Dec. 24, 1957 J. T. FERRARIS 2,817,414

CONTROL UNIT FOR AUTOMATIC VACUUM CLEANERS

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Fig. 1.

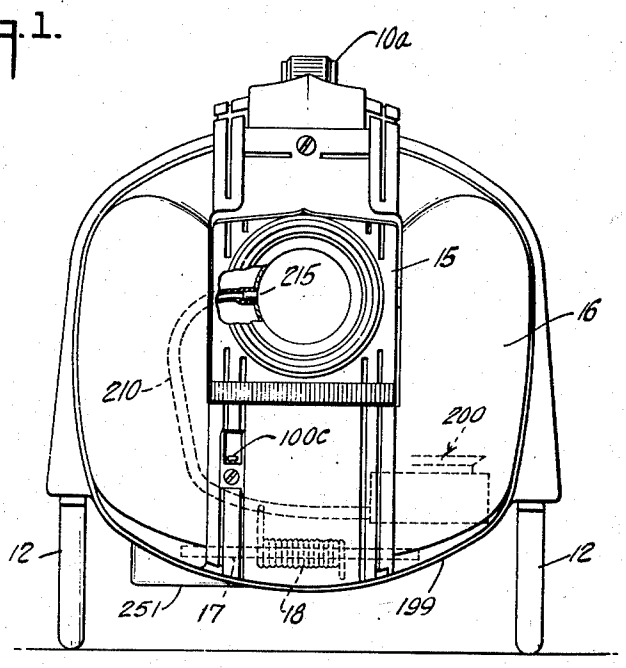
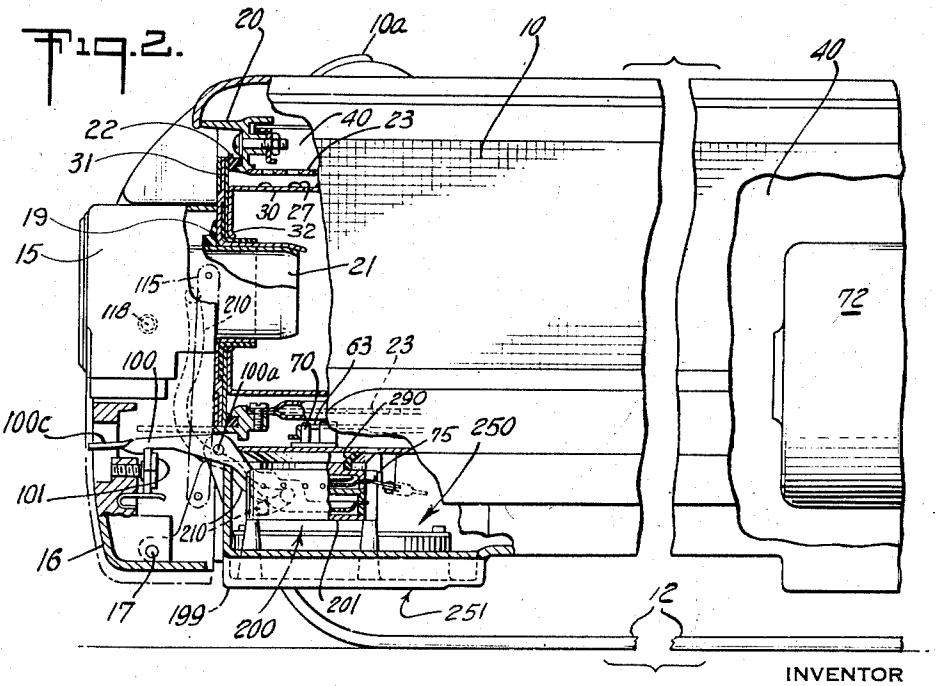


Fig. 2.



INVENTOR
JOHN T. FERRARIS

BY Frank J. Hootey
ATTORNEY

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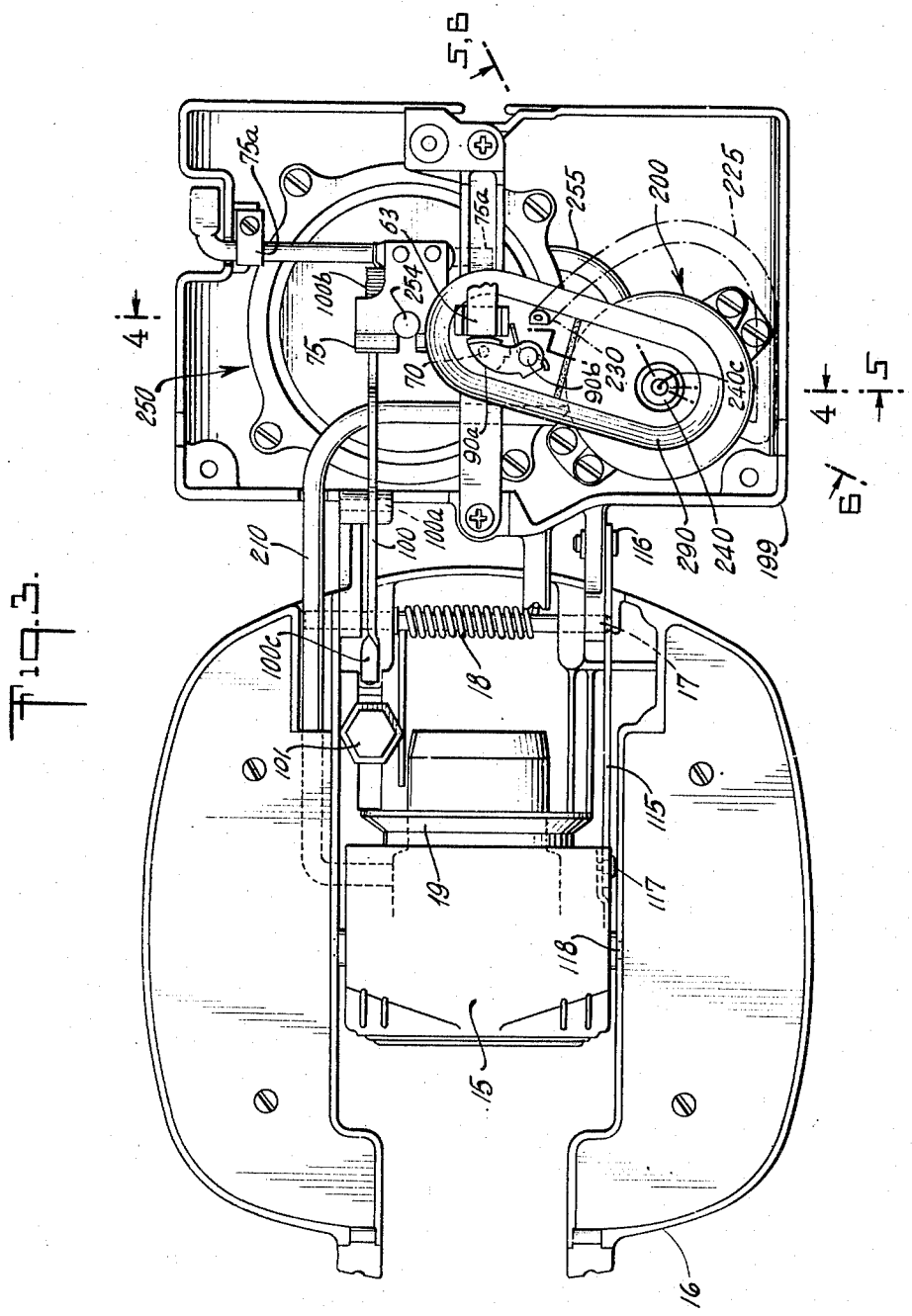


FIG. 2.

INVENTOR
JOHN T. FERRARIS
BY Frank J. Novotny
ATTORNEY

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Fig. 4.

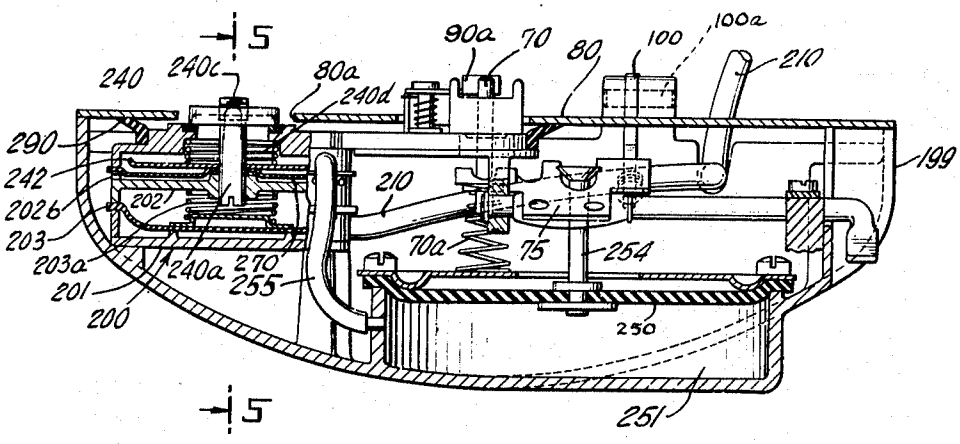


Fig. 6.

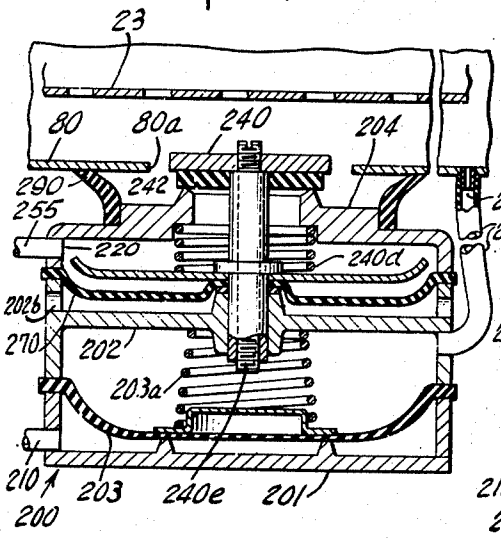
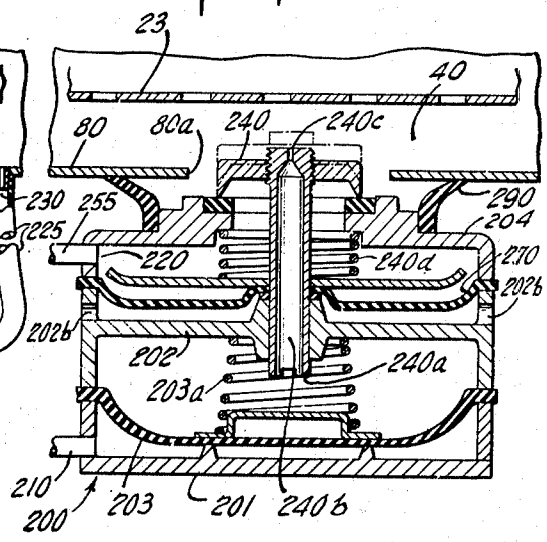


Fig. 5.



INVENTOR.
JOHN T. FERRARIS
BY
Frank J. Novotny
ATTORNEY

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CONTROL UNIT FOR AUTOMATIC VACUUM CLEANERS

John T. Ferraris, Stamford, Conn., assignor to Electrolux Corporation, Old Greenwich, Conn., a corporation of Delaware

Application March 25, 1954, Serial No. 418,717

7 Claims. (Cl. 183—37)

This invention relates to a new and improved control unit for an automatic vacuum cleaner. More particularly it embraces a suction type cleaner adapted to be controlled in one or more of its operational features, including the opening of its cover, the deenergization of its motor fan unit, among other steps, all in accordance with predetermined measurable variations in the air suction stream occurring during its continued use as a dust collecting device.

The present invention has as an object the prevention of any sudden unnecessary operation of the control unit such as may be occasioned by the accidental sealing of a dust collecting nozzle, a result which may be caused by a scrap of paper being sucked against the nozzle mouth or a casual contact of the open nozzle with a flat impervious floor surface.

Another object of this invention is to provide a control unit which effects a direct connection between an actuating power diaphragm and the source of pressure or vacuum available for its operation. This assures rapid and complete operation of the control apparatus and prevents any chattering or fluttering operation thereof.

Other and further objects and advantages of this invention will become readily apparent upon reading the following description together with the accompanying drawings wherein:

Figure 1 is a front plan view of a tank type vacuum cleaner, showing the location of the new control unit in broken lines;

Figure 2 is a side view of a tank type cleaner, with portions of the outside casing broken away to show the location of the control unit more clearly;

Figure 3 is a top plan view of the cover and control unit removed from the cleaner, showing the cover in released position;

Figure 4 is a sectional view taken on the line 4—4 of Fig. 3, showing some internal structural details of the control unit and power diaphragm;

Figure 5 is a vertical section of the control unit taken on the line 5—5 of Fig. 4, showing one modification thereof; and

Figure 6 is a vertical section of a modified type of control unit taken on a line corresponding to that of Fig. 5, but showing a variation thereof utilizing a solid stem, thus necessitating an additional pressure communicating tube.

It is a feature of this invention that the functioning of the cleaner in its dust disposal capacity is automatic, self-contained and after being once initiated by the establishment of predetermined changes in the operational characteristics of the air suction stream within the cleaner, the entire sequence of operations terminating, for example, in a visible or audible signal, in the opening of the cover, etc., is effected in a series of steps. Thus, with continued dust collection during the regular operation of the cleaner, a pressure difference is gradually built up within the cleaner between the inside and the outside of the dust collecting bag, that is between the

upstream and downstream sides thereof. This results in a continuous and progressively increasing force being exerted upon a pressure differential measuring or control diaphragm, the opposite sides of which are subjected to the different pressures built up on the outside and inside of the dust bag, the chamber on one side of the diaphragm being connected to an opening communicating behind the clean side of the dust bag, namely between the dust bag and the motor fan unit, the chamber on the other side of the diaphragm being connected to an opening communicating ahead of the dirty side of the dust bag. Then, upon the attainment of a predetermined value in the resultant force exerted upon the pressure differential diaphragm, motion is imparted to this diaphragm and at a predetermined distortion the diaphragm conditions means which sets into operation a series or sequence of pneumatic and mechanical steps, which sequence when once initiated culminates finally in the opening of the cleaner cover and/or the deenergization of the motor fan unit.

In a preferred embodiment, the differential pressure or control diaphragm actuates means which in turn opens a valve for admitting suction from the motor fan unit to actuate a second or assist diaphragm which, operating through a series of linkages, (1) selectively positions a member which thereafter is in condition for subsequent operation and release of its associated restraining mechanisms; and (2) in timed relation therewith this second diaphragm substantially simultaneously, or thereafter, actuates means which releases a dust conveying inlet conduit from operative communication with its dust receptacle. Then, the conduit after a predetermined angular travel towards its fully released position in turn breaks a circuit cutting off the power supply to the motor fan unit.

Referring now more particularly to the drawings, vacuum cleaner housing **10**, Fig. 2, is a hollow casing. It is appropriately supported on a pair of runners, **12**. The suction or inlet portion of the casing **10** is provided with an inlet nozzle and wand together with a suitable conventional flexible hose (not shown), and connecting coupling fitted into a movable hose coupling assembly **15** which is anteriorly mounted by parallel linkage including front end assembly **16**. Front assembly **16**, as shown in Figs. 2 and 3, is hinged at **17** to base casting **199** and biased to open position by spring **18**. Assembly **16** effects with casing **10** an airtight seal formed by rubber sealing ring member **19**, cardboard disc **31**, Fig. 2, of dust bag **30** and sealing ring **22** positioned in the bag insertion opening of front body ring **20**. Tubular member **21** of the hose coupling assembly **15** extends through the opening **32**, Fig. 2, cut in cardboard disc **31** well into the dust collecting receptacle **30**, and is sealed against disc **31** by rubber sealing ring **19**. Switch button **10***a* on the upper front surface of cleaner housing **10** provides the on-and-off manual control for the cleaner unit.

A perforated inner housing **23** is affixed at one end to front body ring **20** and is adapted for supporting dust bag **30** (of disposable paper or, if desired, cloth construction). This entire unit (inner housing **23**, body ring **30**, etc.) is slidably fitted within the open end of cleaner housing **10** and is affixed thereto by suitable retaining screws. In the embodiment shown, the housing **23** is substantially rectangular in cross-section and is thus adapted to take a bag of substantially similar but slightly smaller cross-section **30**, Fig. 2.

Dust bag **30**, Fig. 2, comprises a dust receptacle of paper or similarly air-pervious, dust-impervious, material affixed at its mouth to the rear surface of a hard paper or cardboard disc **31**, the latter being clamped between rubber sealing ring **19** of hose coupling assembly **15**

and the open end of front body ring **20** with the aid of sealing ring **22**. Cardboard disc **31** has a central opening **32** through which tubular member **21** is inserted in order to introduce the air and entrained dust directly into the interior of dust bag **30**.

The entire inner surface of perforated inner housing or dust bag receiving compartment **23** is provided with apertures **27**, Fig. 2, in order to permit free passage of suction air current therethrough and into chamber **40**. The suction air current is induced by a motor fan unit **72**, through which it passes to the rear of the vacuum cleaner housing **10**.

The particular details of one embodiment for a cover releasing and restraining mechanism which is adapted to control also the movement of a latch bar **63** (Fig. 2) is clearly shown in Figs. 2, 3, and 4. In these figures, a latch bar restraining and releasing pin **70**, Figs. 2 and 3, is biased to latching position by spring **70***a*, Fig. 4, and projects through an opening formed in base plate shelf **80**. Pin **70** is adapted by axial movement to be withdrawn from its latch bar restraining position (Fig. 2) to its latch bar releasing position (Fig. 3) by the downward movement of actuating arm **75**.

The above latch bar restraining and releasing pin **70** for controlling operation of the dust bag ejector mechanism is moved from its normal position (shown in Fig. 2) to its withdrawn position (shown in Fig. 3) by the downward movement of link **254** which actuates arm **75** to withdraw pin **70**. Link **254** is attached at its lower end to a pneumatic means comprising a power diaphragm **250** the upper side of which is subjected to atmospheric pressure and the underside to the pressure existing within a power diaphragm chamber **251**. The withdrawal of pin **70** releases for clockwise rotation pin retaining finger **90***a*, Fig. 3, which, in the form of a lever arm fulcrumed on shaft **90***b* and affixed thereto to move as a unit, functions to prevent relatching of latch bar **63** by pin **70**. The pin retaining finger **90***a* is spring biased to effect this movement.

Thus the above-mentioned selective positioning of pin **70** results in the superpositioning of retaining finger **90***a* (Fig. 3) above pin **70** to retain the latter in releasing position out of the path of latch bar **63**.

Assembly **16** is held closed by latch **100**, Figs. 2, 3, engaging keeper **101**; latch **100** being fulcrumed at **100***a* and biased to latching position by spring **100***b*.

The cleaner housing **10** may be opened for inspection of the bag and its contents without ejecting the dust bag by manually lifting the externally protruding end **100***c* of lever **100**, Figs. 1, 2 and 3, thereby releasing the front end assembly **16**. Since pin **70** most likely will not have been selectively positioned (withdrawn) to latch bar releasing position, pin **70** will still restrain latch bar **63** and hence keep the bag ejector from discharging the dust bag.

It is to be noted that power diaphragm **250** in addition to triggering pin **70** and setting the mechanism for the subsequent release of ejector restraining latch bar **63** also releases, substantially simultaneously, the cover releasing lever **100** by actuating arm **75**, Figs. 3 and 4, formed as a part of latch release device fulcrumed at **75***a* thereby releasing cover **16**.

The parallel linkage of the hose coupling assembly **15** to the base member **199** is most clearly seen in Fig. 3. There, link **115** pivoted at **116** to base casting **199** and at **117** to hose coupling assembly **15** forms one link in the parallel linkage while cover **16** fulcrumed at **17** to base casting **199** and at **118** to hose coupling assembly **15** forms the other link.

Button **10***a*, Figs. 1 and 2, on the upper front surface of housing **10** operates a circuit make and break switch of the conventional toggle snap switch type.

The chamber **251** on one side of power diaphragm **250** is operatively connected to the high suction side of the vacuum cleaner, namely chamber **40**, by conduit **255**, the top chamber **220**, valve **240**, center opening **80***a* in casing **80**, to the inner sealed chamber **40**.

The pneumatic control system includes a control diaphragm **203** disposed in a control housing **201** and dividing the housing into a first chamber below the diaphragm and a second chamber above it. A spring **203***a* in the second chamber biases the diaphragm downwardly and the first chamber is connected through a flexible conduit **210** with the tubular member **21** which communicates with the upstream or dirt collecting side of the dust bag. Separated from housing **201** by a partition **202** is an assist housing **204** in which is located an assist diaphragm **270**. A hollow valve stem **240***a* having a bore **240***b* is slidably positioned in an opening in partition **202**, is secured to assist diaphragm **270**, and carries at its upper end a valve **240** which controls flow through a large aperture connecting the chamber **220** above assist diaphragm **270** with the space **40** within casing **10**. The hollow stem **240***a*, formed with a restriction **240***c* at the upper end of bore **240***b*, establishes communication between space **40** and the aforementioned second chamber in housing **201** above control diaphragm **203**. The chamber **220** in housing **204** above assist diaphragm **270** is connected to power diaphragm chamber **251** through a conduit **255**, while the chamber below the assist diaphragm is open to atmosphere through openings **202***b*. A spring **240***d* urges valve **240** towards closed position.

As dirt accumulates within the dust bag, the resistance to the flow of air therethrough increases, and hence the air pressure on the downstream side of the bag in chamber **40** gradually decreases, while the pressure on the upstream side in member **21** increases. Inasmuch as the former pressure is communicated through bore **240***b* of valve stem **240***a*, to the chamber above control diaphragm **203** and the latter is communicated through conduit **210** to the chamber below the control diaphragm, the diaphragm is caused to move upwardly against the resistance of spring **203***a*. As the pressure difference increases, the diaphragm **203** continues to move until it contacts the lower end of valve stem **240***a*. Further movement lifts the stem and valve **240**, thus suddenly connecting the chamber **220** above assist diaphragm **270** with the low pressure region in chamber **40**. Inasmuch as the lower side of the assist diaphragm is subjected to atmospheric pressure, the assist diaphragm moves up quickly, thus fully opening valve **240** and assuring that the valve will remain open, even if there should be a decrease in the pressure difference acting on control diaphragm **203** which would cause the latter to move downwardly.

The opening of valve **240** connects power diaphragm chamber **251** directly with chamber **40** through a path comprising conduit **255** and chamber **220** which is free of obstructions, such as the restriction **240***c* in the bore **240***b* of valve stem **240***a*. This restriction is desirable so as to dampen sudden fluctuations in pressure, as might result from suddenly sealing or unsealing the rug nozzle. It is not desirable for such fluctuations to operate the controls, and the presence of the restriction **240***c* assures that only changes of substantial duration, such as those resulting from accumulation of dirt in the bag, will cause the controls to operate.

As previously described, the applications of low pressure to power diaphragm chamber **251**, causes power diaphragm **250** and link **254** to move downwardly, thus pivoting arm **75** so as to withdraw pin **70** and to release lever **100** from keeper **101**.

With the opening of front end assembly **16**, the discharge of the bag and the slowing down of the motor fan unit, atmospheric pressure is reestablished on both sides of each of diaphragms **203** and **270** which are returned to their original positions, under the biasing action of springs **203***a* and **240***d*, respectively.

The electrical system for energizing the motor fan unit **72**, Fig. 2, and the electrical controls are of the conventional form and hence need not be specifically described.

The variation of the control unit shown in Fig. 6 is somewhat similar to that of Fig. 5 except that a solid valve stem **240***e* is used and conduit **225**, Fig. 6 (indicated by broken lines in Fig. 3) together with flow restriction means **230** opening into chamber **40** on the clean side of the dust bag is used instead of hollow center bore **240***b* of Fig. 5. In either variation, the flow restriction means **230** or **240***c* functions to prevent surging and sudden movement of diaphragm **203** such as may be caused by the sudden sealing of a cleaning nozzle. A flexible rubber sealing ring **290** serves to effect a leak proof joint between unit **200** and the casing **80**. When the unit shown in Fig. 5 is used, opening **230**, Fig. 3, is sealed or omitted entirely.

It is to be understood that the specific embodiments herein described in considerable detail are merely illustrative of the invention which is to be limited in scope solely by the appended claims.

What I claim is:

1. In a vacuum cleaner, a casing, a dust separating member in said casing, means for producing flow of air through said casing and through said member therein, a control housing, a control diaphragm within said housing dividing the latter into a first chamber and a second chamber, conduit means for connecting said first chamber to the interior of said casing on one side of said member, conduit means for connecting said second chamber to the interior of said casing on the other side of said member, pneumatic means for controlling an operation of said cleaner, and valve means actuated by movement of said diaphragm for connecting said pneumatic means with said means for producing flow of air independently of said conduit means.

2. In a vacuum cleaner, a casing having an inlet opening, means in said casing for producing flow of air therethrough, a dust separating member in said casing between said inlet and said means, a control housing, a control diaphragm therein dividing said housing into a first chamber and a second chamber, conduit means for connecting said first chamber to the interior of said casing between said member and said inlet, conduit means for connecting said second chamber to the interior of said casing between said member and said means for producing flow, flow restricting means in the last mentioned conduit means for dampening the effect on said diaphragm of sudden pressure changes, pneumatic means for controlling an operation for said cleaner, and valve means actuated by movement of said diaphragm for connecting said penumatic means directly and independently of said last mentioned conduit with the interior of said casing between said member and means for producing flow.

3. In a vacuum cleaner, a casing, a dust separating member in said casing, means for producing flow of air through said casing and through said member therein, a control housing, a control diaphragm within said housing dividing the latter into a first chamber and a second chamber, conduit means for connecting said first chamber to the interior of said casing on the up stream side of said member, pneumatic means for controlling an operation of said cleaner, and a valve having a hollow stem for connecting said second chamber to the interior of said casing on the downstream side of said dust separating member, said stem being actuated by movement of said diaphragm for operating said valve to connect said pneumatic means with said means for producing flow of air independently of the passage through said hollow valve stem.

4. In a vacuum cleaner, a casing, a dust separating member in said casing, means for producing flow of air through said casing and through said member therein, a control housing, a control diaphragm within said housing dividing the latter into a first chamber and a second chamber, conduit means for connecting said first chamber to the interior of said casing on the upstream side of said member, pneumatic means for controlling an operation of said cleaner, a valve having a hollow stem for connecting said second chamber to the interior of said casing on the downstream side of said dust separating member, and flow restricting means in said hollow stem for dampening the effect on said diaphragm of sudden pressure changes, said stem being actuated by movement of said diaphragm for operating said valve to connect said pneumatic means with said means for producing flow of air independently of the passage through said hollow stem and the flow restricting means therein.

5. In a vacuum cleaner, a casing, a dust separating member in said casing, means for producing flow of air through said casing and said member therein, a power diaphragm for controlling an operation of said cleaner, a control housing, an assist housing, a partition separating said housings, said partition being formed with an opening, a control diaphragm in said control housing, conduit means for connecting the interior of said control housing on one side of said control diaphragm to the space in said casing on the upstream side of said dust separating member, conduit means for connecting the interior of said control housing on the other side of said control diaphragm to the space in said casing on the other side of said member, flow restricting means in said last-mentioned conduit, said assist housing having an aperture communicating directly and independently of said last-mentioned conduit with the air flow producing means in said casing, means for communicating air pressure from said assist housing to said power diaphragm, an assist diaphragm in said assist housing, a stem connected to said assist diaphragm and extending through said opening in said partition so as to be displaced by motion of said control diaphragm, and valve means carried by said stem for normally closing said aperture and operable by displacement of said stem for establishing communication through said aperture directly between said air flow producing means and said assist housing for operating said power diaphragm.

6. In a vacuum cleaner, a casing, a dust separating member in said casing, means for producing flow of air through said casing and said member therein, a power diaphragm for controlling an operation of said cleaner, a control housing, an assist housing, a partition between said housings, said partition being formed with an opening, a control diaphragm in said control housing, conduit means for connecting the interior of said control housing on one side of said control diaphragm to the space in said casing on the upstream side of said dust separating member, said assist housing having an aperture communicating directly with the air flow producing means in said casing, means for communicating air pressure from said assist housing to said power diaphragm, an assist diaphragm in said assist housing, a stem connected to said assist diaphragm and extending through said opening in said partition so as to be displaced by motion of said control diaphragm, an axial duct in said stem for connecting the interior of said control housing on the other side of said control diaphragm to the space in said casing on the other side of said dust separating member, flow restricting means in said duct, and valve means carried by said stem for normally closing said aperture and operable by displacement of said stem for establishing communication through said aperture directly between said air flow producing means and said assist housing and independently of said duct for operating said power diaphragm.

7. In a vacuum cleaner, a casing, a dust separating member in said casing, means for producing a flow of air through said casing and said member therein, a power diaphragm for controlling an operation of said cleaner, a

control housing, an assist housing, a partition between said housings, said partition being formed with an opening, a control diaphragm in said control housing, means for subjecting the opposite sides of said control diaphragm to the respective pressures on opposite sides of said dust separating member, said assist housing having an aperture communicating directly with the air flow producing means in said casing, means for communicating air pressures from said assist housing to said power diaphragm, an assist diaphragm in said assist housing, a stem connected to said assist diaphragm and extending through said opening in said partition so as to be displaced by motion of said control diaphragm, and a valve means carried by said stem for normally closing said aperture and operable by displacement of said stem for establishing communication through said aperture directly between said air flow producing means and said assist housing for operating said power diaphragm.

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