April 2, 1963 E. P. SENNE ET AL 3,083,396

VACUUM CLEANER CONTROLS

Filed Jan. 3, 1961 4 Sheets-Sheet 1

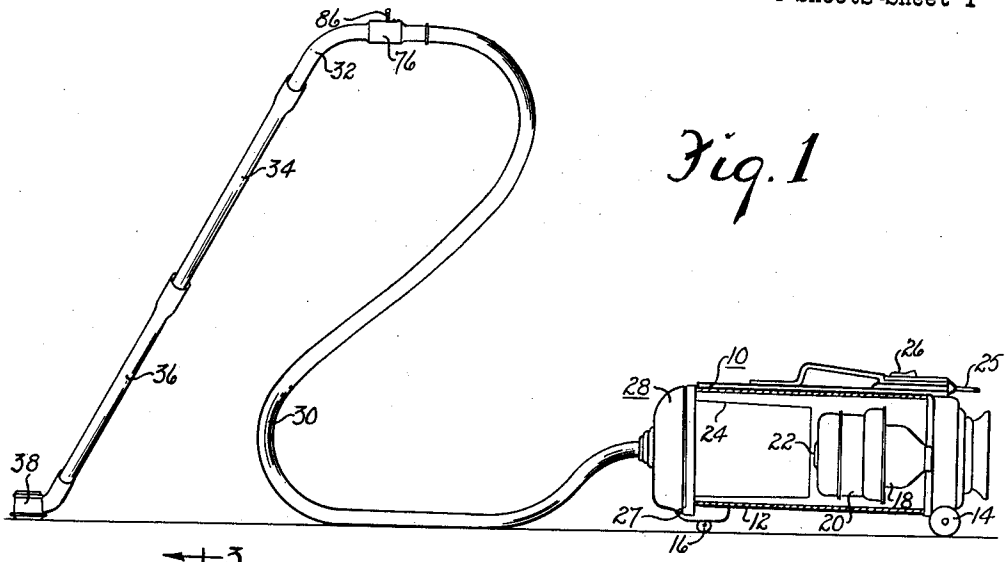

Fig. 1

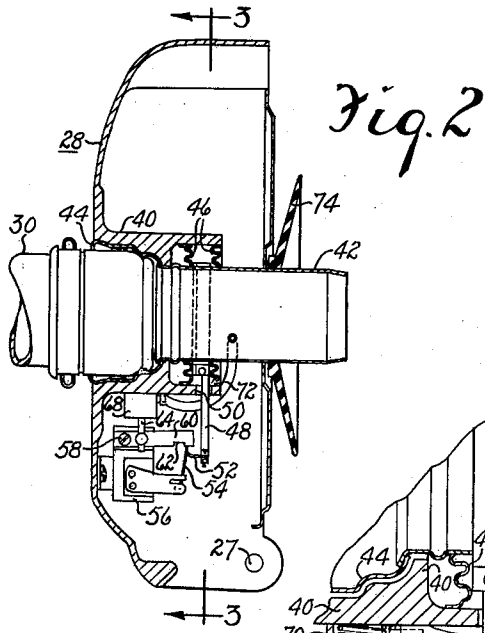

Fig. 2

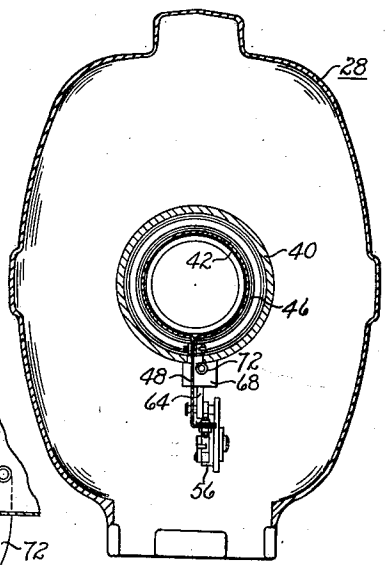

Fig. 3

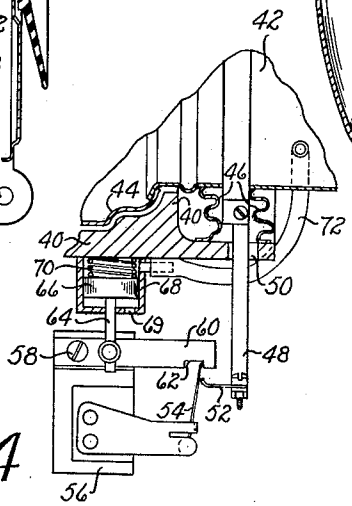

Fig. 4

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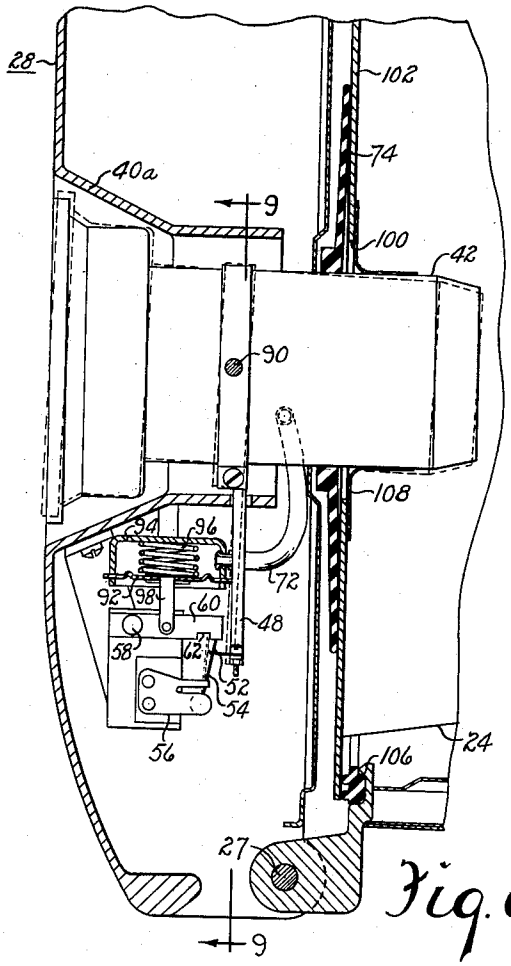

Fig. 8

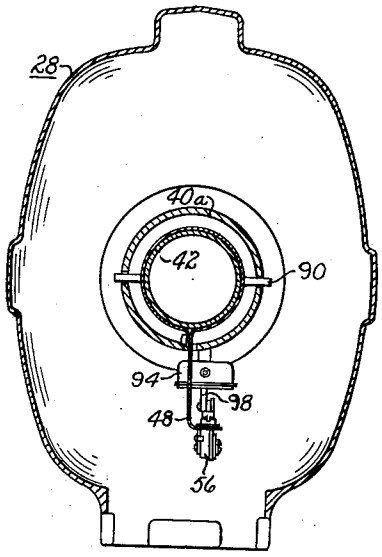

Fig. 9

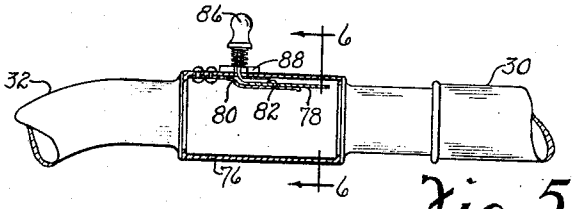

Fig. 5

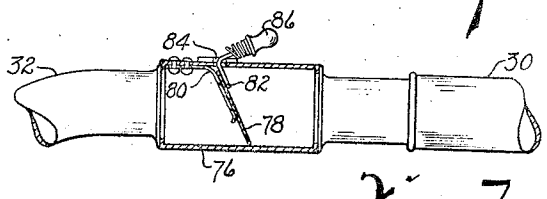

Fig. 7

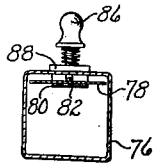

Fig. 6

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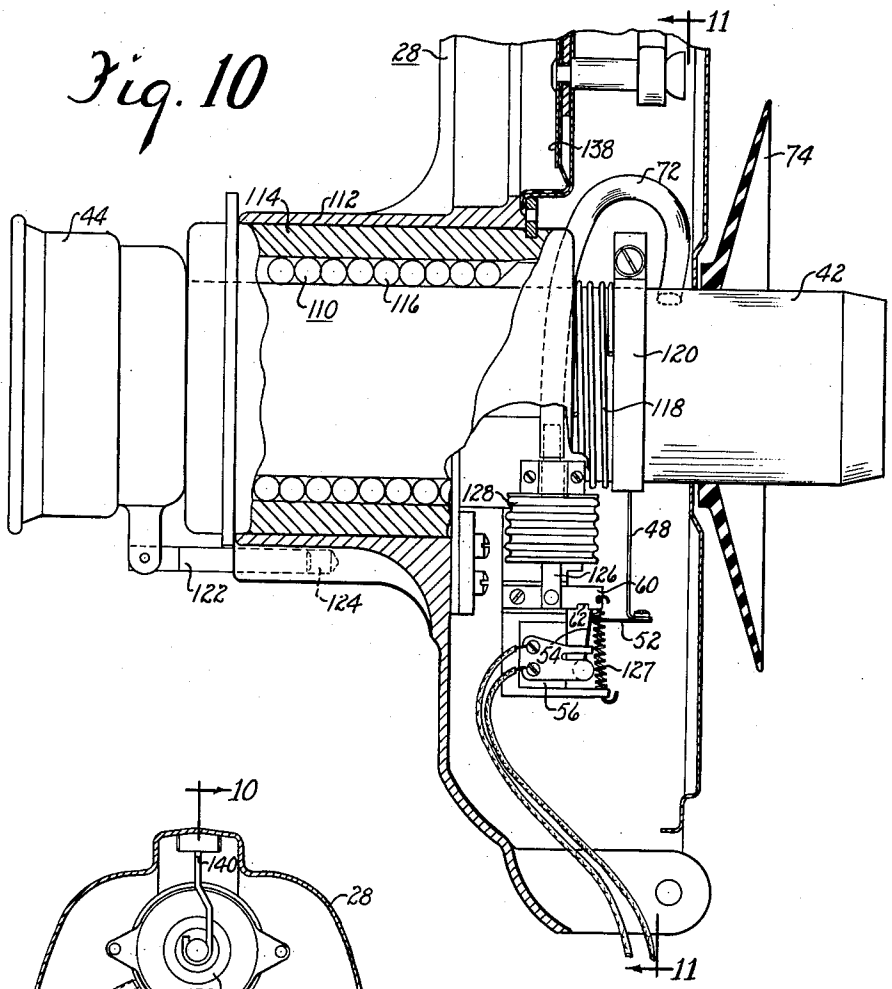
Fig. 10



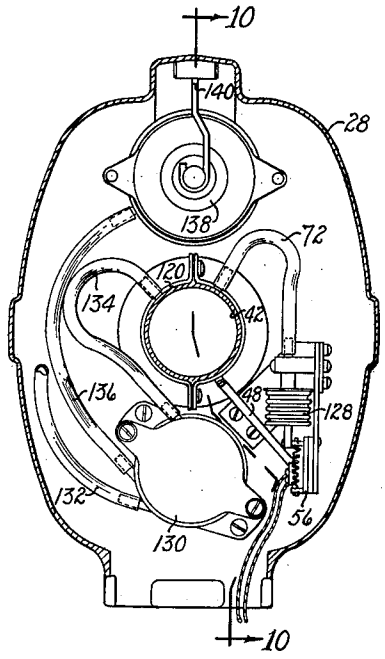


Fig. 11

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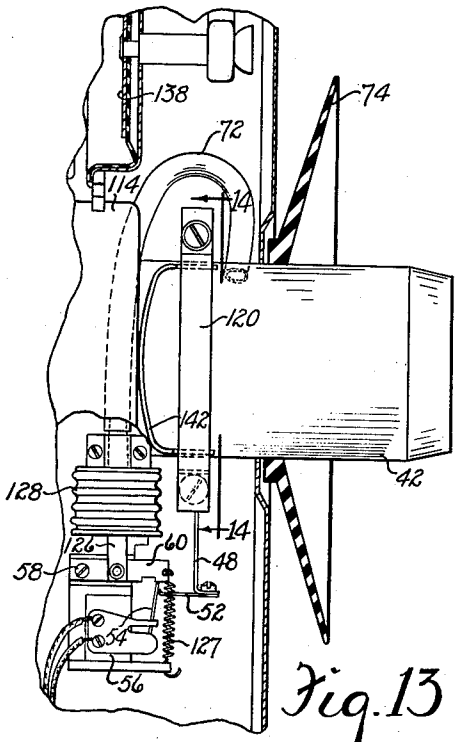

Fig. 13

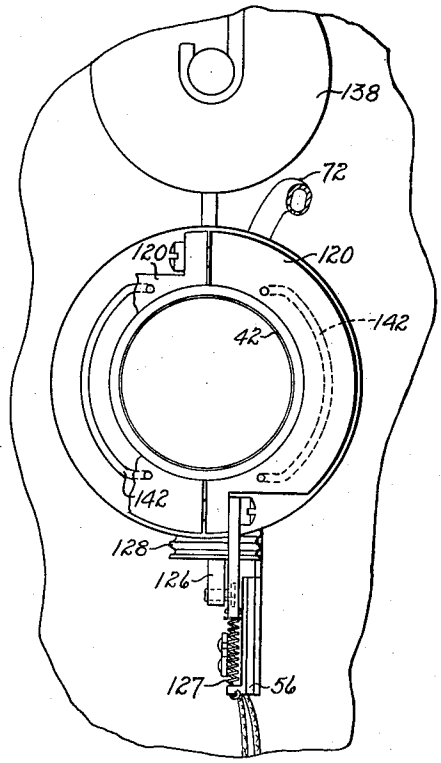

Fig. 14

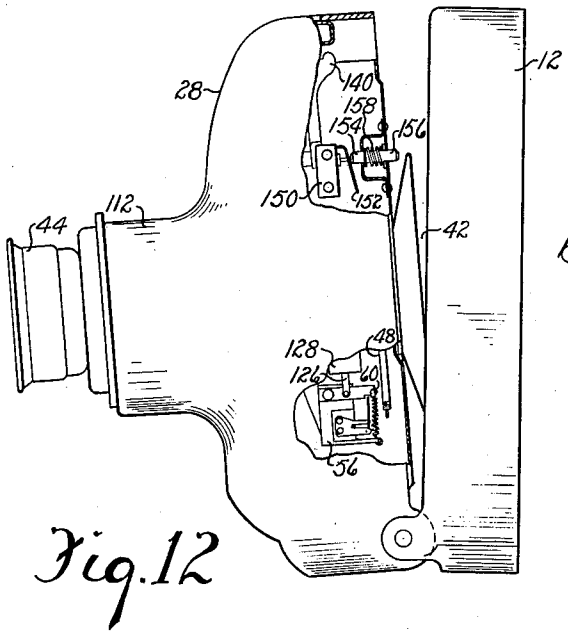

Fig. 12

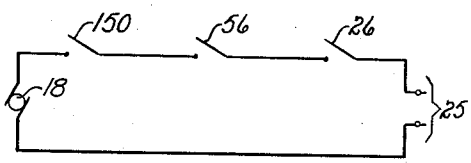

Fig. 15

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United States Patent Office

3,083,396

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VACUUM CLEANER CONTROLS

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Filed Jan. 3, 1961, Ser. No. 80,367
12 Claims. (Cl. 15—319)

Our invention relates to vacuum cleaners and more particularly to tank or canister cleaners. In vacuum cleaners of this type the motor-fan unit and the dust separating member are contained in a housing which is movably supported on the floor and has an inlet which is connected to the suction nozzle through a flexible suction conduit and, if it is a floor nozzle, through one or two sections of rigid conduit, commonly called wands, which also act as a manipulating handle for the nozzle. During cleaning, the housing containing the motor-fan unit and dust separating member remains more or less stationary as the nozzle is moved back and forth, and is moved over the floor only as it follows the operator as the latter progresses from one end of the room to the other. The operation of the motor is usually controlled by means of a foot operated switch located on the cleaner housing, but the operator is normally at the end of the hose 7 or 8 feet away from this switch and hence must walk back this distance every time it is desired to start or stop the cleaner.

It has been proposed to place a switch in the motor circuit at the end of the hose where it would be very convenient for operation, but this requires the incorporation of electric conductors in the hose and also the establishment of electric connections between the vacuum cleaner and the hose through what is normally a separable and rotatable coupling.

In accordance with our invention control of the motor may be effected from the end of the hose without the incorporation of such conductors. An electric switch is located in the front cover of the vacuum cleaner and the hose connection to the front cover is such that the hose may move slightly with respect to the cover in response to a pull on the former. This switch is so arranged that, if it is in the "off" position, movement of the hose resulting from such a pull will turn the switch on and the switch will remain in the "on" position and not be affected by subsequent pulls. In order to throw the switch to the "off" position a pressure responsive member is connected to the inlet and is arranged to open the switch in response to a predetermined pressure change within the hose, which change may be produced by the manual manipulation of a valve at the end of the hose adjacent to the point where the latter is normally held by the operator.

Further objects and advantages of our invention will be apparent from the following description considered in connection with the accompanying drawings which form a part of this specification and of which:

FIG. 1 is a view of a vacuum cleaner unit, hose, wands and nozzle including our invention;

FIG. 2 is a cross-sectional view on an enlarged scale of the front cover of the vacuum cleaner shown in FIG. 1;

FIG. 3 is a cross-sectional view taken on the line 3—3 of FIG. 2;

FIG. 4 is a cross-sectional view on an enlarged scale of a portion of the apparatus shown in FIG. 2, but with certain parts in different positions;

FIG. 5 is a cross-sectional view showing the valve at the end of the hose;

FIG. 6 is a cross-sectional view taken on the line 6—6 of FIG. 5;

FIG. 7 is a cross-sectional view similar to FIG. 5, but with the valve member in a different position;

FIG. 8 is a cross-sectional view similar to FIG. 2, but on a larger scale and showing a second embodiment of our invention;

FIG. 9 is a cross-sectional view on a reduced scale taken on the line 9—9 of FIG. 8;

FIG. 10 is a cross-sectional view of a portion of a front cover of a vacuum cleaner showing a third embodiment of our invention;

FIG. 11 is a cross-sectional view taken on the line 11—11 of FIG. 10, but on a smaller scale;

FIG. 12 is a side view, partially broken away, of the embodiment shown in FIGS. 10 and 11;

FIG. 13 is a cross-sectional view of a portion of a front cover showing another embodiment of our invention;

FIG. 14 is a cross-sectional view taken on the line 14—14 of FIG. 12; and

FIG. 15 is a wiring diagram of an electric circuit employed in our invention.

Referring to the drawings, reference character 10 designates generally a tank type vacuum cleaner which includes a substantially airtight housing 12 having wheels 14 and 16 for movably supporting it on a surface. Disposed within the housing 12 is an electric motor 18 driving a fan 20 having an inlet 22 which communicates with a space within the housing 12 which is occupied by a dust bag or similar dust separating member 24. A cord 25 supplies current and a switch 26 may be provided on the upper part of the housing 12 for controlling the operation of the motor 18, this switch being intended for operation by the foot.

Hinged at 27 to the front of housing 12 is a front cover 28 which may be opened for the insertion and removal of the dust bag 24. Removably connected to the cover 28 is a flexible suction hose 30, the opposite end of which is permanently connected to a rigid tube 32, preferably formed with a bend therein as is shown in FIG. 1. As here illustrated this bent tube is connected to two sections 34 and 36 of rigid tubing, frequently termed wands, the lower end of which is removably connected to a floor nozzle 38.

As is well known, operation of the electric motor 18 causes the fan 20 to produce suction which is communicated through the hose 30 and wands 34 and 36 to the nozzle 38, thus causing air to flow into the nozzle. As the latter is moved over a rug or other surface to be cleaned, the stream of air picks up dirt which is carried through the hose to within the dust bag 24 which serves to separate the dust from the air, the latter passing through the porous material of the bag to the inlet 22 of the fan. From the fan the air is discharged through an outlet in the casing 12 to the atmosphere.

In FIGS. 2 through 4 there is shown in cross-section the front cover 28 within which is embodied structure in accordance with our present invention. Formed integral with the wall is an inwardly extending generally cylindrical part 40. Extending through the part 40 is an inlet conduit 42, the outer end of which is flared outwardly as is shown at 44 to provide the female part of a separable coupling for connecting the hose 30 to the inlet 42. The inlet conduit is movably mounted within the cylindrical part 40 by means of a pair of annular corrugated metallic members 46, the outer edges of which are fixed to the member 40 while the inner edges are secured to the outer surface of the conduit 42. Due to the flexibility of the members 46 resulting from the corrugations therein the conduit 42 is able to move longitudinally within the member 40, but the elasticity of the members 46 tend to hold the conduit in the position shown in FIG. 2, that is with the outwardly flared portion 44 held against the inner surface of the member 40.

Fixed to the conduit 42 between the members 46 is an arm 48 which extends radially from the conduit through a slot 50 formed in the part 40. The lower end of arm

48 carries a projection 52 which bears against the actuating arm 54 of an electric switch 56 when the arm 54 is in the "off" position. The construction of the switch 56 is such that the arm 54 is biased towards the "off" position shown in FIG. 2. This switch 56 is connected in series with the switch 26 in the motor circuit, as is shown in the wiring diagram of FIG. 15.

Pivotally mounted at 58 is an arm 60 having a notch 62 in the lower edge thereof. A piston rod 64 is pivoted to an intermediate point of the arm 60 and is connected to a piston 66 reciprocable within a cylinder 68. The piston 66 is urged downwardly by means of a coil spring 70 and the space within the cylinder above the piston is connected to inlet conduit 42 by means of a tube 72. Conduit 42 carries a flexible rubber gasket 74 which seals against a stiff disc forming the front of the dust bag 24, the inner end of conduit 42 extending through an opening in the disc as is illustrated in detail in connection with the embodiment shown in FIG. 8.

The operation of the embodiment shown in FIGS. 2 through 4 is as follows:

With the parts in the position shown in FIG. 2 the arm 54 of the switch 56 is in the "off" position. Consequently, the motor will not operate even though the foot operated switch is closed. In order to complete the circuit to the switch 56 the operator exerts a pull on the hose 30 which in turn causes the conduit 42 to move forwardly a short distance to the position shown in FIG. 4, the flexibility of the corrugated discs 46 permitting this. This movement causes the arm 48 to also move forwardly so that the projection 52 thereon pivots the switch arm 54 to the "on" position, this movement of the switch arm causing the pivoted arm 60 to be raised slightly against the force of spring 70 until the switch arm 54 is received within the notch 62. Thereupon, the spring 70 moves the pivoted arm 60 downwardly so as to hold the switch arm in the "on" position, thus causing operation of the motor 18.

Once the arm 54 is latched in the "on" position the conduit 42 and the arm 48 may be moved to the right by the elastic discs 46 but the arm 54 remains latched. As the cleaner is used, repeated pulls may be applied to the hose which will cause the conduit 42 to move back and forth, but without any effect on the switch 56 which remains in the "on" position.

In FIGS. 5 through 7 there is shown a valve arrangement located in the bent tube 32. As here shown, this tube has a portion 76 of rectangular cross-section within which is movably mounted a rectangular valve member 78, this member being secured to one wall of the rectangular housing 76 by means of a spring arm 80. A rod 82 is also secured to the valve member and extends through a small opening 84 and at its outer end carries a handle 86, a resilient washer 88 being provided for minimizing leakage around the rod 82.

When it is desired to stop the operation of the motor 18, the operator moves the handle 86 from the position shown in FIG. 5 to that shown in FIG. 7, thereby causing the valve member 78 to be disposed across and interrupt flow of air through the rectangular housing 76. This condition of substantially sealed suction causes a low pressure to exist within the system from the valve through the hose 30, inlet 42 and dust bag 24 to the inlet 22 of the fan. This low pressure is communicated from the conduit 42 through the tube 72 to the space in cylinder 68 above the piston 66. Inasmuch as the lower surface of the piston is exposed to atmospheric pressure through the opening 69 the piston is moved upwardly against the force of spring 70 so as to release the switch arm 44 from engagement within the notch 62. This permits the switch arm to pivot clockwise to the "off" position shown in FIG. 2.

When it is desired to again start the motor it is merely necessary to apply a pull to the hose. It will thus be seen that the motor may be controlled from the end of the hose where the operator is always located during cleaning operations and it is not necessary to walk back to operate the switch 26.

The embodiment shown in FIGS. 8 and 9 is similar to that already described, with the exception that the inlet conduit 42 instead of being mounted for longitudinal movement in the front cover is mounted for pivotal movement with respect thereto. As shown, the inner contour of part 40*a* of the front cover is such as to provide clearance for this movement and the conduit 42 is pivotally mounted within part 40*a* by means of pivot pins 90. Hence arm 48 moves in an arc about pivot pins 90, but the angular movement is so slight that its action with relation to the arm 54 of the switch is exactly the same as that described in connection with the first embodiment.

Another difference between these two embodiments is that a flexible diaphragm, rather than the piston 66 and cylinder 68, is employed to pivot the arm 60. As shown particularly in FIG. 8, a flexible diaphragm 92 forms one wall of a diaphragm chamber 94, the interior of which is connected to inlet conduit 42 by means of tube 72. A spring 96 urges the diaphragm 92 downwardly and the movement of the diaphragm is communicated to the arm 60 through a link 98.

In FIG. 8 there is also illustrated the manner in which conduit 42 extends through an opening 100 formed in a stiff disc 102 constituting the front of the dust bag 24. Conduit 42 carries a flexible gasket 74 which bears against the disc around the opening 100 therethrough and forces the edge of the disc into sealing relation with a gasket 106. Preferably, the disc 102 carries a sheet of thin rubber-like material 108 having a relatively small aperture therethrough which is enlarged by the entrance of the tube 42 and which again contracts to substantially close the opening 100 when the tube 42 is withdrawn. Gasket 104 is sufficiently flexible so as to permit the necessary movement of the inlet tube 42 relative to the housing 12 and disc 102.

This embodiment operates in the same manner as that previously described, except that a slightly upward pull on the hose is required in order to pivot the inlet conduit 42 from the position shown in full lines to that illustrated in broken lines in order to move the switch arm 54 to the "on" position. The switch is moved to the "off" position by closing the valve 78 at the end of the hose, the resulting low pressure being communicated through the tube 72 to within the diaphragm chamber 94, thus moving the diaphragm upwardly against the force of spring 96 so as to release the switch arm 54 from engagement within the notch 62. When it is desired to open the switch in this manner the operator does not pull on the hose and the weight of that portion of the hose immediately adjacent to the conduit 42 causes the outer end of the latter to pivot downwardly so as to maintain it in the position shown in full lines in FIG. 8. Consequently, the projection 52 on the arm 48 does not interfere with the switch arm 54 moving to the "off" position.

The embodiment illustrated in FIGS. 10, 11 and 12 is similar to that shown in FIGS. 2 through 4, with the exception that the inlet conduit 42 is movably supported within the front cover by means of a linear ball bushing designated generally by reference character 110. In this embodiment the front cover 28 is provided with an outwardly extending cylindrical portion 112 within which is secured the outer sleeve 114 of the bushing. Between the sleeve 114 and the outer surface of the conduit 42 there is arranged a series of ball bearings 116 which permit longitudinal movement of the conduit with a minimum of friction and no possibility of binding. A coil spring 118 is disposed between a collar 120 secured to the conduit 42 and the inner wall of sleeve 114 so as to

bias the conduit **42** inwardly, that is to the right as viewed in FIG. 10. Rotation of the conduit **42** within the bushing is prevented by means of a pin **122** reciprocably mounted within a bore **124** formed in the extension **112**.

In this embodiment the pivoted arm **60** is connected by means of a link **126** with a bellows **128** which corresponds to the piston and cylinder of the first embodiment and the diaphragm of the second embodiment. A spring **127** serves to bias arm **60** downwardly and at the same time to expand the bellows. The interior of bellows **128** is connected by means of tube **72** with inlet conduit **42**.

The operation of this embodiment is substantially the same as that previously described. Thus a pull on the hose causes the conduit **42** to move outwardly in the linear ball bushing **110** against the force of spring **118**, thus causing arm **48** and projection **52** thereon to move forwardly so as to pivot the switch arm **54** to the "on" position, where it is latched by engagement within the notch **62** of the pivoted arm **60**. When it is desired to stop the motor **18**, the valve **78** at the end of the hose is closed and the resulting low pressure is communicated through the tube **72** to the interior of the bellows **128**. This tends to collapse the bellows, thus raising the arm **60** to as to release the switch arm **54** from engagement within the notch **62**, whereupon the switch moves to the "off" position.

In this embodiment and particularly in FIG. 11 there is illustrated certain automatic controls which do not per se form part of the present invention, as they are disclosed and claimed in U.S. Patent No. 2,714,425 of August 2, 1955, but they are shown herein so that it may be explained that they may be used in combination with the apparatus of the present invention. As shown in the above mentioned patent, there is provided a pressure differential diaphragm herein designated by reference character **130** which, through a tube **132** is subjected on one side to the pressure existing within the housing **12** but outside of the bag **24**, which is the pressure at the inlet **22** of the fan. The other side of this differential pressure diaphragm is subjected through a conduit **134** to the pressure existing within the inlet conduit **42**. Thus, this diaphragm is subjected to a pressure difference equal to the pressure drop of the air flowing through the dust bag **24**, which pressure difference increases as dirt is accumulated in the bag. As is further shown in the above patent, a predetermined movement of the differential pressure diaphragm opens a valve which connects the tube **132**, in which exists the high suction of the fan inlet, to a tube **136** leading to a power diaphragm **138** which is arranged to release a latch **140** which holds the pivoted front cover **28** in closed position. Thus, when sufficient dust is accumulated within the bag **24** to require replacement of the bag, the front cover is automatically opened, thus signaling the operator that the bag should be replaced.

Opening of the front cover may also serve to open a switch in the motor circuit. As shown in FIG. 12, a switch **150** having an actuating arm **152** is mounted in the front cover. A pin **154** is reciprocably mounted in the cover in such a position that one end bears against the arm **152** while the other end **156** projects beyond the cover towards the housing **12**. A spring **158** biases the pin away from arm **152** and towards the housing. Thus, when the cover **28** is closed, the end **156** strikes the housing **12** and the pin **154** is pushed in against the force of spring **158** to move arm **152** to the "on" position. However, when the cover is opened, as through the release of latch **140** by diaphragm **138**, spring **158** moves pin **156** away from arm **152**, thus permitting the arm to move to the "off" position, which of course opens the circuit of motor **18**. Consequently, an increase in the pressure drop through the dust separating member serves to stop the motor.

Inasmuch as the differential pressure diaphragm **130** acts to open the front cover and stop the motor by opening switch **150** in response to an increase in pressure drop through the dust bag **24**, it will not open the front cover in response to closing the valve **78**. When this valve is closed it substantially stops the flow of air through the cleaner and while this causes a very low pressure to exist, this low pressure exists on both sides of the dust bag and consequently the pressure drop through the bag becomes practically zero. On the other hand, the bellows **128** will not be collapsed so as to shut off the motor in response to increasing dirt in the bag, because the latter condition increases the pressure within the bag and hence within the conduit **42**, whereas the bellows is collapsed in response to a decrease in pressure. Thus it will be seen that these two control systems do not in any manner interfere with each other and may be used in combination in the same vacum cleaner.

The embodiment illustrated in FIGS. 13 and 14 is substantially the same as that shown in FIGS. 10, 11 and 12, with the exception that the coil spring **118** is here replaced by a pair of spring arms **142**. As shown, the ends of these springs are received in bores formed in the collar **120** which is secured around the inlet **42**, while the center of each spring bears against the end of the sleeve **114** forming part of the linear ball bushing. Inasmuch as the operation is exactly the same as that previously described it will not be repeated.

It will thus be seen that we have provided structure whereby the operator of a tank or canister type vacuum cleaner may start and stop the motor while being positioned at the end of the hose 7 or 8 feet from the cleaner unit on which the usual switch is located. This is very convenient, particularly when it is desired to temporarily shut off the motor while for example answering the telephone or the front door. Inasmuch as this is accomplished without the provision of an electric switch at the end of the hose, it is not necessary to run conductors through the hose nor to provide slip rings or the like for conducting current through the swivel between the hose and the front cover.

While we have shown and described several embodiments of our invention, it is to be understood that this has been done for the purpose of illustration only and the scope of our invention is not to be limited thereby, but is to be determined from the following claims.

What we claim is:

1. In a vacuum cleaner, a hollow body, a motor in said body, air moving means driven by said motor, a hose connected to said body in communication with said air moving means, means responsive to a pull on said hose for starting said motor, and means responsive to a predetermined reduction in the air pressure within said hose for stopping said motor.

2. In a vacuum cleaner, a hollow body, an electric motor in said body, a fan driven by said motor, a hose connected to said body in communication with the inlet to said fan, an electric switch for controlling operation of said motor, means responsive to a pull on said hose for closing said switch, and means responsive to a reduction in air pressure within said hose for opening said switch.

3. In a vacuum cleaner, a hollow body, an electric motor in said body, a fan driven by said motor, a hose connected to said body in communication with the inlet to said fan, valve means for reducing flow of air through said hose, an electric switch for controlling operation of said motor, means responsive to a pull on said hose for closing said switch, and means responsive to a reduction in air pressure within said hose resulting from closing said valve for opening said switch.

4. In a vacuum cleaner, a hollow body having an inlet opening, an electric motor in said body, a fan driven by said motor and communicating with said inlet, a suction hose, means for movably connecting said hose to said inlet, an electric switch for controlling operation of

said motor, means responsive to movement of said hose relative to said body resulting from a pull on said hose for closing said switch, and means responsive to a reduction in air pressure within said hose for opening said switch.

5. In a vacuum cleaner, a hollow body having an inlet opening, an electric motor in said body, a fan driven by said motor and communicating with said inlet, a suction hose, means for movably connecting said hose to said inlet, valve means in said hose for reducing flow of air therethrough, an electric switch for controlling operation of said motor, means responsive to movement of said hose relative to said body resulting from a pull on said hose for closing said switch, and means responsive to a reduction in air pressure within said hose resulting from closing said valve for opening said switch.

6. In a vacuum cleaner, a hollow body having an inlet opening, an electric motor in said body, a fan driven by said motor and communicating with said inlet, an inlet conduit movably mounted in said inlet opening, a suction hose connectable to said conduit, an electric switch for controlling operation of said motor, means responsive to movement of said conduit relative to said body resulting from a pull on said hose for closing said switch, and means responsive to a reduction in air pressure within said hose and conduit for opening said switch.

7. In a vacuum cleaner, a hollow body having an inlet opening, an electric motor in said body, a fan driven by said motor and communicating with said inlet, an inlet conduit mounted for limited longitudinal movement in said inlet opening, a suction hose connectable to said conduit, an electric switch for controlling operation of said motor, means responsive to outward movement of said conduit relative to said body resulting from a pull on said hose for closing said switch, and means responsive to a reduction in air pressure within said hose and conduit for opening said switch.

8. In a vacuum cleaner, a hollow body having an inlet opening, an electric motor in said body, a fan driven by said motor and communicating with said inlet, an inlet conduit mounted for limited pivotal movement in said inlet opening about a substantially horizontal axis, a suction hose connectable to the outer end of said conduit, an electric switch for controlling operation of said motor, means responsive to an upward pivotal movement of the outer end of said conduit resulting from an upward pull on said hose for closing said switch, and means responsive to a reduction in air pressure within said hose and conduit for opening said switch.

9. In a vacuum cleaner, a hollow body having an inlet opening, an electric motor in said body, a fan driven by said motor and communicating with said inlet, an inlet conduit mounted for limited longitudinal movement in said inlet opening, a suction hose connectable to said conduit, an electric switch for controlling operation of said motor, means for biasing said conduit inwardly relative to said body, means responsive to outward movement

of said conduit against said bias resulting from a pull on said hose for closing said switch, and means responsive to a reduction in air pressure within said hose and conduit for opening said switch.

10. In a vacuum cleaner, a hollow body having an inlet opening, an electric motor, in said body, a fan driven by said motor and communicating with said inlet, an inlet conduit movably mounted in said inlet opening, a suction hose connectable to said conduit, an electric switch for controlling operation of said motor, said switch including an operating member biased to switch open position, an arm carried by said conduit and movable therewith in response to a pull on said hose for moving said operating member to switch closed position, a latch for retaining said member in switch closed position, and pressure responsive means movable in response to variations in air pressure in said hose and conduit for releasing said latch.

11. In a vacuum cleaner, a hollow body having an inlet opening, an electric motor in said body, a fan driven by said motor and communicating with said inlet, an inlet conduit, flexible diaphragm means between said conduit and said body for axially movably mounting said conduit in said inlet opening, said diaphragm means biasing said conduit inwardly from its outermost position, a suction hose connectable to said conduit, an electric switch for controlling operation of said motor, means responsive to outward movement of said conduit relative to said body resulting from a pull on said hose for closing said switch, and means responsive to a reduction in air pressure within said hose and conduit for opening said switch.

12. In a vacuum cleaner, a hollow body having an inlet opening, an electric motor in said body, a fan driven by said motor and communicating with said inlet, an inlet conduit, ball bearing means between said conduit and said body for axially movably mounting said conduit in said inlet opening, spring means for biasing said conduit inwardly, a suction hose connectable to said conduit, an electric switch for controlling operation of said motor, means responsive to outward movement of said conduit relative to said body resulting from a pull on said hose for closing said switch, and means responive to a reduction in air pressure within said hose and conduit for opening said switch.

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